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Zbornik 23. mednarodne multikonference

INFORMACIJSKA DRUŽBA

Proceedings of the 23rd International Multiconference

INFORMATION SOCIETY

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Slovenian Conference on Artificial Intelligence

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Ljudje in okolje
People and Environment

Vzgoja in izobraževanje v informacijski družbi
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Interakcija človek-računalnik v informacijski družbi
Human-Computer Interaction in Information Society

Uredili / Edited by

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5.—9. oktober 2020 / 5—9 October 2020
Ljubljana, Slovenia

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PREDGOVOR MULTIKONFERENCI
INFORMACIJSKA DRUŽBA 2020

Triindvajseta multikonferenca Informacijska družba (http://is.ijs.si) je doživela polovično zmanjšanje zaradi korone. Zahvala za preživetje gre tistim predsednikom konferenc, ki so se kljub prvi pandemiji modernega sveta pogumno odločili, da bodo izpeljali konferenco na svojem področju.

Korona pa skoraj v ničemer ni omejila neverjetne rasti IKTja, informacijske družbe, umetne inteligence in znanosti nasploh, ampak nasprotno – kar naenkrat je bilo večino aktivnosti potrebno opraviti elektronsko in IKT so dokazale, da je elektronsko marsikdaj celo bolje kot fizično. Po drugi strani pa se je pospešil razpad družbenih vrednot, zaupanje v znanost in razvoj. Celo Flynnov učinek – merjenje IQ na svetovni populaciji – kaže, da ljudje ne postajajo čedalje bolj pametni. Nasprotno - čedalje več ljudi verjame, da je Zemlja ploščata, da bo cepivo za korono škodljivo, ali da je korona škodljiva kot navadna gripa (v resnici je desetkrat bolj). Razkorak med rastočim znanjem in vraževerjem se povečuje.

Letos smo v multikonferenco povezali osem odličnih neodvisnih konferenc. Zajema okoli 160 večinoma spletnih predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic in 300 obiskovalcev. Prireditev bodo spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad – seveda večinoma preko spleta. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (http://www.informatica.si/), ki se ponaša s 44-letno tradicijo odlične znanstvene revije.

Multikonferenco Informacijska družba 2020 sestavljajo naslednje samostojne konference:

- Etika in stroka
- Interakcija človek računalnik v informacijski družbi
- Izkopavanje znanja in podatkovna skladišča
- Kognitivna znanost
- Ljudje in okolje
- Mednarodna konferenca o prenosu tehnologij
- Slovenska konferenca o umetni inteligenci
- Vzgoja in izobraževanje v informacijski družbi

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in institucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2020 bomo petnajstič podelili nagrado za življenjske dosežke v čast Donalda Michieja in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejela prof. dr. Lidija Zadnik Stirn. Priznanje za dosežek leta pripada Programskemu svetu tekmovanja ACM Bober. Podeljujemo tudi nagradi »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je prejela »Neodzivnost pri razvoju elektronskega zdravstvenega kartona«, jagodo pa Laboratorij za bioinformatiko, Fakulteta za računalništvo in informatiko, Univerza v Ljubljani. Čestitke nagrajencem!

Mojca Ciglarič, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD
INFORMATION SOCIETY 2020

The 23rd Information Society Multiconference (http://is.ijs.si) was halved due to COVID-19. The multiconference survived due to the conference presidents that bravely decided to continue with their conference despite the first pandemics in the modern era.

The COVID-19 pandemics did not decrease the growth of ICT, information society, artificial intelligence and science overall, quite on the contrary – suddenly most of the activities had to be performed by ICT and often it was more efficient than in the old physical way. But COVID-19 did increase downfall of societal norms, trust in science and progress. Even the Flynn effect – measuring IQ all over the world – indicates that an average Earthling is becoming less smart and knowledgeable. Contrary to general belief of scientists, the number of people believing that the Earth is flat is growing. Large number of people are weary of the COVID-19 vaccine and consider the COVID-19 consequences to be similar to that of a common flu dispute empirically observed to be ten times worst.

The Multiconference is running parallel sessions with around 160 presentations of scientific papers at twelve conferences, many round tables, workshops and award ceremonies, and 300 attendees. Selected papers will be published in the Informatica journal with its 44-years tradition of excellent research publishing.

The Information Society 2020 Multiconference consists of the following conferences:

- Cognitive Science
- Data Mining and Data Warehouses
- Education in Information Society
- Human-Computer Interaction in Information Society
- International Technology Transfer Conference
- People and Environment
- Professional Ethics
- Slovenian Conference on Artificial Intelligence

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national engineering academy, the Slovenian Engineering Academy. In the name of the conference organizers, we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

For the fifteenth year, the award for life-long outstanding contributions will be presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Dr. Lidija Zadnik Stirn for her life-long outstanding contribution to the development and promotion of information society in our country. In addition, a recognition for current achievements was awarded to the Program Council of the competition ACM Bober. The information lemon goes to the "Unresponsiveness in the development of the electronic health record", and the information strawberry to the Bioinformatics Laboratory, Faculty of Computer and Information Science, University of Ljubljana. Congratulations!

Mojca Ciglarič, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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INFORMATION SOCIETY – IS 2020

Volume A

Slovenska konferenca o umetni inteligenci
Slovenian Conference on Artificial Intelligence

Uredili / Edited by

Mitja Luštrek, Matjaž Gams, Rok Piltaver

6. – 7. oktober 2020 / 5 - 7 October 2020
Ljubljana, Slovenia

PREDGOVOR

Leto 2020 je bilo za informacijsko družbo zelo pomembno: zmanjšanje medosebnih stikov zaradi COVID-19 je pokazalo, da se da s pomočjo informacijskih tehnologij postoriti še precej več, kot smo si do zdaj mislili. S pomočjo telekonferenčnih sistemov smo se sestajali, digitalno smo prenašali in podpisovali dokumente, prek spleta smo lahko naročili domala vse izdelke in storitve ... Čeravno sta umetna inteligenca in informacijska družba vedno tesneje povezani, pa podobno dramatičnega napredka pri umetni inteligenci ni bilo opaziti. Seveda to ne pomeni, da napredka ni bilo – raznotere metode umetne inteligence še naprej postajajo vedno zmogljivejše in predvsem prodirajo v vedno manjše in cenejše naprave: opažamo lahko, da se namenski procesorji za operacije umetnih nevronskih mrež vedno pogosteje pojavljajo v pametnih telefonih, pametnih zvočnikih z govornimi asistenti in podobnih napravah.

Umetno inteligenco smo zapregli tudi v spopad s COVID-19. Raziskovalci so jo uporabili za določanje strukture virusa in za iskanje učinkovitih zdravil in cepiv. Skupina ameriških organizacij je razpisala nagrado za najboljše pristope rudarjenja po besedilih, ki bodo iz 19 GB besedil, povezanih z boleznijo, izluščila koristne informacije. Razvitih je bilo več diagnostičnih sistemov za podporo odločanju, ki analizirajo slike pljuč in druge podatke. Precej raziskovalcev se je z metodami umetne inteligence lotilo napovedovanja širjenja bolezni in določanja dejavnikov, ki nanj vplivajo. Tovrstne raziskave se dogajajo tudi v Sloveniji.

K sreči COVID-19 naši konferenci ni storil dosti žalega. Resda se ob pisanju tegale uvodnika še ne ve zagotovo, ali bo konferenca potekala na daljavo ali jo bomo uspeli speljati hibridno, kot načrtujemo – da bo del udeležencev prisoten v živo v predavalnici, del pa na daljavo. A verjamemo, da to na kakovost izvedbe ne bo bistveno vplivalo. Z zadovoljstvom pa ugotavljamo, da smo letos dobili največ prispevkov v zadnjih petih letih – v zbornik jih je vključenih kar 28. Tokrat je bolje kot običajno zastopana Fakulteta za računalništvo in informatiko Univerze v Ljubljani, ki ima skupaj z Institutom Jožef Stefan (od koder je – kot vsako leto – največ prispevkov) vodilno vlogo pri raziskavah umetne inteligence v Sloveniji. Nekaj prispevkov je tudi iz tujine in industrije, čeprav bi si zlasti slednjih želeli več. Slovenija namreč izobrazi veliko strokovnjakov s področja umetne inteligence in precej jih najde pot v industrijo, kjer se dogaja marsikaj zanimivega, o čemer vemo premalo. V to smer si bomo zato še bolj prizadevali v prihodnjih letih.

FOREWORD

2020 was an important year for the information society: social distancing due to COVID-19 showed that information technologies allow us to do even more that we previously thought. Teleconferencing systems allowed us to meet virtually, we transferred and signed documents digitally, we ordered every imaginable product and service online … However, even though artificial intelligence and information society are increasingly interlinked, the progress of artificial intelligence this year was not as significant. This certainly does not mean there was no progress – various artificial-intelligence methods are still steadily improving, and, perhaps even more importantly, becoming available in ever smaller and cheaper devices: dedicated processors accelerating neural-network computations are becoming common in smartphones, smart speakers with conversational assistants and similar devices.

Artificial intelligence also helps fight COVID-19. It was used to determine the structure of the virus and to discover effective drugs and vaccines. A group of USA organizations offered a prize for the best data-mining methods that can extract information from 19 GB of texts related to the disease. Several diagnostic decision support systems were developed, which analyse images of the lungs and other data. Many researchers used artificial intelligence to forecast the spread of the disease and the factors that affect it. Such research is also conducted in Slovenia.

Fortunately, COVID -19 did not much affect our conference. At the time of writing this editorial, it is still not clear whether it will take place remotely, or we will succeed with planned the hybrid approach, where a part of the participants will attend live in a lecture room with the rest connected via teleconference. Either way, we are confident this will not have a major impact on the quality of the conference. We are pleased to report that this year we have the largest number of papers in the last five years – there are 28 in these proceedings. The Faculty of Computer and Information Science is represented better than in previous years, which is quite appropriate considering that – aside from Jožef Stefan Institute (which contributed the largest number of papers, as usual) – it is the leading Slovenian research institution on artificial intelligence. There are also some papers from abroad and from the industry, although we would prefer to see more of these, especially the latter. The number of experts on artificial intelligence in Slovenia is quite large and a significant number find their way to the industry, where many interesting but not widely known developments take place. We aim to improve on this aspect in the following years.

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Using Mozilla's DeepSpeech to Improve Speech Emotion Recognition

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ABSTRACT

A lot of effort in detecting emotions in speech has already been made. However, most of the related work was focused on training a model on an emotional speech dataset, and testing the model on the same dataset. A model trained on one dataset seems to provide poor results when tested on another dataset. This means that the models trained on publicly available datasets cannot be used in real-life applications where the speech context is different. Furthermore, collecting large amounts of data to build an efficient speech emotion classifier is not possible in most cases.

Because of this, some researchers tried using transfer learning to improve the performance of a baseline model trained on only one dataset. However, most of the works so far developed methods that transfer information from one emotional speech dataset into another emotional speech dataset.

In this work, we try to transfer parameters from a pre-trained speech-to-text model that is already widely used. Unlike other related work, which uses emotional speech datasets that are usually small, in this method we will try to transfer information from a larger speech dataset which was collected by Mozilla and whose main purpose was to transcribe speech.

We used the first layer from the DeepSpeech model as the basis for building another deep neural network, which we trained on the improvisation utterances from the IEMOCAP dataset.

KEYWORDS

speech emotion recognition, feature transfer, DeepSpeech

1 INTRODUCTION

There are many issues when trying to build a model for speech emotion recognition, but the main problem is the lack of emotional speech data. Collecting a dataset is often a challenging and effortful task, but in speech emotion recognition a few additional problems arise when creating a dataset. One of the main problems is that speech is a context-dependent problem. One could gather a dataset from job interviews and build a precise model that detects emotions in job applicants' speech. however, the same model would probably not work for a phone application that tries to analyze the emotions of its users. Thus, to build a general model for speech emotion recognition, one would need to

gather a dataset composed of speeches used in different contexts, which is a hard task.

Most of the currently available emotional speech datasets are composed of actors performing scenes with different emotions. Finding actors and writing the scenes could be a costly and effortful task and, thus, it is hard to collect large amounts of data in this way. However, the major problem of this type of data is that all of the emotions are acted and may be more exaggerated when compared to real-life emotions [8]. This type of data is probably pretty different when compared to data from real-life applications where emotions are expressed with less intensity. To solve this problem, some researchers tried using transfer learning methods to build a model that is more robust to changes in the data.

Some researchers tried using speeches recorded in real-life scenarios and asked people to listen to these speeches and annotate the emotions they recognize in the speakers' voices. When collecting a dataset in this way one needs to find people that would listen to the whole dataset and annotate the data. The annotators would probably have different abilities to detect the emotions and different perceptions of what each emotion should be like. Because of this, in many cases not all of them will agree on which emotion is present in a sample. Another drawback of this type of data collection is that most of the time people do not experience extreme emotions. Because of this, such datasets will result in almost no emotions – the speech would be mostly neutral.

The main idea behind transfer learning is to use information from a dataset called source dataset to improve the performance of a target dataset. The source and the target datasets may have labeled or unlabeled data, may have the same data distribution or different data distribution, and they can be constructed to solve the same task or they may try to solve different tasks. Depending on this, there are different approaches to transfer learning. They are more thoroughly explained by S. J. Pan et al. [5].

In this work, we decided to follow the usual transfer learning approach, and use a pre-trained speech-to-text model trained on a large nonemotional English dataset collected by Mozilla. This model may not contain any emotional information that would be useful for our task, but we believe it contains information about the speech of the subjects that could be used in speech emotion recognition.

2 RELATED WORK

While research in speech emotion recognition where training and testing are done on one dataset has already been well-studied, using other datasets to make the model more generalized has been in focus only in recent years.

Table 1: Emotion distribution in IEMOCAP.

Anger	Happiness	Sadness	Neutral
500	94	467	392

Some researchers tried using unlabeled target data to improve speech emotion recognition models. Thus, Parthasarathy and Busso [6] connected supervised and unsupervised learning to improve the performance of speech emotion recognition on a target dataset. They used a network architecture similar to autoencoders to encode large amounts of unlabeled target data in an unsupervised way by putting the same speech in the input and the output of the network. To force the network to encode the emotional information from the speech, they connected the last encoding layer to another layer that was trying to learn the arousal, valence, and the dominance annotations on the speech in a supervised way. When they compared their method to other state-of-the-art models, it showed improvement in the arousal and the dominance space while in the valence space they got results slightly worse than the state-of-the-art.

Some authors thought about bringing the feature space from the source and the target data closer together. Thus, Song et al., [7] used MMDE optimization and dimension reduction algorithms to bring the feature spaces from the source and the target datasets closer together. After that, they used the shifted feature space from the source dataset to train an SVM model. They used the EmoDB dataset as a source dataset, and a Chinese emotional dataset collected by them as a target dataset. After they trained the SVM model on the source dataset only, they applied the model on the target dataset and showed that the model performed with 59.8% accuracy. These results show improvement when compared to an SVM model trained on the source dataset and tested on the target dataset without any dimension reduction applied, which performs with 29.8% accuracy. However, the best performance was achieved with a model trained and tested on the target dataset, which achieved 85.5% accuracy.

3 DATASET

In this research we used the Interactive emotional dyadic motion capture database (IEMOCAP) [1]. IEMOCAP consists of speech from ten different English-speaking actors (five male and five female), and it is the largest dataset for speech emotion recognition that we found publicly available. It consists of approximately twelve hours of data where actors perform improvisations or scripted scenarios, specifically selected to elicit emotional expressions. Since the actors were not given any specific emotions that they had to act, the database was annotated by multiple annotators into categorical labels, as well as dimensional labels, such as valence, activation, and dominance. The set of emotions the annotators could choose from was anger, happiness, excitement, sadness, frustration, fear, surprise, other, and neutral, but because most of the related work on transfer learning in speech emotion recognition only used anger, happiness, sadness and neutral utterances in their methods, we decided to also just use these emotions in our method.

We noticed that most of the time, the three annotators did not perceive the same emotion and, thus, we decided to eliminate all data where all three annotators did not agree on the detected emotion. This reduced the amount of data significantly. The

distribution of the emotions after the data reduction is given in Table 1.

4 METHODOLOGY

We developed methods that transfer information from a large nonemotional speech dataset into a target emotional speech dataset. Since in most of the related work researchers were extracting information from smaller emotional speech datasets and transferring this information to other emotional speech datasets, this is the first attempt that we know of in which a transfer of information is tried from already well-defined pre-trained speech dataset into a smaller emotional speech dataset, which is the standard approach in most transfer learning applications.

However, to compare if the methods provide any useful improvement, we compare them to a baseline model that was trained and tested on IEMOCAP, and which does not use any kind of information transfer.

4.1 Baseline Model

To build a baseline classifier, we decided to use standard machine learning approaches trained on features extracted using OpenSMILE [2] as a baseline method. After testing several different machine learning approaches, we saw that Random Forest obtained the best results for most of the target datasets. Because of this, we decided to use a Random Forest classifier with 1000 trees and a maximal depth of 10 as a baseline model.

4.2 DeepSpeech Model
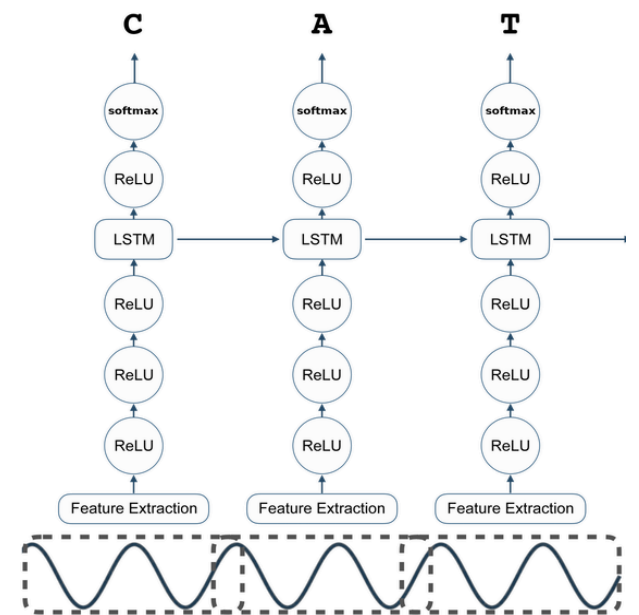
Figure 1: Architecture of the original DeepSpeech model.

DeepSpeech is a model that tries to provide transcriptions of a given speech. The model has been trained on the English

Table 2: Classification accuracy obtained from the majority classifier and baseline Random Forest Classifier compared to the DeepSpeech features method.

Model	Majority	Baseline	DeepSpeech features
Dense	34%	67%	58%
LSTM	34%	67%	7%
Dense1+Dense2	34%	67%	26%
Dense1+LSTM2	34%	67%	66%

data from the Mozilla Common Voice dataset [3]. This dataset consists of 1469 hours of speech data that has been recorded by 61521 different voices. The people whose voices were collected belonged to different nationalities (and thus different English accents), and different ages. All of this data is publicly available and can be easily accessed.

The architecture of the DeepSpeech model is presented in Figure 1. Each utterance is a time-series data, where every time-slice is a vector of MFCC audio features [4]. The goal of the network is to convert an input sequence x into a sequence of character probabilities for the transcription y.

The network is composed of five hidden layers. The first three layers are dense layers with 'ReLU' as an activation function. The fourth layer is an LSTM layer, the fifth layer is once again a dense layer with 'ReLU' activation function. The output layer has a softmax function which outputs character probabilities. In the example in Figure 1 the output of the first frame is the character 'C', the second frame outputs the character 'A', and the third frame outputs the character 'T', resulting with the word 'CAT'.

4.3 Transfer Learning Using DeepSpeech

We decided to experiment if we could transfer information from the DeepSpeech model that would be useful for the speech emotion recognition task. We used the representation learned by the DeepSpeech network to extract features for the IEMOCAP dataset. We used the output from the first layer in the Deep-Speech model as features for a given frame. We ended up with 2048 features for every 10-millisecond frame. So, if the whole utterance was 3 seconds long, we would receive a matrix with dimensions 1800x2048 after the deep speech feature extraction.

After the features from all the samples in IEMOCAP have been extracted, we trained a deep neural network using them. We simply added the layers from the new deep neural network on top of the first layer from the DeepSpeech model, and trained the new deep neural network from scratch by just using the samples from the IEMOCAP dataset. This way we repurpose the feature representations from the first layer of the DeepSpeech model.

We experimented with several different deep neural network architectures to see which one works best for this problem. In the first architecture, we used a feed-forward network on the extracted features per each frame. We used one hidden dense layer with 'relu' activation function and 204 neurons. We connected this layer to a dense layer with softmax activation function which predicted the emotion probabilities for each frame separately. Although in the IEMOCAP dataset there are no labels for each of the frames separately, we use the target label for the whole utterance as target label for each of the frames.

The second model architecture we tried was to use the features from the whole frame as input, and use a LSTM layer to learn the representations from the features. The LSTM layer is activated by a 'relu' function and has 20 hidden states. It is then connected to a dense layer activated by a 'softmax' activation function which predicts the label of the whole utterance.

The third network architecture is composed of two parts. In the first part we predict the emotion probabilities for each frame separately and in the second part we use the emotion probabilities predictions from the first layer to predict the emotion probabilities for the whole utterance. The first part of the architecture is the same as in the first network architecture and is trained one one half of the training data. In the second part of this network, we use the predictions from the first part as input to a dense layer with a softmax activation function. The second part of the network is trained on the other half of the training data. In this network architecture, for each sequence of 20 frames we predict one vector of emotions.

The fourth network consists of two separate parts and is presented in Figure 2. The first part takes the output of the Deep-Speech model, and tries to predict the probability for each of the target emotions separately. The first dense layer has a 'relu' activation function and outputs 204 features. It is then connected to another dense layer with a softmax activation function that predicts the emotions present in each frame separately. The second part of the network uses the output emotion probabilities from the first part of the layer as an input. The second part of the network consists of one LSTM layer which is trained on the second half of the training data. The LSTM layer is activated by a 'relu' function and has 20 hidden states. It is then connected to a dense layer activated by a 'softmax' activation function which predicts the label of the whole utterance. This network architecture in a way is a combination from the first and the second network architecture.

5 RESULTS

Since the DeepSpeech model is capable of learning language phases in the speech, we decided to remove all scripted utterances from the IEMOCAP dataset and use just the utterances in which the actors were asked to improvise. To evaluate the neural network architectures we used the leave-one-subject-out cross validation.

In Table 2 we present the results obtained from each of the deep neural network architectures that we tried as well as the accuracy of the baseline model and the majority classifier. In the results we can see that the LSTM network architecture that we tried performs quite poor, with classification accuracy of only 7%. The most probable explanation for this is that this architecture is quite complex since it has 2048 features for each frame, and it tries to train an LSTM model on all of these features. To train a model with this amount of parameters, we would need much more samples than the IEMOCAP improvisations.

The architecture that provides the best results is the one that uses a FFN to predict the features in each frame, and then uses a
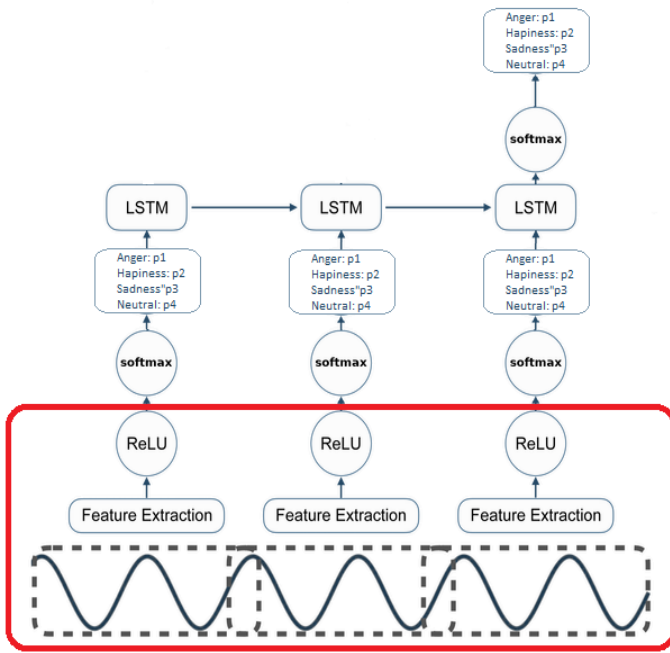
Figure 2: Architecture of the original DeepSpeech model.

LSTM network to predict the final emotion predictions for the whole utterance. We further experimented with this network architecture to see how much the length of the frames changes the performance of the model. The results are presented in Figure 3. In this figure, we can notice that the performance of the model can be improved by using bigger frames when training the LSTM part of the DeepSpeech model. However, the performance of the model does not differ a lot – only a few percentage points.

The results show that some of the DeepSpeech architectures can perform better than the majority classifier but none of the architectures outperforms the baseline model. A possible explanation for this could be that these two tasks are simply not related enough and we cannot use information from the DeepSpeech model to improve the performance of a model for speech emotion recognition.
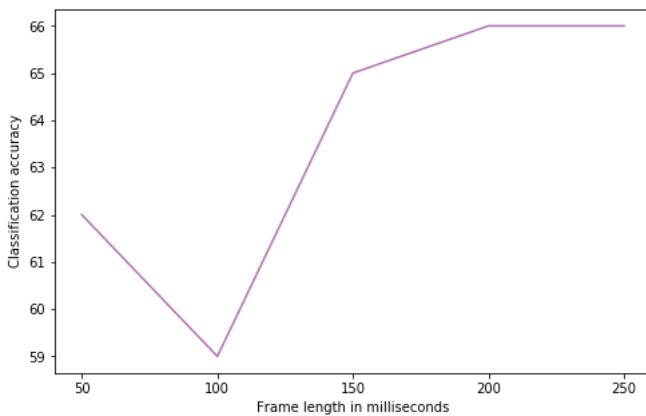
Figure 3: Performance of DeepSpeech model by using different frame lengths.

6 CONCLUSION

In this work we tried to improve a baseline speech emotion recognition classifier by transferring information from a pre-trained model. Although this transfer learning method has been most widely used in other computer science fields, most of the related work in speech emotion recognition developed transfer learning methods that transfer information from other emotional speech datasets into a target emotional speech dataset.

The pre-trained model we used was Mozilla's DeepSpeech that was developed as a speech-to-text model. To recognize emotions in speech, we used the first layer from the DeepSpeech model, on top of which we added a new classifier that was trained from scratch on an emotional speech dataset. This way we repurposed the feature maps learned previously for the dataset.

The results from this approach did not seem to improve the classification accuracy of the improvisations part in the IEMO-CAP dataset. A possible explanation for this could be that the speech-to-text and speech emotion recognition tasks are simply not sufficiently related, and because of this the model could not extract any useful information from the DeepSpeech model. However, since this was the first attempt to transfer information from a well-defined pre-trained model to a speech emotion recognition task, we believe it is still a valuable attempt.

7 ACKNOWLEDGMENTS

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Towards Automatic Recognition of Similar Chess Motifs

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ABSTRACT

We present a novel method to find chess positions similar to a given query position from a collection of archived chess games. Our approach considers not only the static similarity due to the arrangement of the chess pieces, but also the dynamic similarity based on the recognition of chess motifs and dynamic, tactical aspects of position similarity. We use information retrieval techniques to enable efficient approximate searches, and implement textual encoding that captures the position, accessibility and connectivity between chess pieces, pawn structures, and moves that represent the solution to the problem. We have shown experimentally how important the inclusion of both static and dynamic features is for the successful detection of similar chess motifs. In another experiment the program was able to quickly traverse a large database of positions to identify similar chess tactical problems. A chess expert found the resulting program useful for automatically generating instructive examples for chess training.

KEYWORDS

problem solving, chess motifs, automatic similarity recognition

1 INTRODUCTION

A significant part of acquiring human skills is to identify our weaknesses and take measures to remedy them. In problem-solving domains such as chess, the analysis of past games is important for players trying to improve their game. Identifying their mistakes enables chess players to work on improving some aspects of their game. This is often done by training on similar problems. Finding relevant similar problems involves recognising both static patterns, i.e. finding similar chess positions, and dynamic patterns, i.e. finding similar move sequences that solve a problem. These static and dynamic patterns are often referred to as *chess motifs*. Learning and recognising chess motifs during the game is one of the main prerequisites for becoming a competent chess player [2].

Chess instructors often look for examples containing relevant chess motifs from real games to provide their students with useful teaching material. However, it is impossible for a human being to go through thousands or even millions of games and find problem positions with similar chess motifs and similar solutions to those overlooked by the students in their game. Finding contextually similar chess positions could also be used for annotating chess games [5] and in intelligent chess tutoring systems [10].

The goal of our research is to develop a method to automatically retrieve chess positions with similar chess motifs for a given query position from a collection of archived chess games.

1.1 Related Work

Existing chess search systems equipped with a query-by-example (QBE) [11] search interface are limited to searching only the exact matches in response to a given query position. To alleviate the problem of exact position searches, the Chess Query Language system (CQL) [1] allows the search for approximate matches of positions. However, it requires the user to define complex queries in the system-specific language. The search results can be sorted by any user-defined feature. In addition, the CQL works directly on game files and checks each game sequentially, making it inefficient for querying larger databases.

To overcome these problems, an approach has been proposed which is based on information retrieval for obtaining similar chess positions [4], constructing a textual representation for each board position and using information retrieval methods to calculate the similarity between these documents. Instead of constructing a query manually, the user specifies a chess position and a query encoding the characteristics of the position is automatically generated internally. Initially, a naive encoding was used, which only contains the positions of the individual pieces. The results have been improved by including additional information about the mobility of the individual pieces and the structural relationships between the pieces. Further work has been carried out to improve the quality of retrieval by implementing automatic recognition of pawn structures [7]. The additional information provided by the application of domain knowledge has proved useful, however, the positions are still only statically evaluated.

All existing approaches have a common shortcoming: they only allow the search for statically similar positions, while ignoring the dynamic factors, which are often far more important to obtain relevant search results.

2 DOMAIN DESCRIPTION

In this paper, we will focus on automatic retrieval of similar chess tactical problems from a large database of chess games. In chess, the term *tactic* is used to describe a sequence of moves that takes advantage of a certain position on the board and allows the player to gain material, a positional advantage, or even leads to a forced checkmate sequence.

Chess tactical problems are particularly important for the progress of chess players. Knowledge of tactical motifs helps them to quickly recognise the possible presence of a winning or drawing combination in a position. Chess players improve their tactical skills by solving tactical problems. A large number of games are decided by tactics, since a single mistake, which gives the opponent an opportunity for tactics can change the outcome of a game. To help players to discover tactical possibilities in games, many common patterns or *tactical motifs* have been defined in the chess literature [6]. Stoiljkovikj et al. developed a method for estimating the difficulty of chess tactical problems [9]. They introduced a concept of *meaningful search trees*, which can
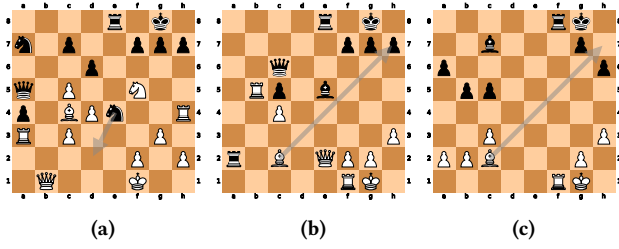
Figure 1: Tactical motifs.

Figure 2: Static and dynamic similarity.

potentially be used either for motif recognition or as an additional feature for positional similarity ranking.

We use standard chess annotation. Chess games are stored using Portable Game Notation (PGN), chess positions are described with Forsyth-Edwards Notation (FEN), and chess moves are described with Standard algebraic notation (SAN) [3].

Figure 1 shows some of the more common motifs. In Figure 1a, Black performs a *double attack* on the white king and queen at the same time. White must move the king out of check, allowing Black to capture the queen. Figure 1b is an example of a *discovered attack*. By moving the bishop, White opens the queen's line of attack on the rook on a2. After Black responds to move out of the check, White can capture the black rook. The tactic in Figure 1c is called *deflection*. The black king protects the rook on f8. White gives a check with the bishop, forcing the black king to move away from the rook so that it can be captured.

To illustrate the difference between static and dynamic similarity using an example, we compare the query position in Figure 2a with the positions in Figure 2b and Figure 2c. The position in Figure 2b seems to be very similar to that in Figure 2a: only the white rook on h4 and the black rook on e8 have been removed. These two positions are statically similar. On the other hand, the position in Figure 2c seems to be quite different. However, if we compare the move sequences that represent solutions to these two tactical problems, we notice a great dynamic similarity. The solution in Figure 2a is 1. Rh8+ Kxh8 2. Qh6+ Kg8 3. Qxg7#. The solution in Figure 2c contains the same tactical motif as the solution mentioned above: the white rook is sacrificed on h8 and the black king must capture it, allowing the white queen to appear with check on h6 (note that it cannot be captured due to the activity of the white bishop along the long diagonal) and deliver checkmate on the next move. Note that such motif is not possible in the position shown in Figure 2b.

We are particularly interested in recognising the dynamic similarity, i.e. finding positions with similar motif(s) in the solution of the problem. However, we also want to take into account the static similarity, i.e. finding problems with similar initial position.

3 SIMILARITY COMPUTATION

To determine similarity between tactical problems we use an approach based on information retrieval. A set of features is computed from each problem's starting position and its solution move sequence. The features are then converted into textual terms, forming a document that represents the problem. A collection of documents is used to build an index, which can then be queried using the textual encoding of a new position to retrieve the most similar positions in the index. For the implementation of the system for indexing and retrieval of similar tactics we use the *Apache Lucene Core* library. Search results are ranked using the BM25 ranking function [8].
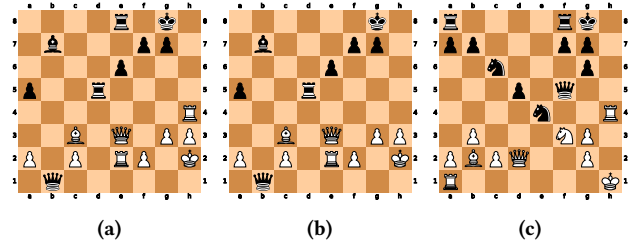
For each tactic, the input consists of a starting position in FEN format and a solution move sequence in algebraic notation. The solution can be provided with the position or calculated using a chess engine. Sections 3.1 and 3.2 describe the features and terms that are generated, and Figure 3 shows an example of a text encoding.

3.1 Static Features

The static part of the encoding includes information about the positions of pieces on the board, structural relationships between pieces and pawn structures present in the position.

The implementation is based on previous work on similar position retrieval [4] and pawn structure detection [7] and is intended to serve as a baseline on which we aim to improve by implementing encoding of dynamic features.

3.1.1 Piece positions and connectivity. The section describing piece positions and connectivity encoding consists of three parts:

- *naive encoding* - the positions of all the pieces on the board.
- *reachable squares* - all squares reachable by pieces on the board in one move, with decreasing weight based on distance from the original position, in format *{piece symbol and position}|{weight}*.
- *connectivity between the pieces* - the structural relationships between the pieces in the positions. For each piece it is recorded which other pieces it attacks, defends or attacks through another piece (*X-ray attack*). Attacks are encoded as *{attacking piece symbol}>{attacked piece symbol and position}*. For defense and X-ray attack terms, < and = separators are used instead.

3.1.2 Pawn structures. For this section of the encoding, we use pawn structure detection algorithms [7] to detect the following pawn structures in the position and encode them into terms: isolated pawns (*I{pawn position}*), (protected) passed pawns (*F{pawn position}*), backward pawns, doubled pawns and pawn chains. Terms *P({number})* and *p({number})* are used to encode the number of pawn islands for white and black, respectively.

3.2 Dynamic Features

In the dynamic part of the encoding, we focus more on the solution of the tactical problem, trying to capture the motif behind it. We first encode some general characteristics of the solution, then add more specific terms describing the move sequence.

3.2.1 General dynamic features. In this part we encode some basic features of the solution move sequence that can help us determine similarity. We use a single term for each of the following features if it holds for the solution:

- *?px* - the player captures a piece in at least one of the moves
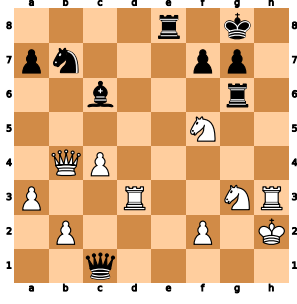
(a) Encoded position. Black to play, solution: 1... Qh1+ 2. Nxh1 Rg2#.

Feature set	Generated terms
static_positions	qc1 Pb2 Pf2 Kh2 Pa3 Rd3 Ng3 Rh3 Qb4 ...
	qa1|0.78 qb1|0.89 qd1|0.89 qe1|0.78 ...
	q>Pb2 q>Pc4 Q>nb7 N>pg7 r>Ng3
	P<Pa3 P<Ng3 K<Ng3 K<Rh3 P<Qb4 ...
	q=Pa3
static_pawns	If2 ia7 Fc4 P(2) p(2)
dynamic_general	?ox ?+ ?# ?S
dynamic_solution	!-q !-N !-r !-qN !-Nr !xq
	!Sq
	!#b !#r !#br
	!K>q !N>q !q>K !b>N !K>r !r>K !r>P

(b) Text encoding of each set of features for the above position.

Figure 3: Text encoding of a tactical position.

- *?ox* - the opponent captures a piece in at least one of the moves
- *?+* - the player gives a check at least once during the sequence
- *?=* - the player promotes a pawn in at least one of the moves
- *?S* - the player sacrifices one or more pieces
- *?#* - the solution ends with a checkmate
- *?1/2* - the solution ends in a draw

3.2.2 Solution sequence features. In this section we encode information about the solution move sequence. The encoding includes a term for each:

- type of piece moved: *!-{piece symbol}*
- type of piece captured: *!x{piece symbol}*
- attack between pieces that occurs during the solution: *!{attacking piece symbol}>{attacked piece symbol}*
- type of piece sacrificed: *!S{piece symbol}*
- (if the final position is a checkmate) type of piece involved in checkmate: *!#{piece symbol}*

We count a piece as involved in checkmate if it is attacking either the king directly or any of the squares where the king could move from the current position (ignoring checks).

To include information about the order of moves and captures we also include a term for each two consecutive moves and captures in the solution. We also include a term for each pair of pieces involved in checkmate to capture more specific combinations of pieces.
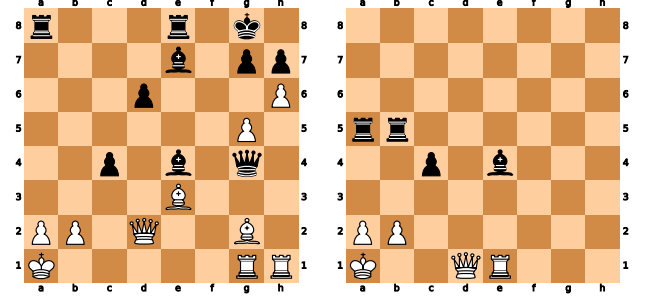
(a) Base problem. Black to play, solution: 1... Rxa2+ 2. Kxa2 Ra8+ 3. Ba7 Rxa7+ 4. Qa5 Rxa5#.

(b) Simplified problem. Black to play, solution: 1... Rxa2+ 2. Kxa2 Ra5+ 3. Qa4 Rxa4#.

Figure 4: A pair of tactical problems from the data set.

4 EXPERIMENTAL RESULTS

To evaluate the effectiveness of our methods, we used a number of problems that we have collected from the Chess Tactics Art (CT-ART 6.0) training course[1]. Many puzzles in this course consist of pairs of positions: one is taken from a real game, another represents a simplified version where the same tactical motif usually appears on a smaller 5×5 board. This fact allowed us to obtain a set of position pairs that were considered similar by human experts. We manually checked the puzzles and verified the similarity between the solutions of the individual problem pairs. A total of 400 pairs were collected for the test data set.

An example of such a pair is shown in Figure 4. The solution to both problems is to sacrifice the rook on the a-file to expose the king, resulting in checkmate with the other rook and the bishop on e4. The solution in the simplified problem contains the same motif, but there are much fewer pieces, so the solution is generally easier for the students to find.

4.1 Evaluation of Similarity Detection

We tested the effectiveness of our methods using the set of 400 pairs of problems described in the previous section. We first built an index using the simplified version of the problem from each pair, then performed a query on the index with each of the regular problems. For each query we recorded the rank of the matching position in the results and calculated how often the matching position appeared as the top result or within the first N results.

We tested the search accuracy using the following feature subsets: each feature group on its own, all static features, all dynamic features and all features combined. All runs used the default BM25 parameters $k_1 = 1.2$ and $b = 0.75$ and all included feature sets were weighted equally. The results are presented in Table 1.

Using either only static or dynamic features did not yield the best results. The results were significantly improved when both static and dynamic features were combined. This shows that each set of features covers a different aspect of a tactic, both of which need to be considered when determining similarity.

4.2 Similar Position Retrieval

In the second experiment, we selected 10 contextually different chess tactical problems and then automatically retrieved 5 most similar positions for each of them from a large database of 278,840

[1] https://chesskingtraining.com/ct-art

| | Accuracy | | |
Feature set used	top-1	top-5	top-10
static_positions	0.234	0.378	0.428
static_pawns	0.033	0.083	0.126
dynamic_general	0.008	0.038	0.071
dynamic_solution	0.421	0.657	0.761
all static features	0.252	0.370	0.433
all dynamic features	0.418	0.652	0.761
all features, equal weights	**0.481**	**0.736**	**0.814**

Table 1: Success rates for different configurations.

tactical problems constructed from the lichess.org game database. Building the index took about 14 minutes (it only needs to be done once), and retrieval was fast: only about 4 seconds.

Figure 5 shows a query position and the first two of the five most similar retrieved positions. This example illustrates how similarity ranking works and how the static and dynamic features contribute to the similarity scores of the results. The query position is an example of a discovered attack motif. With 1... Bh2+, Black sacrifices the bishop to later capture the rook on e1 with the queen. The first result shows the same motif with an almost identical move sequence. The main difference is that the key pieces are on the d-file and not on the e-file. The second result is another case of a discovered attack. In this example it is not a bishop but a knight sacrificed with a check to the white king. It is the static similarity (the arrangement and position of the pieces in the initial position) that contributes most to the great overall similarity of this tactical problem, although a certain dynamic similarity was also detected.

The resulting most similar positions were shown to a chess expert. The expert was asked to comment on the reasons for the similarity of the resulting problems with the original query positions, taking into account both static and dynamic aspects. The expert was able to explain the similarity in 48 out of 50 problems. Overall, the expert praised the program's ability to detect dynamic similarity of positions, even if the initial positions differ significantly.

5 CONCLUSIONS
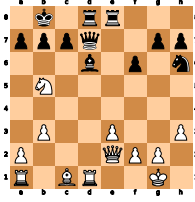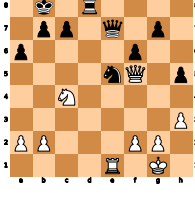
We introduced a novel method for retrieving similar chess positions, which takes into account not only static similarity due to the arrangement of the chess pieces, but also dynamic similarity based on the recognition of chess motifs and dynamic, tactical aspects of position similarity. The merits of the method were put to the test in two experiments. The first experiment emphasized the importance of including both static and dynamic features for the successful detection of similar chess motifs. In the second experiment, the program was able to quickly traverse a large database of positions to identify similar chess tactical problems. A chess expert was able to explain the similarity in the vast majority of the retrieved problems and praised the program's ability to detect dynamic similarity of positions even if the initial positions differ significantly. The resulting program can be useful for the automatic generation of instructive examples for chess training.

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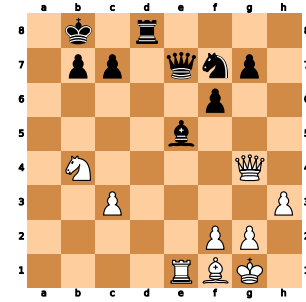
(a) Query position. Black to play, solution: 1... Bh2+ 2. Kxh2 Qxe1.

Position	Solution	Similarity score	
	1... Bh2+ 2. Kxh2 Qxd1	static dynamic **total**	38.95 45.04 **83.99**
	1... Nf3+ 2. Qxf3 Qxe1+	static dynamic **total**	64.62 12.32 **76.94**

(b) Retrieval results.

Figure 5: Example of retrieval results.

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Drinking Detection From Videos in a Home Environment

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ABSTRACT

We present a pipeline developed with the aim of helping people with mild cognitive impairment (MCI) in the accomplishment of every-day tasks. Our system adopts a number of computer vision methods to analyze RGB videos collected from cameras, and provides a successful, quasi real-time detection of the targeted activity (drinking) when the latter is at least partially visible to the camera.

KEYWORDS

computer vision, activity recognition, object detection, pose estimation

1 INTRODUCTION

Mild cognitive impairment (MCI) is a common problem among elders, affecting 15–20% of people over 65 in the USA [10]. In order to help people affected by MCI in the accomplishment of every-day tasks, we adopt various kind of detection techniques to predict what users are currently doing, which, combined with a knowledge of their activities schedule, allows our system to provide context-based reminders. Here, we present our attempts to detect one of such activities (i.e. drinking) from videos, by the use of computer vision and deep learning algorithms.

This paper is organized as follows. In the remainder of this section, we give an overview of the current SOTA regarding activity recognition from videos. In Section 2 we describe the computer vision techniques used to trigger the more computationally intensive task of activiry recognition, to obtain a quasi real-time monitoring of the user's activities. Finally, in Sections 3 and 4 we present the results and conclusions of the paper.

1.1 Video Activity Recognition

Differently than what happened for image classification, where in the last years a number of clear front runner architectures and techniques have been established, the topic of activity recognition from videos still presents numerous open issues [1].

An immediate approach to the problem consists in using image classification networks to extract features from each frame of the video; then, predictions for the whole video can either be obtained by pooling over frames (at the cost of losing information about temporal ordering) [5] , or by adopting LSTM layers [2].

A more elaborate way to adapt the concepts used in image classification methods to video recognition consists in using 3DCNN, i.e. convolutional models characterized by an additional third temporal dimension [4, 12, 13]. The increased number of

parameters makes 3DCNNs generally harder to train than their 2D counterparts. One way to fix this is to produce 3D models by "inflating" 2D ones, i.e. by adding a temporal dimension to a model pre-trained for image classification. This allows to determine the architecture of the 3D network and to bootstrap its values starting from the corresponding values in the 2D model: convolutional kernels with dimensions $N \times N$ are inflated to a 3D kernel with dimensions $N \times N \times t$, spanning t frames, and each of the t planes in the $N \times N \times t$ kernel is initialized by the pre-trained $N \times N$ weights rescaled by 1/t [1, 9].

Another approach separately analyzes spatial components (i.e. single frames), providing static information about scenes and objects in the picture, and temporal components related to motion and variation between frames [11]. A two-stream network parallelly processes single frames and optical flows, respectively, and then combines their predictions.

Finally, another method worth mentioning is based on the observation that some actions (i.e., clapping hands) are better characterized by high-frequency temporal features, whereas other ones (i.e., dancing) can be better understood when lower frequency variations are observed. As a result, a model characterized by two parallel channels can be used. The first (slow) channel operates at low framerate and analyzes few sparse frames, in order to deduce the semantics of the action, while the second (fast) branch is responsible for capturing fast variations, and so operates at higher framerate [3].

In this work, we adopted a modified version of an inflated 3D network as described in [14], to include non-local blocks. Unlike convolutional and recurrent operations, which are only able to capture spatio-temporal features in a local neighborhood, non-local blocks compute the response at a certain position as a weighted sum of features at all positions in space and time. This allows the model to capture dependencies between pixels that are distant both in space and time, and makes it more accurate for video classification.

2 SYSTEM ARCHITECTURE

The purpose of our system is to provide users context-based reminders related to the activity of drinking. To this aim, a RGB camera is placed in the kitchen of the user's apartment (where the activity is most likely to take place) and the video is sent through a RTSP stream to a remote server, to be analyzed by the activity recognition model during the day. The results are uploaded to a Cloud Firestore Database, which is queried to determine whether the users have been drinking enough, and reminders are provided through an app running on a local device if not.

One problem arising from this scheme is that most action recognition algorithms are computationally expensive, which prevents them from running in real time. For this reason, we decided not to run the model continuously, but to execute it only in moments where it is most likely that the users are about to perform the targeted activity. We employed a combination of

De Masi, Luštrek
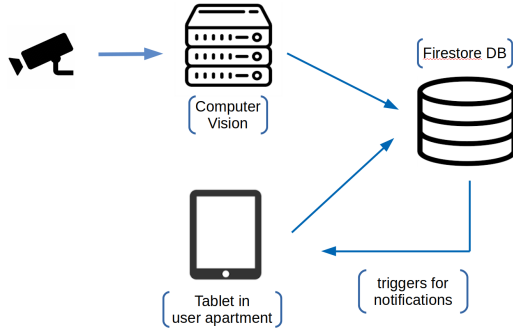
Figure 1: System architecture. Video stream from RGB cameras is sent to a remote server and fed to the activity recognition model. Results are uploaded to a Firestore database, where they are monitored so that notifications can be sent back to an app.

classic and deep-learning-based computer vision techniques to identify some ***triggers*** for the video activity recognition model, such as: (i) user standing in certain areas of the kitchen; (ii) user standing in certain areas of the kitchen, and interacting with some objects (tap, fridge); (iii) a specific object, assumed to be used by the user for drinking, is moved from its current position.

2.1 User Localization And Interaction With the Environment

The localization of the user and their interactions with the environment are detected through a combination of object detection and pose estimation techniques. For the object detection, we adopted a Single Shot MultiBox Detector (SSD) [8], pre-trained on the 80 classes of the COCO dataset [7], which also include "person". As for pose estimation, we used a SimpleNet model with a ResNet backbone [15].

During the initial setup, the camera image is shown to the user (Fig. 2a) and regions of interest (ROIs) can be selected (Fig. 2b). These can be of two types, i.e. single or double-zone. The first ones are identified by a single rectangular box, which is activated when the user's feet are within the box, hence providing indications on the user's location (see Fig 2c). Double-zone ROIs are formed by two rectangular boxes; one of them, analogously to the previous case, is activated when the user steps inside of it, while the second box is activated if one of the user's hands (located by the pose estimation model) is within it (Fig. 2d). Overall, a double-zone ROI is considered activated only if both conditions are met. Once the ROI is configured, the user is requested to input:

- the name used to identify the current ROI;
- an observation time t_{obs} (in seconds), i.e. the time after which the ROI is activated, once the requirements (user and hands positions) are met;
- an action to be performed once the ROI is activated. Currently, only one default action - recording and analyzing video clips - is supported, but this will be extended to include further possibilities.

2.2 Drinking Vessel Position Detection

A second trigger for activity recognition is given by the displacement of a particular object (mug, cup, glass). To this regard, in the pilot phase of the project users will be asked to always use one specific drinking vessel when they are drinking, which the model will be trained to recognize.
For this task, we considered two possibilities:

- a classic computer vision approach, where the drinking vessel is located through a color/shape-based detection;
- a deep learning object detection algorithm, re-trained to detect a personalized mug.

In the fist scenario, we applied a series of filters (Gaussian blur, dilation/erosion) to reduce noise, followed by a color mask in the HSV space to select only objects with a certain color. A further selection is then done based on the shape properties of the previously selected areas; a polygonal approximation of their contours is performed, and other shape-related features such as area, circularity and convexity are considered to eliminate shapes different from the expected one.

In the second case, we collected a dataset of about 500 images of the selected mug, and used it to re-train a second SSD model. In order to account for false negatives in the mug detection, that may occur in some frames even if the mug has not been moved, for each frame the current position of the mug is compared to the history of positions in the past few frames. Once a displacement of the mug is detected, the trigger is activated.

2.3 Clip Recording and Activity Recognition

Following the activation of one of the triggers, the next video frames (for a time interval of about 30 seconds) are used to generate short video clips, each of which has a duration of 10 seconds, with an overlapping window of 4 seconds. These values have been selected to have a higher probability to obtain at least one video clip completely capturing the whole drinking process, and to match the length of the videos in the Kinetics400 dataset [6], which has been used for the activity-recognition model training.

3 RESULTS AND DISCUSSION

In this section, we present the results of the various steps involved in the whole drinking-detection pipeline.

3.1 User Localization - Results

We tested the efficiency of the localization module in different scenarios, varying based on how clearly the user was visible (completely visible; legs occluded; head occluded; head and legs occluded, only torso visible) and on which side (front/back/right/left) of the user was visible, and the results showed an average accuracy of over 98%.

3.2 Drinking Vessel Position Detection - Results

As illustrated in Sec. 2.2, for the task of detecting the displacement of the drinking vessel we adopted two approaches, one based on classic computer vision methods and one on deep learning.

The first method does not provide a confidence score for detections, nor the coordinates of the object's bounding box, so we took a simpler approach than with normal object detection algorithms in evaluating the results. We collected some videos in a home-like environment, with the object located in different positions, or with a person handling it (moving it, using it to drink...), and analyzed them frame-by-frame to check whether the objects present in each frame were detected or not. The resulting confusion matrix, reported in Table 1, shows that the detection algorithm scored precision and recall values of .93 and .90, respectively. This method proved to be very efficient, when correctly fine-tuned, and the algorithm detected the object in most of the frames where it was at least partially visible. The

(a) **(b)** **(c)** **(d)**
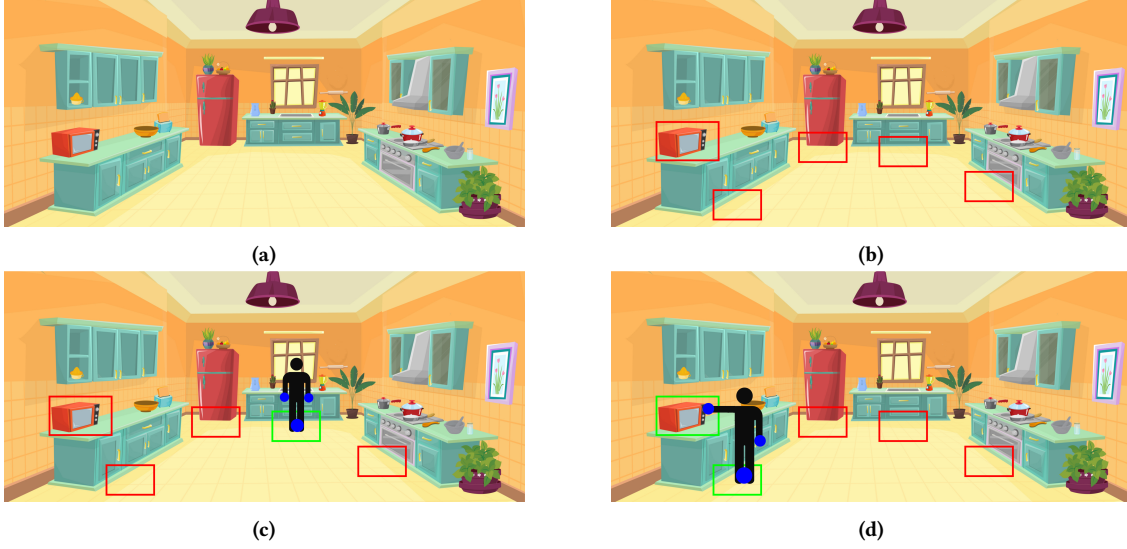
Figure 2: Triggers based on user's location and their interaction with the environment. Regions of Interest are selected during the setup phase (b), and they are activated either if the user steps inside (c), or if the user steps inside and has their hands next to another object (d).

Table 1: Confusion matrix for the color/shape-based detection of the mug

		Pred	
		P	N
True	P	133	15
	N	10	1

greatest issue of the method is that it had to be very carefully tuned, especially regarding the color selection part, which is still sensible to lightning variations even after converting the image to the HSV colorspace. False detection can also be a problem. We tested the algorithm in situations where some of the objects present in the scene had colors similar to the object we wanted to detect, and in spite of being able to filter out most of them we still obtained some false positives, especially when the lighting varied, thus rendering the selection of the parameters for the color mask less efficient.

The results of the evaluation of the SSD model are shown in Fig. 3. As evident from the plot, the model immediately reached a very high mAP [7], of the order ≈ 0.9, on our test dataset. It should be noted that, while preparing the training dataset, we followed a somewhat different approach than what is usually done for training object-detection models. In most situations, one wants to make the model as general as possible and avoid overfitting, which is achieved by taking images of the desired object in as many different conditions (size, aspect ratio, point of view angle, rotation, lightning) as possible. In our case, however, the location of the camera will be more or less constant, i.e. attached to the ceiling of the room, in order to provide a good view of the environment. As a result, this will greatly limit the variability in the images of the object the system will analyze, especially regarding the aspect ratio and the orientation of the mug. Moreover, whereas an object detector is usually tasked to identify many different instances of objects in a certain class (i.e., a generic "mug"), in our case the task is greatly simplified by the fact that we are looking to locate one very specific object.

3.3 Activity Recognition - Results

We tested the adopted activity recognition model on a new custom dataset, consisting of roughly 100 videos we recorded ourselves in a variety of environments and conditions. In order to make the clips as similar as possible to real-life situations, the videos contained instances where actions similar to drinking were performed, to increase the recognition difficulty. The clips can be classified as belonging to two difficulty categories, based on the angle the user was facing with respect to the camera; videos were classified as "hard" whenever this angle was greater than 90° (see Fig. 4). The precision-recall curve for the model on this dataset is shown in Fig. 5.

4 CONCLUSIONS

The tests performed on triggers are very encouraging for the one based on the user location and their interaction, and indicate that the deep-learning approach should be preferable for the detection of the drinking vessel and its displacement, especially after increasing the amount of training data. The activity-recognition model based on inflated 3D CNN with the addition of non-local blocks provided the best accuracy in situations were the user is facing the camera at least partially, and the use of triggers allows for a quasi real time usage. A number of improvements will be added to the pipeline in the future. Currently, only one action is triggered, i.e. recording and analysis of video clips, but we plan to include other possibilities, such as using the information on the user location to check whether they need assistance in operating domestic appliances. The object detection model could also be extended, in order to identify interactions with other elements of the environment, and provide corresponding context-based responses. Finally, the only action currently recognized is drinking, but as mentioned in the introduction the aim of the project is to assist users in the accomplishment of various activities. In this sense, the next planned step is to include detection of parts of the morning toilet routines, such as brushing teeth and washing hands.
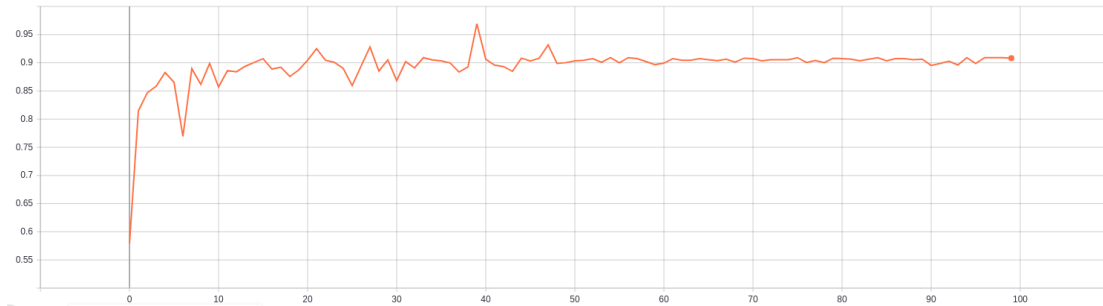
Figure 3: mAP values on the test dataset for the SSD model, re-trained to recognize the project custom mug.

Figure 4: Difficulty classes for the custom dataset we used to test the activity recognition model. Video clips were classified as "hard" whenever the angle between the user front side and the camera was greater than $90°$.
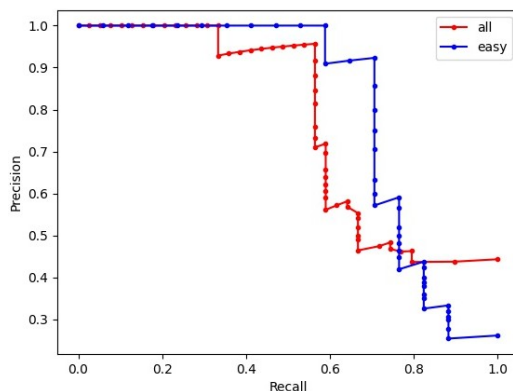
Figure 5: Test results of the activity recognition model on the test dataset.

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Semantic Feature Selection for AI-Based Estimation of Operation Durations in Individualized Tool Manufacturing

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ABSTRACT

Accurate estimation of operation durations is of key importance in production processes, since the accuracy of estimations directly affects the quality of production plans and thus the entire production process. This task is even more challenging when individualized tools are being produced. From the machine learning point of view, this means a low number of diverse samples, while the number of features can be significantly higher. To tackle this issue, we introduce semantic feature selection that reduces the number of features. This results in obtaining a better ratio between the number of samples and features and, at the same time, reduces the prediction error. We demonstrate the proposed approach on the problem of estimating the operation durations in the manufacturing of injection molds and show the prediction accuracy improvement resulting from the semantic feature selection.

KEYWORDS

injection molding, tool manufacturing, duration prediction, feature selection, random forest

1 INTRODUCTION

The efficiency of tool shop manufacturing processes heavily depends on the accuracy of production plans. Inaccurate plans can lead to significant delays in production, due date violations, late delivery penalties, and even loss of customers. A key step of planning is accurate estimation of durations of all the operations to be executed in the manufacturing process. The estimation can be performed manually by an expert utilizing his/her expert knowledge, or automatically by means of tools such as those involving AI methods as, for example, demonstrated in [3].

Automated estimation of operation durations with AI methods consists of learning a predictive model from the features extracted from examples of past, i.e., already concluded operations and their actual durations, and then applying the model to new operations with known features and unknown durations. In the case of tool manufacturing, the features can be extracted from 3D computer models of already manufactured tools. To build an accurate predictive model, a large set of already manufactured tools has to be processed. However, this is not possible in certain cases, for example, when dealing with individualized tools, such as injection molds. This is due to the fact that the tool shops specialized in individualized tool manufacturing typically produce only few such tools per year. In addition, these tools are

very diverse, which increases the difficulty of automated duration prediction.

We propose an approach for predicting operation durations in the manufacturing of individualized tools. The tools are manually divided into several positions of varying complexity, where each position is specified with a 3D computer model. In addition, a set of operations are predefined for each of these positions. The proposed approach processes the 3D model of each position and predicts the duration of the corresponding manufacturing operations. To this end, it firstly extracts a set of volume, surface, gradient and other features from the 3D model, and then applies the Random Forest regression model [1] to predict the duration of each operation. This process is additionally enhanced with semantic feature selection that evaluates various sets of semantically related features, such as volume features, in order to assess the predictive capability of these feature sets. We demonstrate the proposed approach on the problem of estimating the operation durations in the manufacturing of injection molds in a specific tool shop. By processing a dataset from this tool shop, we show the prediction accuracy improvement resulting from the semantic feature selection.

The rest of the paper is organized as follows. Section 2 introduces the relevant tool positions and the related operations, and describes the extracted features and the semantic feature selection. Numerical experiments and the obtained results are presented in Section 3. Finally, Section 4 concludes the paper with the summary of our work and the ideas for future work.

2 PREDICTING OPERATION DURATIONS WITH AI METHODS

Prediction of operation durations consists of extracting features from the tool data in the form of 3D computer models, and applying a machine learning model to predict the durations. This approach is applied for each tool position and each operation at this position independently, thus a custom machine learning model is built and applied for each combination of position and operation. In addition, when feature selection is involved, a different set of features is considered for each of these combinations.

2.1 Relevant Positions and Related Operations

The tools regarded in this study are injection molds that are used to form the final products made of plastic under high pressure. Although the injection mold is composed of several positions, its most complex and thus the most relevant positions are the bottom and the top element. These two elements have to be manufactured with the highest precision. Since they are in physical contact with the final product, any defect of the mold surface would result in a defect of the final product. An example of the injection mold is shown in Figure 1, where the red color indicates the surface

that is in contact with the final product. In the dataset used in this study, these two elements are marked as positions 1 and 30. These positions require a set of operations, where the most relevant operations are shown in Tables 1–2.
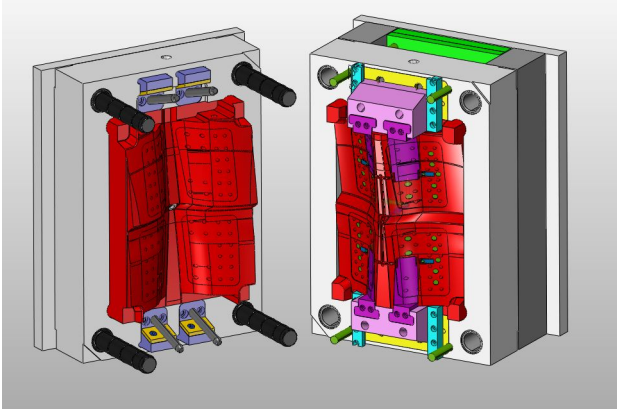
Figure 1: Example of a 3D computer model of an injection mold, https://grabcad.com/library/injection-mold-pc-abs-1 by Mauro Menchini.

Table 1: Operations at Position 1

Operation	Description
32	CAM rough
31	CAM fine
43	CAM erosion
19	Heat treatment
23	Measuring machine
36	CNC milling 3 axis, rough
41	CNC milling 3 axis, fine
42	CNC milling 5 axis, fine
13	Submersible erosion

Table 2: Operations at Position 30

Operation	Description
32	CAM rough
31	CAM fine
37	CAM wire erosion
43	CAM erosion
19	Heat treatment
11	Wire erosion
23	Measuring machine
36	CNC milling 3 axis, rough
41	CNC milling 3 axis, fine
42	CNC milling 5 axis, fine
13	Submersible erosion

2.2 Description of the Extracted Features

The proposed approach extracts a set of features from a 3D computer model of a tool. These features were suggested by a tool shop expert and can be categorized as follows:

- volumes of the entire tool position (such as volume of the shape and volume of the mold),
- volumes of the holes that are open, and of those that are closed,
- features for each of 6 directions, i.e., projections (x, y, z, each of them increasingly or decreasingly), for example, direction (z, decreasingly) defines the features obtained from the top-down projection, while direction (z, increasingly) defines the features obtained from the bottom-up projection; the features for each direction are as follows:
  - volumes (including the volumes of holes),
  - surface area,
  - number of faces,
  - number of faces per dm^2,
  - valley features, computed as the height versus width ratio of the valleys (in all valley directions to find the maximum value); this feature is aimed at identifying deep and narrow valleys that are harder to process,
  - valley height, computed as the height of the valleys in all valley directions to find the maximum value; this feature is aimed at obtaining the depth of valleys that represents the drill distance,
  - gradient features, calculated as the maximum gradient in all directions; this feature is aimed at identifying areas with non-horizontal and non-vertical gradient that are harder to process.

Since the valley features, valley height and gradient features are calculated for each point of the projection, the number of features is very high and varies across the tool positions which are of varying sizes. To reduce the number of features and obtain a constant number of features independently of the position size, histograms of these features are calculated using expert-defined bins.

The 3D model of each position also contains expert-defined annotations of the model parts with different colors of model faces (see the example in Figure 1). These model parts are also taken into account when extracting features and therefore obtaining additional features that characterize a feature for each part independently. For example, when calculating the number of faces, one feature is obtained for all the faces, and for each part an additional feature is calculated denoting the number of faces on that specific part. The part-specific features are calculated for the following features:

- volumes of the holes: total, open, closed,
- projection features:
  - volume,
  - surface area,
  - number of faces,
  - number of faces per dm^2,
  - valley features,
  - valley height,
  - gradient features.

Examples of parts that are annotated in the 3D computer models include: (1) Free holes, (6) Tolerance holes, (7) Parting surface, (10) Matching surfaces, (12_4) Part shape: High gloss polished, (12_5) Part shape: Optical faces, (12_7) Part shape: Galvanic pins, (12_8) Part shape: Special surface finishing. In total, 30 parts are annotated by the expert.

Table 3: Feature Sets

Name	Number of features
expert	524 on average
volume	6
volume_projection	30
volume_no_hole	3
volume_projection_no_hole	6
volume_hole	3
volume_projection_hole	24
volume_hole_part	90
volume_projection_no_hole_part	180
material	4
surface_projection	6
surface_projection_part	180
faces_count_projection	6
faces_count_projection_part	180
faces_per_dm2_projection	6
faces_per_dm2_projection_part	180
valley_hist_projection	18
valley_hist_projection_part	540
valley_h_projection	48
valley_h_projection_part	1440
grad_hist_projection	18
grad_hist_projection_part	540
projection_*	562
projection_side	2248
projection_top_bottom	1124
part_*	111

2.3 Semantic Feature Selection

The total number of features obtained in the presented feature extraction procedure is 3472. Since this is a large number, we introduce semantic feature selection that combines semantically similar features into (partially overlapping) feature sets. In addition, the tool shop expert also selected a set of the most relevant features for each operation. However, this was defined only for a limited set of crucial operations. The resulting feature sets and the related numbers of features are shown in Table 3. Specifically, if the name of a set contains "part", the set contains all the features of the specific part. The "valley_hist_" contains the valley features, "valley_h_" valley height, and "grad_hist_" gradient features. Projection sets "projection_" contain all the features from specific projections and are defined as follows:

- projection_100: projection from left to right (x axis)
- projection_200: projection from right to left (x axis)
- projection_010: projection from front to back (y axis)
- projection_020: projection from back to front (y axis)
- projection_001: projection from bottom to top (z axis)
- projection_002: projection from top to bottom (z axis)

In total, 60 sets of features were defined.

3 EXPERIMENTS AND RESULTS

We evaluated the proposed approach on a dataset from the Plamtex tool shop [4, 2]. Due to individualized tool manufacturing, the number of already produced tools was low, namely 30 instances of position 1 and 26 instances of position 30. Besides the actual duration of each operation, each instance also included the duration estimated by the tool shop expert.

The operation durations were predicted with the Random Forest regression model. Its performance was assessed with the leave-one-out test using the default model-building parameters. The selected performance metric was the Root Mean Squared Error (RMSE), which has to be minimized. RMSE was also calculated for durations estimated by the expert. The effectiveness of feature selection was determined by comparing the Random Forest performance when using all the features and when using only a selected set of features.

The initial experiment aimed at finding whether the prediction of operation durations involving the proposed feature selection outperforms the prediction without feature selection considering all the features (i.e., the default feature set). To this end, for each combination of position and operation, all the feature sets were processed and the feature set with the lowest RMSE was selected. The results are shown in Figure 2. These results are normalized with respect to the RMSE of durations estimated by the expert and are therefore expressed as percentages of the RMSE resulting from the expert estimation. They show that for each combination of position and operation, there exists at least one set of features that allows for more accurate prediction than the default feature set (since it reduces the RMSE). In addition, for position 1, operation 32, and position 30, operation 31, the default feature set produces a RMSE equal to the RMSE of the expert estimation, while feature selection improves it. For position 30, operation 32, the default feature set results in a higher RMSE than the RMSE of the expert estimation. Although in this case feature selection improves the result, it still performs worse than the expert estimation.
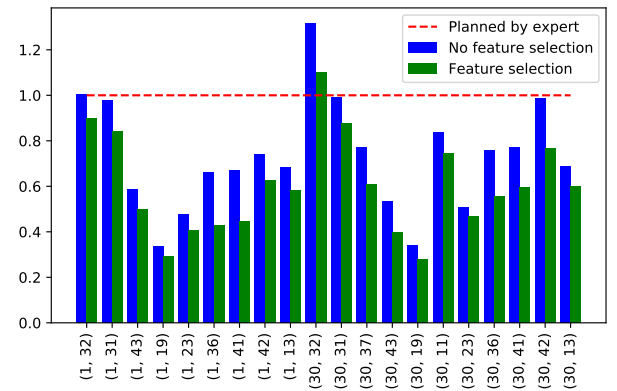
Figure 2: Percentages of RMSE with respect to the RMSE of durations estimated by the tool shop expert. The horizontal axis denotes the combinations of (position, operation).

Subsequently, the most relevant combinations of positions and operations were analyzed in more detail and selected results are presented in Figures 3–5. These results show the RMSE of durations estimated by the expert, the RMSE obtained without feature selection, and the RMSE obtained with various sets of features. To make the figures readable, we only show the best 33% feature sets. Figure 3 shows position 1 and operation 36 (i.e., CNC milling 3 axis, rough). The best features are the gradient features, surface features and features from the bottom-up projection. Note also that the bottom side of this position is the most complex one, thus the bottom-up projection is of high importance. The same projection is also the most relevant for position 1, operation 13 (i.e., submersible erosion) (see Figure 4), since

the erosion is applied only to the bottom side of this position. Part 9 (i.e., released surfaces) and faces count are also among the most important features, where faces count can be used to estimate the complexity of the surface that has to be eroded. Finally, position 30, operation 13 (i.e., submersible erosion) is shown in Figure 5. For this combination, the top-down projection is the most relevant, since the erosion is applied only to the top side of this position. Part 1 (i.e., free holes) and faces count are also very important. The importance of the appropriate projection and the faces count is consistent with the results for position 1 and the same operation (see Figure 4).
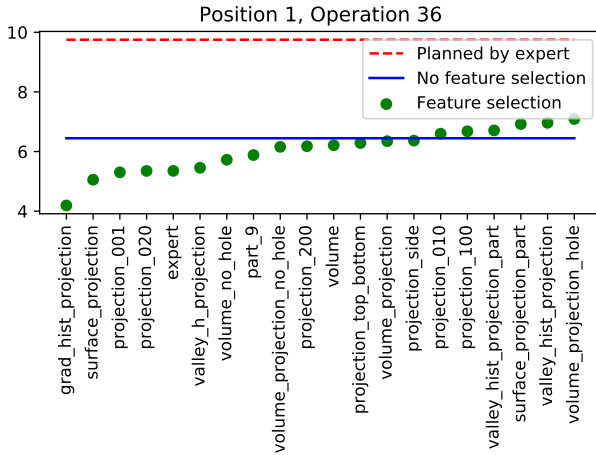
Figure 3: RMSE obtained when predicting the duration of operation 36 (CNC milling 3 axis, rough) at position 1.

Figure 4: RMSE obtained when predicting the duration of operation 13 (submersible erosion) at position 1.

4 CONCLUSION

We presented an AI-based approach to predicting the operation durations in individualized tool manufacturing, which is, in a long run, aimed at replacing the existing human-based estimation process. The proposed approach extracts a set of features from 3D computer models of tools and applies Random Forest regression to predict the operation durations. To further improve
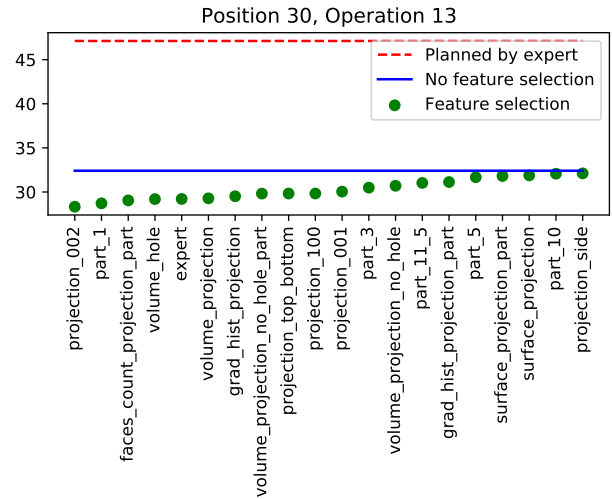
Figure 5: RMSE obtained when predicting the duration of operation 13 (submersible erosion) at position 30.

the prediction accuracy, it includes semantic feature selection by combining features into semantically meaningful feature sets. The experimental results showed that this approach in most cases outperforms the expert predictions. In addition, semantic feature selection outperforms the approach with no feature selection. A detailed analysis of the proposed feature selection approach showed that there exist meaningful relations between the tool manufacturing operations and the best performing feature sets for predicting the durations of these operations.

In future work we will evaluate additional regression algorithms to assess the quality of Random Forest predictions. It would be also relevant to analyze the samples for which the prediction error is the highest. Special attention should be given to the operation for which the presented approach did not outperform the expert prediction.

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Generating Alternatives for DEX Models using Bayesian Optimization

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ABSTRACT

Multi-attribute decision analysis is an approach to decision support in which decision alternatives are assessed by multi-criteria models. In this paper, we address the problem of generating alternatives: given a multi-attribute model and an alternative, the goal is to generate alternatives that require the smallest change to the current alternative to obtain a desirable outcome. We present a novel method for alternative generation based on Bayesian optimization and adapted to qualitative DEX models. The method was extensively evaluated on 42 different DEX decision models with a variable complexity (e.g., variable depth and variable attribute's weight distribution). The method's behavior was analyzed with respect to computing time, time to obtaining the first appropriate alternative, number of generated alternatives, and number of attribute changes required to reach the generated alternatives. The experimental results confirmed the method's suitability for the task, generating at least one appropriate alternative within one minute. The relation between the decision-model's depth and the computing time was linear and not exponential, which implies that the method is scalable.

KEYWORDS

multi-attribute models, method DEX, alternatives, decision support, Bayesian optimization

1 INTRODUCTION

Hierarchical multi-attribute models are a type of decision models [1],[2],[3], which decompose the problem into smaller and less complex subproblems and represent it by a hierarchy of attributes and utility functions. Such decision models are especially useful in complex decision problems [4],[5].

DEX is a hierarchical qualitative multi-attribute method whose models are characterized by using qualitative (symbolic) attributes and decision rules. The method is supported by DEXi [6],[6],[7],[8], an interactive computer program for the

development of qualitative multi-attribute decision models and the evaluation of alternatives (options). DEXi has been used to analyze decision problems in different domains in healthcare [9], agriculture [10], [11], [12], economy [13], etc.

A useful extension of DEX would be the possibility to search for new alternatives that require the smallest change to the existing alternative to obtain a desirable outcome. This task is important for practical decision support [14], however the related work on generating alternatives for qualitative multi-attribute decision models is quite scarce. The only related study was presented by Bergez [15], in which the focus is on attribute scoring (and not on the alternatives), and the starting (current) alternative was not taken into a consideration. More specifically, Bergez developed a genetic algorithm for searching a set of the ''worst-best'' i.e., lowest scores for the input attributes that lead to the highest score for the root attribute (the decision model's output), and ''best-worst'' i.e., highest scores for the input attributes that lead to the lowest score for the root attribute.

In this study, we developed a stochastic method for generating alternatives that require the smallest change to the current alternative to obtain a desirable outcome. To avoid combinatorial explosion, the method uses guided search based on Bayesian optimization. The method is evaluated on 42 different qualitative multi-attribute models with a varying complexity. The method's behavior was analyzed with respect to several characteristics including: computing time, time to first appropriate alternative, number of generated (appropriate) alternatives, and number of attribute changes required to reach the generated alternatives.

2 DOMAIN DESCRIPTION

In this study, a set of 42 DEX multi-attribute decision models were used. The models are benchmark mock models, designed by Kuzmanovski et al. [16]. The decision models are designed by taking into account properties such as model depth, distribution of attributes' aggregation weights (weights' distribution), and inter-dependency of attributes (input links). Table 1 presents a summary of the decision models. The weights' distribution is given with descriptive names: skewed, normal, and uniform. All the attributes in the models are defined with same value scale (low, medium, high), including the input and the output attributes. Additional assumption is that all attribute combinations are possible.

Table 1: Properties of the mock DEX decision models.

Leaves	Depth	Weights' distribution			Links	Versions
8	3	skewed,	normal,	uniform	yes	3, 3, 1
9	3	skewed,	normal,	uniform	no	3, 3, 1
19	4	skewed,	normal,	uniform	yes	3, 3, 1
20	4	skewed,	normal,	uniform	no	3, 3, 1
38	5	skewed,	normal,	uniform	yes	3, 3, 1
39	5	skewed,	normal,	uniform	no	3, 3, 1

3 METHOD FOR GENERATING ALTERNATIVES

An efficient search strategy is required to generate alternatives that require the smallest change to the current alternative to obtain a desirable outcome. A naïve approach would be to generate all possible alternatives, or to iteratively generate random alternatives, and to evaluate the outcome for each alternative. However, for reasonably complex decision models, the search space can be enormous, rendering the naïve approaches unsuitable.

A more appropriate approach would be to use informed search based on the history of previously generated and evaluated alternatives. The history can be used to estimate the search space and the behavior of the decision model. Based on that estimation, more promising alternatives can be generated. By focusing on the more promising alternatives the search space is reduced, and consequently, the time needed to find the appropriate alternatives is also reduced. The next subsections describe a stochastic method that uses Bayesian optimization to efficiently generate such alternatives. The method assumes that we do not know the internal rules by which the decision models operate, thus it falls into the category of ''black-box'' optimization techniques. Knowing and utilizing the decision rules might help the search algorithm, but this option was not addressed in this study.

3.1 Implementation

The problem of generating alternatives that require the smallest change to the current alternative to obtain a desirable outcome can be defined as an optimization problem with two objectives: (1) improved outcome (desired output) of the decision model, and (2) maximum similarity between the current alternative $\overline{c}$, and the new proposed alternative $\overline{a}$. For each decision model DM, one alternative can be defined as a tuple of attributes $\overline{a} = (a_1, a_2, \ldots, a_n)$, where each attribute can take any value of a limited set of values. Usually, that set includes ordinal values (e.g., low, medium and high) and those values can be encoded with integers (e.g., 0, 1 and 2). Consequently, a distance d between alternatives can be defined over Euclidean space. The specific distance function used by the method is a modified element-wise difference between the candidate alternative $\overline{a}$ and the current alternative $\overline{c}$. This distance considers only the attributes for which the candidate alternative has higher values compared to the current alternative $\overline{c}$.

$$d(\overline{c}, \overline{a}) = \sum \begin{cases} a_j - c_j, & if \ a_j > c_j \\ 0, & if \ a_j \leq c_j \end{cases}$$

From the distance function, a similarity function s can be also defined as one minus the normalized distance. The distance is normalized using the maximum plausible distance for the specific problem. For example, if $\overline{a}$ has 20 attributes with possible values between 0 and 2 and each attribute has the highest possible value, and if $\overline{c}$ has only attributes with the lowest possible value (0), then the maximum distance is 20 * 2.

$$s(\overline{c}, \overline{a},) = 1 - \frac{d(\overline{c}, \overline{a})}{\max\_distance}$$

Finally, the optimization function can be defined as:

$$f(\overline{c}, \overline{a}, DM(\overline{c},), DM(\overline{a}))$$
$$= \begin{cases} s(\overline{c}, \overline{a},), & if \ DM(\overline{a}) > DM(\overline{c}) \\ 0, & if \ DM(\overline{a}) \leq DM(\overline{c}) \end{cases}$$

where $DM(*)$ is the output of the decision model for the specific alternative. By optimizing f, the method searches for alternatives that are as similar as possible to $\overline{c}$ and improve the output of the decision model $(DM(\overline{a}) > DM(\overline{c}))$.

In order to apply the Bayesian optimization approach, a surrogate function (a model), an acquisition function, and a generator of alternatives, need to be defined. The surrogate model SM is a model that estimates the objective function for a given alternative as input. Typically, models based on Gaussian Process (GP) [17] are used because by exploiting the mean and the standard deviation of the output distribution, we can balance the trade-off of exploiting (higher mean) and exploring (higher standard deviation). Since GP models are computationally expensive with the complexity of $O(n^3)$, ensemble models such as Random Forest (RF) can be also used [18]. In that case, the mean and the variance are calculated based on the predictions of all base models available in the ensemble. Our method uses RF with 1000 decision trees as base models.

The acquisition function operates on top of the mean and standard deviation of the SM's output. The final version of the method uses the expected improvement (EI) as an acquisition function [19]. This acquisition function checks the improvement that each candidate alternative brings with respect to the maximum known value ($\mu(SM(\overline{a})) - a_b$), and scales those improvements with respect to the uncertainty. If two alternatives have a similar mean value, the one with higher uncertainty ($\sigma(SM(\overline{a}))$) will be preferred by the acquisition function.

Finally, we need to define the generator of alternatives. Our method uses two generators of alternatives: a neighborhood generator and a random generator. Based on the distance function d, neighborhood relation can be defined. Two alternatives $\overline{a_1}$ and $\overline{a_2}$ are considered as neighbors with a degree k, if $d(\overline{a_1}, \overline{a_2})$ = k. . The random generator is a generator of alternatives which: (1) avoids generating known alternatives; and (2) is conditioned by the best-known (with respect to the optimization function) alternative discovered in the previous iterations.

Algorithm 1 presents the implementation of the proposed method. The function *check_promising_values* runs the SM on a set of promising alternatives. This set contains all alternatives that have been previously generated as neighbors to a specific best alternative, but have not been evaluated with the DM because the acquisition function has selected other alternatives. This enables one final check of the most promising solutions which may have been missed because of an earlier bad prediction of the SM.

Algorithm 1:

```
Input: Decision model DM, current alternative CA,
Output: best_alternatives
# parameters and initialization
max_e = 150 # maximum number of epochs
n_candidates = 10 # candidates per iteration
objective_jitter = 0.8 # if an alternative is close to the current
    best  (e.g, 75% as good as the current best , the
    alternative's neighbors should be checked)
random_sample_size = 10000
best_alternatives = []
surrogate_model = new Random_Forest()
promising_alternatives_pool = []
#initial values
candidate_alternatives = generate_random_alternatives(10)
real_objective_values = objective_func(DM, CA, alternatives)
surrogate_model.fit(candidate_alternatives, real_objective_values)
known_alternatives.add(candidate_alternatives,
    real_objective_values)
best_alternative,best_score = max(candidate_alternatives
    ,real_objective_values)
neighboring_alternatives= gen_neighborhood(best_alternative)
while counter < max_e do:
    if size(neighboring_alternatives)>0:
    alternatives_pool = neighboring_alternatives
    else:
    alternatives_pool = gen_rand_alternatives(best_alternative,
        random_sample_size)
    # get top ranked (e.g., 10) candidates using the acquisition
        function
    candidate_alternatives, candidate_scores =
        perform_acquisition(alternatives_pool,          n_candidates)
    #evaluation of candidate alternatives
    real_objective_values = objective_func(DM, CA, alternatives)
    known_alternatives.add(candidate_alternatives,
        real_objective_values)
    #update current best and promising alternatives
    i=0
    while i < size(candidate_scores) do:
    if best_score*objective_jitter <= candidate_scores[i] do:
    neighboring_alternatives = gen_
        neighbourhood(candidate_alternatives[i])
    promising_alternatives_pool.add(neighboring_alternatives)
    if  best_score< candidate_scores[i] do:
    best_alternatives = []
    best_alternatives.add(candidate_alternatives[i])
    if  best_score==candidate_scores[i] do:
    best_alternatives.add(candidate_alternatives[i])
    i++
    #update the surrogate model
    surrogate_model.fit(candidate_alternatives, real_objective_values)
    counter++
end
#peform final check of the promising alternatives
best_alternatives =
    check_promising_values(promising_alternatives_pool,best_alt
    ernatives)
return best_alternatives
```

4 EXPERIMENTS

4.1 Experimental Setup

The method was evaluated with the 42 decision models described in Section 2. For each decision model, nine different randomly sampled starting alternatives (current alternatives $\overline{c}$) were sampled. Three of those alternatives were with a final attribute value low, three with a final attribute value medium, and three with a final attribute value high. The desirable outcome was also

varied, i.e., from low to medium, from low to high, from high to medium, and from high to low. This experimental setup resulted in 756 different experimental runs. Each experiment was running for a minimum of 100 epochs, a maximum of 150 epochs, and 50 epochs without improvement. The method and the experiments were implemented in Python, and are available online[1].

4.2 Experimental Results

The average experiment duration for the models with depth 3 was less than 5 min. For the models with depth 4, the duration increased for 3 min and for the models with depth 5 the duration increased for additional 3 min. This indicates that the relation between the computational time and the model depth is linear.

The final output of the algorithm is a set of thousands of different alternatives. However, from a user perspective, only one or just a few alternatives should be enough. Figure 1 presents the number of epochs required to generate the first alternative for the most complex models (depth 5). From the figure it can be seen that on average, the first alternatives are generated in the first 10 epochs. For the less complex models, the number of required epochs was less than 5.
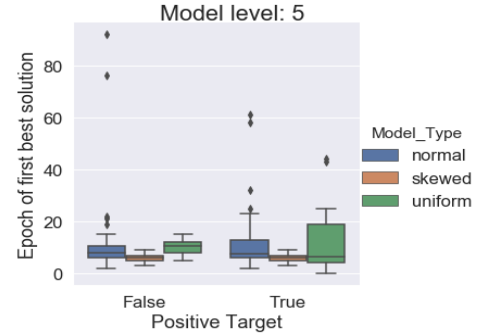
Figure 1: Number of epochs required to generate the first alternative in the final set of alternatives.

In each epoch, the algorithm selects the top 10 alternatives with respect to the optimization score. The higher the score, the better the alternatives are. The selected alternatives depend on the acquisition function, which in turn depends the predictions of the surrogate model. Figure 2 present the average optimization score in each epoch for the most complex models (depth 5). For a comparison, the average optimization score of 10 randomly sampled alternatives at each epoch is also presented (dashed line). From the figure it can be seen that the optimization score of the random samples is significantly lower than the optimization score of the samples selected using the proposed algorithm.

Finally, the presented algorithm is stochastic and the optimality of the solution cannot be guaranteed. One metric that presents the quality of the solutions is the number of attribute changes required to achieve the final solution starting from the current state of the current alternative. Figure 3 presents that metric, which is the same as the distance defined in Section 3.1. From the figure it can be seen that in the majority of the cases, the final solution can be reached with less than 5 attribute changes. Exception of this are the decision models that have a depth 5 and uniform weights' distribution.
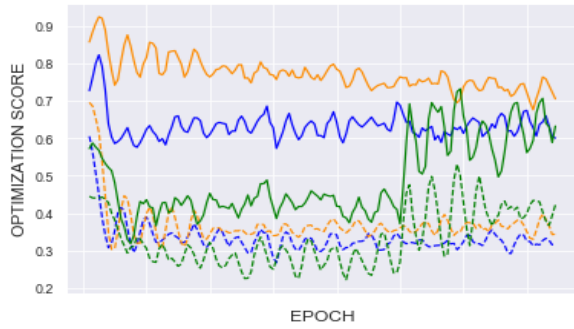
Figure 2: Average optimization score for the decision models with depth 5. Full line - alternatives generated by the surrogate model. Dashed line - random alternatives. The type of attribute weights is color-coded (blue-normal, orange-skewed, green-uniform).

This is because these models have a larger number of input attributes and the uniform distribution requires many attributes to be changed in order for that change to be prolonged to the aggregate attribute. On the other hand, the models with normal and skewed weights' distribution require smaller number of attribute changes for that change to be propagated to the aggregate attributes.

5 DISCUSSION AND CONCLUSION

We presented a novel method for generating alternatives for multi-attribute DEX decision models based on Bayesian optimization. The main goal of the method was to generate alternatives that require the smallest change to the current alternative to obtain a desirable outcome. The method was extensively evaluated on 42 different DEX decision models. The models were with a variable complexity (e.g., variable depth and variable attribute's weight distribution). The method's behavior was analyzed with respect to several characteristics: computing time, time to first appropriate alternative, number of generated (appropriate) alternatives, and number of attribute changes required to reach the generated alternatives.

The experimental results confirmed that the method is suitable for the task i.e., it generates at least one appropriate alternative in less than a minute, even for the most complex decision models. In the majority of the cases, the computing time was lower than that. The discovery of the alternatives was equally distributed throughout the overall runtime. Exception of this is the final check performed by the algorithm (see *check_promising_values* in Algorithm 1), which generates the majority of the alternatives for the more complex models (depth 4 and depth 5). The quality of the alternatives was also appropriate as in the majority of the cases, the generated alternatives could be reached by less than 5 attribute changes. Finally, the relation between the decision-model's depth and the computing time was linear and not exponential, which implies that the method is scalable.

The method implementation considers ordinal attribute values. However, there is possibility for considering other types of distance measures that would work in nominal settings (e.g., Levenshtein distance).
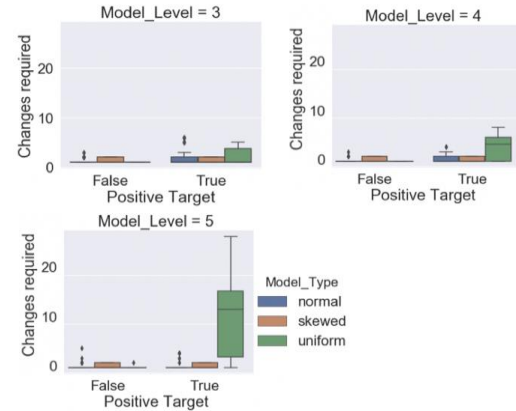
Figure 3: Boxplots for the number of changes required to switch from the starting alternative to the best alternative.

Regarding the future work, the proposed method is stochastic and the optimality of the final solution cannot be guaranteed. In order to do that, the method needs to be validated additionally. Promising options include comparison of the proposed method with deterministic methods and methods that utilize internal rules by which the decision models operate.

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Detekcija napak na industrijskih izdelkih

Defect Detection on Industrial Products

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POVZETEK

V članku predstavimo različne metode za detekcijo napak na industrijskih odkovkih. Raziskava je bila narejena v okviru projekta ROBKONCEL. Napake, ki jih želimo zaznati, so manjši udarci ter poškodbe na struženi površini. V začetnih poskusih smo uporabili metode računalniškega vida ter metode zaznavanja napak s tresljaji. Začetni rezultati niso zadovoljivi, vendar nekatere metode kažejo vzpodbudne rezultate, ki bi se jih dalo izboljšati z večjim naborom podatkov.

KLJUČNE BESEDE

Detekcija napak, računalniški vid, tresljaji, industrijski izdelki

ABSTRACT

In this paper different methods for error detection on industrial forks are presented. Part of the research was done for project ROBKONCEL. The types of errors that are detected are mostly scratches and dents on smooth metal surfaces. First a computer vision approach is used and then method for detecting errors from vibrations is discussed. Initial results are not encouraging, but could possibly be improved with larger dataset for training.

KEYWORDS

Error detection, computer vision, vibrations, industrial products

1 UVOD

V zadnjem času so z napredkom strojnega učenja ter umetne inteligence napredovali tudi procesi kontrole kakovosti v industriji. Namen naše raziskave je razviti algoritem za zaznavanje napak na industrijskih izdelkih/odkovkih za podjetje Unior d.d. Raziskave so bile narejene v okviru projekta ROBKONCEL ([1]), ki ga sofinancira Republika Slovenija iz Evropskega sklada za regionalni razvoj. Klasični pristopi, ki so uporabljeni za detekcijo napak na industrijskih objektih, temeljijo na računalniškem vidu ([2], [3], [4], [5]). V naši raziskavi uporabimo dva pristopa računalniškega vida, in sicer, detekcijo objektov (angl. »object detection«) ter segmentacijo slike (angl. »image segmentation«). Prav tako smo poskusili zaznati napake s tresljaji izdelkov. Glede na inicialne eksperimente, ki niso dali optimalnih rezultatov, se v prihodnje usmerjamo na poskuse strojnega učenja z večjim naborom podatkov ter drugimi, konkretno laserskim čitalnikom, ki se trenutno kaže kot najbolj perspektivna možnost. Raziskave so zanimive predvsem zato, ker so pokazale določene težave v uporabi metod strojne inteligence pri delu z industrijskimi produkti.

2 PRISTOP RAČUNALNIŠKEGA VIDA

V tem pristopu se napake na izdelkih zaznavajo iz navadnih slik. Podani so primeri brezhibnih izdelkov in primeri z napakami, tipično poškodbami na struženi površini. Algoritmi, ki zaznavajo napake, temeljijo na pod-področju strojnega učenja, to je globokega učenja. V zadnjih nekaj letih je področje globokega učenja doseglo izjemne rezultate na področju računalniškega vida, kot npr. detekcija objektov, segmentacija slik ter klasifikacija slik. Pomanjkljivost globokega učenja je, da zahteva velik nabor učnih podatkov. V naših poskusih smo, kot rečeno, uporabili dva (pod) pristopa, to sta, detekcija objektov (angl. »object detection«) ter segmentacija slike (angl. »image segmentation«). Nekaj primerov detekcije napak iz industrijskih

izdelkih z uporabo računalniškega vida je opisanih v [2], [3], [4] ter [5].

2.1 Detekcija objektov

V pristopu detekcije objektov tipično skušamo poiskati izbrani objekt (to je lahko npr. avto, pešec, kolo, prometni znak itd.). V našem problemu je izbrani objekt napaka na industrijskem odkovku. Za ta pristop smo imeli na razpolago 9 izdelkov, iz katerih smo naredili nabor 46 slik.

Nabor slik smo nato ločili na učno in testno množico. Delitev je narejena tako, da se isti izdelek ne pojavi v različnih množicah. Na vsaki sliki v učni množici je bilo potrebno ročno označiti napako/napake s pravokotniki. Ko imamo označene slike, jih lahko uporabimo za učenje globoke nevronske mreže, ki je sposobna prepoznavanja objektov (napak) v slikah.

Nevronska mreža je na začetku sestavljena iz več t.i. konvolucijskih slojev (angl. »convolution layers«), na koncu pa imamo par polno povezanih slojev (angl. »fully connected layers«). Konvolucijski sloji so sposobni kreiranja uporabnih značilk (kot npr. razni robovi in oblike na sliki), ki so nato uporabljene v polno povezanih slojih (glej sliko 1 za primer). V primeru detekcije objektov nevronska mreža v prvem delu odkrije t.i. regije zanimanja (angl. »regions of interest«) na sliki, le te regije so v obliki pravokotnikov. Vsaka regija zanimanja je nato vhodni podatek v drugi del nevronske mreže, katere naloga je klasifikacija dane regije (glej sliko 2). V našem primeru smo uporabili že v naprej zgrajeno in naučeno nevronsko mrežo, ki smo jo nato »naučili« prepoznavati naše objekte (napake). Nevronsko mrežo, ki smo jo uporabili, se imenuje »Faster RCNN inception« in je bila naučena na podatkovni množici imenovani »COCO« [6]. Ta nevronska mreža je prosto dostopna ter podprta s strani Python knjižnice *Tensorflow* [7].

Ko imamo naučeno nevronsko mrežo, klasificiramo določeno sliko kot »napako«, v primeru da mreža zazna napako z več kot 40% verjetnostjo (glej sliko 3 za primer). V tabeli 1 in tabeli 2 lahko vidimo rezultate mreže na učni množici oziroma na testni množici.

Tabela 1: Učna množica: 27 slik, 26 z napako, 1 brez. Točnost: 81%, priklic: 81%, natančnost: 100%.

TP	FP	TN	FN
21	0	1	5

Tabela 2: Testna množica: 19 slik, 18 z napako, 1 brez. Točnost: 10%, priklic: 5%, natančnost: 100%

TP	FP	TN	FN
1	0	1	17

Opazimo, da na učni množici dobimo zadovoljivo natančnost, vendar model ni sposoben generalizacije, kar se vidi v slabih
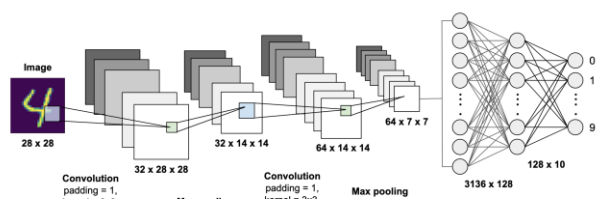
Slika 1: Globoka nevronska mreža s konvolucijami, vir: [8]
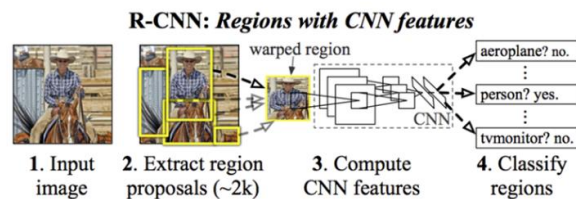
Slika 2: Nevronska mreža za prepoznavanje objektov, vir: [9]

rezultatih na testni množici. Za boljše rezultate bi očitno potrebovali več slik in več različnih napak.
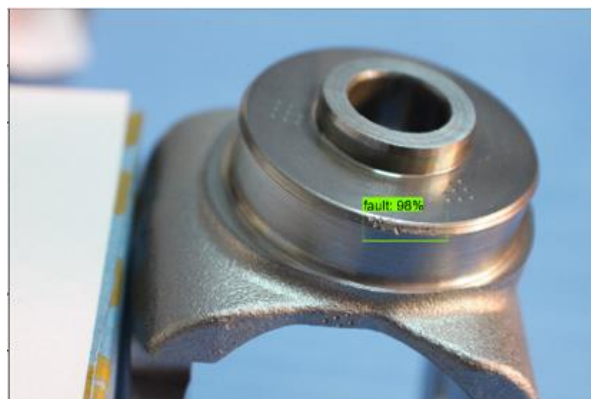
Slika 3: Detekcija napak s prepoznavanjem objektov

2.2 Segmentacija slike

V segmentaciji slike klasificiramo vsako slikovno točko v določen razred (glej sliko 4 za primer). V našem primeru imamo samo dva razreda, to sta, »napaka« in »ni-napake«. Tudi v tem pristopu uporabimo (globoke) nevronske mreže za segmentacijo in klasifikacijo.

Za arhitekturo nevronske mreže smo uporabili arhitekturo, ki je bila uporabljena za podoben problem (glej [5] za podrobnosti). Arhitektura je vidna sliki 5. Nevronska mreža je sestavljena iz dveh delov, in sicer, segmentacijskega dela ter klasifikacijskega dela. Vhodni podatek v segmentacijski del je črno-bela slika objekta, klasifikacijski del pa ima dva vhodna podatka (tenzorja) in sicer gre za dva tenzorja iz segmentacijske mreže. Prvi tenzor je segmentacija (pomanjšane) slike objekta, (na sliki 5 je označen kot »segmentation ouput«) to je tenzor debeline 1, kjer vsak element (ki se ga lahko predstavlja kot slikovno točko) predstavlja verjetnost napake. Drugi tenzor pa je predzadnji tenzor v segmentacijski mreži.

Izhodni tenzor za klasifikacijsko nevronsko mrežo je verjetnost, ali slika vsebuje izdelek z napako, za segmentacijsko nevronsko mrežo pa je segmentacija pomanjšane slike objekta.

Segmentacijski del se uči ločeno od klasifikacijskega. In sicer, se uči iz ročno označenih slik segmentacije. Klasifikacijski del pa se uči iz binarnih oznak (1 pomeni, da ima objekt napako in 0 pomeni, da slika nima napake).

V tem pristopu razdelimo podatke na učno, validacijsko ter testno množico (kjer noben izdelek ne more biti v dveh množicah). Nato vsako slikovno točko v sliki označimo, kot napako ali ni-napake. To naredimo za vsako sliko v učni in validacijski množici.

Nevronska mreža nam poda segmentacijo slike ter klasifikacijo slike. Primer izhoda nevronske mreže za segmentacijo je prikazan na sliki 6.

Na validacijski množici smo določili število epoh za učenje mreže in sicer smo za segmentacijsko mrežo uporabili 2900 epoh in za klasifikacijsko nevronsko mrežo 200 epoh. Za treniranje mreže je bil uporabljen gradientni spust (angl. Gradient Descent) algoritem s parametrom hitrost učenja (angl. »learning rate«) 10^{-3}. Posamezni rezultati so zbrani v tabelah 3,4 in 5.

Tabela 3: Učna množica: 43 slik, 29 z napako, 14 brez napake. Točnost:100%, priklic: 100%, natančnost: 100%

TP	FP	TN	FN
29	0	14	0

Tabela 4: Validacijska množica: 25 slik, 21 z napako, 4 brez napake. Točnost: 64%, priklic: 66,7%, natančnost: 87,5%.

TP	FP	TN	FN
14	2	2	7

Tabela 5: Testna množica: 28 slik, 21 slik z napako, 7 brez napake. Točnost: 71,4%, priklic: 81%, natančnost: 81%

TP	FP	TN	FN
17	4	3	4

Vidimo, da se je nevronska mreža sposobna naučiti s 100% točnostjo, vendar ima, podobno kot prejšnji pristop, problem z generalizacijo.

Slika 4: Primer segmentacije slike, vir: [10]
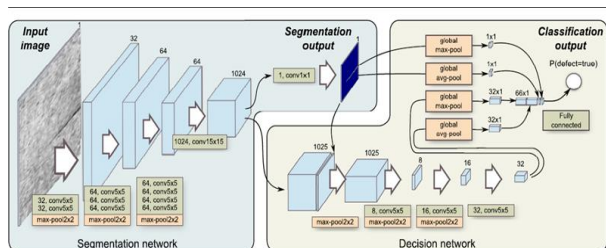
Slika 5: Arhitektura
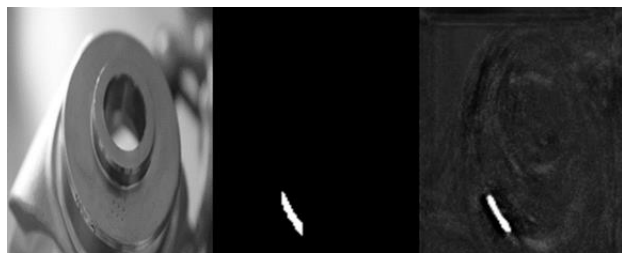
Slika 6: Primer segmentacije slike. Levo: original, sredina: ročna segmentacija, desno: modelska segmentacija.

3 PRISTOP S TRESLJAJI

Eden izmed "alternativnih", vendar potencialno obetavnih pristopov je analiza na osnovi oscilatornega vzbujanja pomika. Eksperiment je potekal v laboratoriju odseka E2 na IJS. Pozitiv izdelka (dejanski odkovek) smo postavili v negativ (stojalo za odkovke – glej sliko 7) ter generirali oscilatorni pomik negativa (stojala) s pomočjo generatorja vibracij. Zanimalo nas je, ali bi utegnile poškodbe izdelka na naležni površini s stojalom (negativom) kakorkoli vplivati na sklopitev med izdelkom in stojalom. V ta namen smo opazovali dva signala: vzbujevalni signal pomika stojala in izmerjeni signal pomika izdelka ter opazovali odnos med obema. Za vzbujanje pomika negativa (stojala) smo uporabili sinusni vzbujevalni signal. Meritve pomika izdelka smo opravili z laserskim merilnikom razdalje z visoko natančnostjo. Merilnik kontinuirano meri razdaljo do izdelka, ter nato z numeričnim odvajanjem izračuna hitrost, ki je izhodni signal. Za osnovni preizkus smiselnosti metode smo na enem od izdelkov simulirali napako tako, da smo na naležno površino prilepili droben kos izolacijskega traku. Izkazalo se je, da le-ta bistveno vpliva na sklop izdelek-negativ in to nam je dalo upanje, da bi utegnile tudi poškodbe naležne površine izdelka vplivati na sklopitev in s tem na relacijo med pomikom negativa in izdelka.

Posnetki meritve izhodnega signala so dolgi 10s. Meritve smo opravili pod 4 različnimi nastavitvami vhodnega signala, in sicer:

- Nastavitev 1: Amplituda: 0,389 Vpp frekvenca: 50Hz

- Nastavitev 2: Amplituda: 0,389 Vpp; frekvenca: 60Hz

- Nastavitev 3: Amplituda: 0,2026 Vpp; frekvenca: 60Hz

- Nastavitev 4: Amplituda: 0,2026 Vpp; frekvenca: 50Hz

Nastavitve so bile izbrane na podlagi izhodnega signala, izkaže se, da za višje amplitude izhodni signal postane šumen.

Za ta pristop imeli na voljo 24 izdelkov.

Preizkusili smo sledeče možne pristope detekcije napak iz signalov:

- Ekspertno izbrane značilke ter uporaba klasičnih metod strojnega učenja.

- Računalniško generirane značilke ter uporaba 2-slojne nevronske mreže
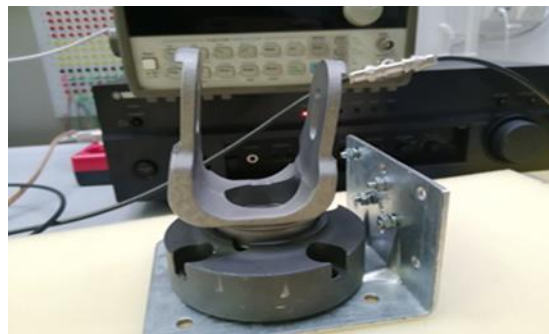
Slika 7: Meritev vibracij

3.1 Ekspertno izbrane značilke ter uporaba klasičnih metod strojnega učenja

V tem pristopu so značilke, uporabljane v algoritmih strojnega učenja, izbrane na podlagi dobrih izkušenj. Značilke, ki so bile izbrane, so se namreč izkazale kot dobre v drugi aplikaciji strojnega učenja. Izbranih značilk je 22 in uporabljajo osnovne značilke signala iz časovnega ter frekvenčnega spektra, npr. 3 najvišji vrhovi spektralne gostote ter njihove frekvence, energija spektralne gostote, itd.

Vsak posnetek odkovka je razdeljen na 10 kosov, kjer je vsak kos 1s dolg posnetek. Za vsak kos se nato izračuna ekspertno izbrane značilke. Tako za vsak vzorec dobimo 10 podatkovnih točk z 22 značilkami.

Uporabljen model je sestavljen iz dveh modelov. In sicer iz osnovnega ter končnega modela. Osnovni model za vsako podatkovno točko izračuna verjetnost, da ta točka pripada produktu z napako. Ker imamo za vsak produkt 10 podatkovnih točk, dobimo z osnovnim modelom 10 verjetnosti za vsak produkt. Končni model potem klasificira produkt v »odkovek z napako« ali »odkovek brez napake«. Vhodni podatek v končni model je 10 verjetnosti, dobljenih iz osnovnega modela.

Preizkusili smo več možnih algoritmov, in sicer algoritem podpornih vektorjev (angl. »support vector classifier«), algoritem naključnih gozdov, logistično regresijo, algoritem »AdaBoost« ter algoritem »XGBoost«. Te algoritme smo preizkušali tako za osnovni kot končni model.

V prvem poskusu, so bili podatki razdeljeni na učno ter testno množico. Na učni množici smo z 8 delnim prečnim preverjanjem izbrali optimalne parametre za osnovni ter končni model. Nato smo celoten model testirali na testni množici.
Uporabljena je bila nastavitev 2 vhodnega signala, kjer je bila amplituda 0,389 Vpp s frekvenco 60 Hz. Rezultati so zbrani v tabelah 6 in 7.

Osnovni model: XGBoost
Končni model: Naključni gozdovi

Tabela 6: Učna množica: 19 produktov: 12 z napako, 7 brez napake. Točnost: 100%, priklic: 100%, natančnost: 100%.

TP	FP	TN	FN
7	0	12	0

Tabela 7: Testna množica: 5 produktov: 2 z napako, 3 brez napake. Točnost: 100%, priklic: 100%, natančnost: 100%.

TP	FP	TN	FN
3	0	2	0

Da se izognemo naključnemu dobremu rezultatu na testni množici, uporabimo še drug poskus. In sicer, uporabimo metodo prečnega preverjanja za določanje učne in testne množice. Konkretno uporabimo 5-delno prečno preverjanje, kjer so podatki razdeljeni na 5 delov. Naš postopek ima 5 iteracij, na vsaki iteraciji je en del podatkov izbran kot testna množica, ostali štirje deli pa so izbrani kot učna množica. Na vsaki iteraciji na učni množici z 8 delnim prečnim preverjanjem izberemo optimalne parametre in naučimo model na učni množici, nato pa ocenimo model na testni množici. Ker uporabljamo 5 delov, dobimo 5 ocen točnosti, priklica ter natančnosti, iz katerih nato izračunamo povprečje. (uporabljena je bila nastavitev 2

vhodnega signala, kjer je bila amplituda 0,389 Vpp s frekvenco 60 Hz). Najboljše testne rezultate so v tabeli 8.

Tabela 8: Osnovni model: logistična regresija. Končni model: AdaBoost

Točnost	Priklic	Natančnost	F1
68 %	85 %	76 %	73 %

3.2 Računalniško generirane značilke ter uporaba 2-slojne nevronske mreže

Za avtomatsko generacijo značilk smo uporabili za to namenjeno knjižnico. Pri nastavljenem parametru FDR (False Discovery Rate) na privzeto vrednost, ki je 0,05 po statističnem testu, nismo dobili nobene značilke, ki bi bila relevantna za klasifikacijo. Ker knjižnica uporablja statistično analizo za ocenjevanje relevantnosti značilk, torej ni nujno, da niso pomembne pri strojnem učenju, zato smo dvignili prag FDR na začetku na 0,5 in nato še na 0,99. Pri tem smo pri vrednosti 0,5 FDR dobili le eno značilko. Ta je 50. Fourierev koeficient oziroma pri nastavitvi 2 in 3 smo dobili 60. Fourierev koeficient. Slednja vrednost je seveda osnovni harmonik vzbujalnega signala. Pri nekaterih nastavitvah in pri večji vrednosti FDR smo dobili nekatere Fouriereve koeficiente v okolici 50. in 60. koeficienta, kar je smiselno, ker je odziv odkovka različen glede na poškodbo. Zaradi tega smo sklenili, da izračunamo Fouriereve koeficiente v okolici 50. in 60. in jih uporabimo za klasifikacijo. Hevristično smo določili, da izračunamo prvih 256 koeficientov. S tem smo zajeli vse koeficiente v okolici 50. in 60. Izračun prevelikega števila koeficientov pomeni, da lahko porabimo vse vire, ki so na voljo nevronski mreži, prav tako pa uradni viri [11] v tem primeru navajajo 28 x 28 točk oziroma vhodnih nevronov.

Nevronska mreža je sestavljena iz vhodne plasti, ki ima 256 nevronov, nato sledita dve skriti plasti, prva z 16 nevroni, ter druga z 8. Zadnja izhodna plast je sestavljena iz 2 nevronov, ta predstavljata poškodovan ali nepoškodovan odkovek. Takšne nastavitve smo dobili od večkratnega testiranja modela (optimizacija hiperparametrov). Za razliko od prejšnjega pristopa smo uporabili celoten 10-sekunden posnetek za izračun koeficientov.

Kot v predhodnem primeru smo na začetku uporabili optimizacijo hiperparametrov na učni množici. To pomeni, da smo z izbranimi parametri, ki so dosegli najvišjo točnost pri modelu nevronske mreže uporabili za učenje modela. Vseh 24 učnih primerov smo razdelili na učno (19 primerov) in testno (5 primerov). Uporabili smo 5-delno prečno preverjanje kot v prejšnjem primeru. Ker dobimo 5 vrednosti posameznih metrik, na koncu izračunamo povprečje. Rezultati so zbrani v tabeli 9.

Tabela 9: Točnost priklic in natančnost brez F1 metrike

Točnost	Priklic	Natančnost
48 %	42 %	91 %

4 ZAKLJUČEK

V tem prispevku so opisani pristopi ter modeli za detekcijo napak na industrijskih izdelkih - odkovkih.

Rezultati za detekcijo napak z uporabo računalniškega vida in segmentacije slike so se izkazali kot nezadovoljivi za praktično uporabo, kjer se zahtevata visoka točnost in priklic. Rezultati z uporabo računalniškega vida in detekcije objektov so nezadovoljivi najbrž zato, ker so napake na kovini podobne temnim lisam na kovini, ki jih je polno na odkovkih.

Rezultati za detekcijo napak z uporabo tresljajev so vzpodbudni, ampak nezadovoljivi.

Glavni razlog za slabše rezultate je pomanjkanje podatkov ter zajem podatkov v nekontroliranem okolju. Menimo, da ko bo na voljo več podatkov, se bodo rezultati izboljšali.

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Data Protection Impact Assessment - an Integral Component of a Successful Research Project From the GDPR Point of View

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ABSTRACT

Artificial intelligence and algorithmic decision-making systems help generate new knowledge about diseases which then help better manage it and assist people in clinical treatment needs. The blood of such AI systems is personal data that is both used for training or is already the output of the algorithmic assessments. This work aims guiding the AI researchers to be familiar with the legal rules binding them while processing personal data within their AI-based projects as indicated in the General Data Protection Regulation rules with a specific focus on why and how to conduct a self-Data Protection Impact Assessment. The self-assessment guideline presented throughout the work is an output of the mutual experiences and collaboration between a lawyer and an AI researcher on the topic.

KEYWORDS

data protection, impact assessment, GDPR, artificial intelligence, medical data

1 Introduction

It is possible to look out for artificial intelligence (AI) systems dealing with personal data from two different perspectives. On one hand, it offers great benefits for the users, developers, and researchers, if used correctly. For example, AI-enabled health care technologies could predict the treatment of diseases 75% better, and could reduce the clinical errors 2/3 at the clinics using AI compared to the clinics that do not [1]. On the other hand, the improper handling of personal data can quickly lead to abuse, sharing sensitive information, or other problems (unwanted data disclosure, complex and costly legal procedures, high fines, etc.), therefore it has to be handled with the utmost care. In this paper, we will focus on the legality of medical applications containing personal data that is defined as sensitive data in legal documents, such as the analysis of sensor data to help patients with chronic diseases manage their condition and improve the quality of life, or to help the elderly with independent living by providing safety features and improved communication channels.

Developing an AI-based service for a target population, for example people with diabetes, chronic heart failure, obesity, dementia, skin cancer, etc., typically starts with a research project. One of the key components of such a project is collecting substantial amounts of data in a pilot study, with participants that resemble the target audience for the final service. When planning the pilot study, researchers enter a slippery terrain of dealing with personal data, as the participants are providing their own data for the purpose of the study. For the illustration, we can imagine a project where we collect medical data of three types; general medical data provided by the medical doctor responsible for the participant, lifestyle data collected by either wearable or stationary sensors, and self-reported data that is obtained via questionnaires that the participants fill.

The data provided by the participants fall under the scope of the European Union's General Data Protection Regulation (GDPR) since it refers to identified or identifiable personal issues of them. The GDPR entered into force on the 25th of May 2018 with one of the aims of keeping up with the technological developments challenging efficient protection of personal data [2]. The risk-based approach embedded in the GDPR came along with several safeguards as one of them is the Data Protection Impact Assessment (DPIA). The DPIA can help AI-researchers to comply with the GDPR requirements at an early stage of a new project. It can help reduce the risks arising from the use of AI technologies challenging the efficient protection of fundamental rights and principles [3]. Several policy papers generated by the EU institutions [4] [5] focusing on regulation of AI state that legal compliance is a keyword for gaining user trust and DPIA is one way to reach user trust. However, there is no standard set for conducting a DPIA that could guide the AI-researchers. In this paper, we present some of the key points of conducting the DPIA that could be useful for the AI-researchers.

2 Data Protection Impact Assessment in the GDPR

The term DPIA was not specifically described in the GDPR, however, was referred as it is a process to help managing the risks to the data subjects' (participants of the research project, in this case) rights and freedoms as a result of data processing. In other words, DPIA is a process consisting of several other sub-processes to describe the risks and assess the legality of the system in terms of data protection. These risks could be related to system security, system design, implementation,

administration and development on a further run. The aim of the DPIA is to take appropriate safeguards to minimize the risks, if impossible to eliminate all. DPIA is not a simple one-time reporting activity, it is an ongoing process that should be continuously carried out during the lifetime of a project, therefore DPIA should always be monitored and updated [6].

It is the AI-researcher's responsibility to convey a DPIA when the data processing activity is likely to constitute a "high risk" to the rights and freedoms of natural persons (e.g. users of an AI service who both benefit from the service and contribute to it with their data). How to decide whether a certain data processing activity would be resulting in a high risk is not an easy task, but there are several guidelines and list of processing requiring DPIA published by the National Supervisory Authorities [7]. These lists could be the first sources for the data controllers to decide about the necessity of the DPIA for a certain project [8].

Failure to conduct a right DPIA raises a risk for the AI-researchers; they may face several sanctions, especially financial penalties. Apart from that, conducting a right DPIA would be beneficial for the data controllers not only from the legal and the financial point of view. A DPIA could help data controllers to avoid implementing irrelevant solutions from the beginning of the project which may refer to assessing the technical feasibility of the system in parallel with the legal compliance [8]. Therefore, the DPIA could help data controllers to save time and money. It also prevents the companies from losing their reputation (or from the scandals, as such occurred with the Cambridge Analytica, Equifax, Facebook, etc.). Finally, a DPIA document can prove the trustworthiness of the project team before the public, as well as the related authorities, since it is an evidence of the respect towards the right to data protection.

An AI project aiming to collect personal data and evaluate the data with an automated decision-making system with the help of profiling tools such as surveys and hardware equipment must be assessed from the risk point of view. Below, we present a step-by-step guideline on how to conduct a DPIA on AI-based research.

3 Conducting a Data Protection Impact Assessment

In this section, we assume a project aiming at developing a medical software with the help of an algorithm that is going to enable collecting and processing participants' sensitive data based on profiling. Additionally, a large amount of data will be collected for feeding the algorithm, meaning that the participants may lose a degree of control of their data stored and processed by the AI system. Based on these inputs, the project may reveal risks for rights and freedoms of the data subjects involved, if these are not mitigated. Therefore, we need to conduct a DPIA and identify the risk categories with the planned mitigations.

We identified three steps for conducting a successful DPIA in the project: the Data Specific Assessment, the Data Subject Specific Assessment, and the Project Specific Assessment.

The **Data Specific Assessment** (DSA) is the procedure where the data to be used in the AI project should be introduced very specifically in order to comply with the basic rules of the GDPR, mainly, the purpose limitation, transparency, accuracy, data minimization, and consent. It should be kept in mind that one of the requirements to be ensuring a valid consent is identifying the concrete data list, together with the planned processing activities of that data in the frame of a research project. Information serving to identify the persons involved with data processing are the natural elements of the DSA. For example, AI-researchers in the project should identify the data processing purposes specific to the project aims and present the list of purposes in a written form to the participants. The indicated purposes should follow the related data to be processed listed again in a written form, followed by the clear identification of the AI-researchers and other people involving the processing activity.

Next, the **Data Subject Specific Assessment** should follow the procedure where the focus is on explaining all the details about how the AI-researchers will ensure the rights of the participants by protecting their informational self-determination right. The key point in this assessment is to gain trust of the participants as required by law and ethics. One of the key aspects here is to make sure that the participants are introduced by the project team on the ways their data will be used, as well as the possibility for them to request removal of their data if so desired. The project team shall also ensure that the participants have a certain degree of accession to the decisions made by the algorithm about them. Explaining an algorithmic decision relating the participants' personal assessment should be understandable to them since the classification models based on decision trees are easily comprehensible to humans. On the other hand, models that are based on complex multilayer neural networks are essentially black boxes where it is not possible to determine why a particular decision was reached based on easily interpretable rules. Bearing in mind the black box nature of the algorithmic assessment, choosing a model that is firstly understandable and explainable to the AI-researchers is a suggested action in this sense. The social implications of choosing a black box algorithm is an emerging research field. Finally, the project team should ensure that the system offers tools for the participants to keep their data accurate and to block third party access.

The **Project Specific Assessment** is the last part of the DPIA, presenting and explaining the legal basis for data processing, the external project partners involved with data processing activities, and the security measures that will be implemented to safeguard the data processed during the project. As the project likely deals with sensitive medical data, security protocols have to be elaborated, which include proper hierarchy regarding the data access, encryption algorithms, regular security updates, and physical access to the hardware where the data is located.

The final but an ongoing phase of the DPIA is the monitoring phase. Whenever there is a new element embedded in the project, and this element seems to change the balance of the risks that were assessed earlier, the DPIA should be reviewed. This element could be involving a new data type in the algorithm or planning a commercial use of the algorithm. Bearing in mind the fact that machine learning techniques and algorithms are referred

to as entirely new technologies [3] and the growing amount of data together with a variety of hardware would raise risks to persons' right to data protection [9], we suggest the project team to review the DPIA periodically, for instance, every year at least.

4 Conclusion

Data Protection Impact Assessment is an integral part of any research project focusing on development of an AI algorithm with personal data. Such data might be sensitive in nature, such as medical data, to be used for developing an algorithm to detect diseases. Besides it is a legal requirement as provided for by the GDPR, a DPIA is a tool for the AI-researchers to assess the weaknesses in the system that may then risk the protection of fundamental rights of the persons participating in the research project who contribute to the development of the project with their personal data. Since there are few guidelines on how to conduct a DPIA for a research project specific to the topic, this work initiates a step-by-step guideline for the AI-researchers.

The first step considers a Data Specific Assessment that the data and the purposes of the data processing are clearly identified and listed in a written form to be presented to the participants. It is followed by the Data Subject Specific Assessment which focuses on the ways the AI-researchers ensure the protection of the participants' right to data protection in line with the GDPR requirements. Such requirements include providing explanation on the decisions reached as a result of algorithmic assessments. The third step relates to the Project Specific Assessment and this step focuses mostly on the security measures planned to be taken by the project team to mitigate the risks that appeared during the previous two assessments. We would suggest the AI-researchers review the DPIA at least once a year, otherwise revision is required whenever a new element is added to the system ending with a new data processing.

From the planning stage of the project to the annual revisions, the DPIA could help the project team to identify the potential risks and find mitigation strategies for certain weak points. Last but not least, by conducting the DPIA, the project team fulfills the legal requirements, ensures higher trust of people involved, and avoids unforeseeable problems that might later occur.

ACKNOWLEDGMENTS

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Deep Transfer Learning for the Detection of Imperfections on Metallic Surfaces

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ABSTRACT

In the last decade, consumers' expectations have significantly increased regarding the availability and quality of the products they buy. To this end, manufacturers have focused on streamlining their manufacturing lines by employing intelligent solutions wherever possible. Since the field of quality control remains dependent mainly on specialized workers, interest in incorporating artificial intelligence (AI) advances in this field has dramatically increased. In this paper, we present a short exploration into a computer vision system built to detect imperfections on metallic surfaces. In particular, we leverage deep transfer learning to build a model that can classify small segments of a bigger image while using a tiny dataset for training. In these initial experiments, we show that layers trained on the ImageNet dataset can be used as feature extractors when building a model for a vastly different problem.

KEYWORDS

deep transfer learning, computer vision, quality control

1 INTRODUCTION

Today, products are expected to be available fast, in vast quantities, and with exceptional quality. To this end, manufacturers have started streamlining their manufacturing lines by employing network-connected intelligent machines wherever possible [10]. This has created great interest in incorporating advances in artificial intelligence (AI) in the industry. In recent years industrial adoption of AI is becoming more and more feasible [7], mainly thanks to the significant progress in hardware computational resources.

In spite of this, quality control is one manufacturing process which still remains highly dependent on expert human workers. This dependence, in some instances, makes it slower, more prone to errors, and more expensive. To mitigate this, there has been limited adoption of computer vision systems paired with classical

image processing for detecting imperfections in the manufacturing processes [1]. However, these systems rely heavily on specialized lighting solutions in order to highlight imperfections on the surfaces of objects [6]. The systems are usually expensive and require close proximity to the object which is being investigated in order to provide good detection accuracy. Furthermore, methods which do not use any kind of learning require features which are hand-crafted for each application specifically and require some degree of uniformity in size and shape of the errors which might appear. This problem with hand-crafted features, for us, exists even when using classic machine learning models, as we were not provided with details regarding the size and shape of the errors. To solve this, we opted to use deep learning models, as they automatically extract features based on the training set and have proved to produce state-of-the-art results in many areas [3]. With this in mind, the aim of this paper is to investigate low cost state-of-the-art deep learning methods which work in suboptimal lighting and which automatically extract features which are robust to the shape and size of the errors which appear on metallic surfaces. Finally, since our dataset is extremely small, we leveraged transfer learning in order to use the full potential of deep models.

2 PROBLEM DEFINITION

The ultimate goal of the ROBKONCEL project is to create a quality control process for the detection of several possible manufacturing errors on both the inside and outside of ovens. In this work, we focus on detecting scratches and dents, i.e., imperfections on the oven faceplates' metallic surface. We perform this quality check in the manufacturing process's final phases, as almost fully assembled ovens get transported on a conveyor belt. In order to produce a method that is least costly to implement, we chose a simple RGB camera as the sensor in this application. The camera is positioned such that it can take a picture that contains the whole metallic surface while not interfering with other quality control processes, thus improving efficiency. Finally, our method is supposed to highlight the areas where dents and scratches are found so that an inspection of the algorithm's work can be done at any time. Figure 1 shows an example image used for the purposes of this paper.

Figure 1: An image taken by an RGB camera of the metallic surface of interest.

2.1 Data

Due to the frequency with which these imperfections occur, we did not have a large dataset to include in this study. On the contrary, the number of faceplates we could use to get the necessary number of images was only five. Of those five faceplates, one was without imperfections, and the rest contained a varying number of defects on the metallic surface. Since any deep learning requires a large amount of data and since the number of faceplates is small, using images that portray the whole area of one faceplate as examples to a deep neural network (DNN) would be ineffective. To combat this problem, we took images of the different front panels (five images in total) and segmented them into hundreds of smaller examples, which we use as inputs to fine-tune several models. Additionally, by performing class-invariant transformations on these smaller images, we attempt to diversify the set of examples used to fine-tune the models. The segmentation of images into smaller examples and their augmentation are presented in subsection 3.1 and subsection 3.2, respectively.

3 METHOD

3.1 Segmentation

In order to segment the images, we first created a hand-annotated set of binary images (masks). These masks complement the original set of five images by showing where in them, a scratch or a dent is visible on the metallic surface. In more detail, the masks were produced by having humans mark the exact locations of these imperfections. In the masks, pixels which are part of some imperfection (in the RGB image) are marked with the color white, while all others are represented in black. An image and its corresponding mask are shown on Figure 1 and Figure 2, respectively.

Figure 2: A mask constructed for the image in Figure 1.

The next step in the segmentation process is to divide the image into chunks (windows). We do this by "sliding" a window with a fixed size across the whole image. Each of these windows covers a specific area of the image and will serve as a training or testing instance when fine-tuning the models. Overlap between several windows is allowed in fact, it is encouraged, seeing that some overlap means that we can generate more examples. The size of the window is 200 by 200 pixels and the allowed overlap between windows is 75%.

However, since in this paper's scope, we are only interested in the faceplate's metallic parts, we make sure that none of the windows cover an area that includes the display. In Figure 3 we can see (in green) the windows produced by the segmentation step and how none of them overlap with the area of the display.
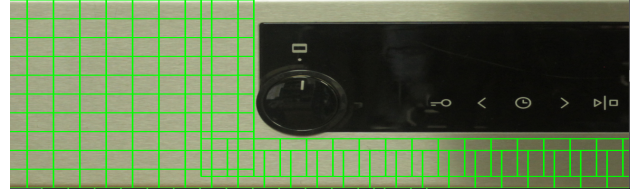
Figure 3: Example of image segmentation.

Finally, since the newly constructed windows will be used to train a deep learning model, we need to assign a label to each one of them. In this application, the labels are "0" and "1". If the label "0" is assigned to a window, it means that the window's area does not include any scratches or dents on the surface. On the other hand, the label "1" means that the area covered by the window includes a scratch or a dent. The labels are assigned to each window by examining the mask. For each window, we take the corresponding area it covers in the mask, and if it includes a certain number of pixels annotated as belonging to an imperfection, then the window is assigned a label "1". Otherwise, it is assigned the label "0". The number of pixels that are used as a threshold for labeling the windows is:

$$threshold = 0.1 \times numPixelsInWindow$$

3.2 Augmentation

Augmentation of images in the data-space has been shown to produce great results when it comes to improving the accuracy of classifiers [5]. Since after segmenting the image, the number of examples (windows) that do not contain an imperfection is largely greater than the number of examples that do, we apply certain transformations to the windows that contain an error, and we save each of those transformed windows as a new example. It is important to emphasize that none of these transformations affect the example's label, meaning that if we apply them to an example containing an error, the transformed example will also contain the same error. The transformations we use are:

- rotation
- change of contrast
- change of brightness
- flipping

After applying these transformations to a single example, 23 new samples are obtained.

3.3 Deep Transfer Learning

For the task of classifying windows based on whether they contain an imperfection or not, we tested four different model architectures. One is a simple Convolutional Neural Network (CNN), and the other three are more complicated architectures that are well established in the world of image recognition.

The simple CNN is used as a baseline for what an end-to-end model can achieve on this dataset. However, since the number of examples is still relatively low, training an end-to-end deep learning model was not expected to yield great results.

On the other hand, the VGG16 [8], InceptionV3 [9] and ResNet101V2 [2] architectures were used to leverage deep transfer learning [4]. To be more specific, all of these networks have been used in the ImageNet competition, and their internal parameters (weights), from that competition, are openly available for use. By using their pretrained convolutional layers as feature extractors and

training our own set of fully connected layers, we can significantly improve our performance and training time. Effectively, we transfer the knowledge stored in their parameters (weights) from the ImageNet dataset to our quality control problem.

To implement this, in every architecture, we disregard the fully connected layers included with these architectures and generate our own (with random weights). We then attach these fully connected layers to the output of the convolutional layers (provided as pretrained on ImageNet) and train only the fully connected layers while freezing the convolutional layers' parameters. The number of fully connected layers we generate is four, and the number of neurons per layer is 512, 256, 128, and 64, respectively.

The implementation and the weights of these models are acquired from the Keras package in TensorFlow.

4 EVALUATION

4.1 Experimental Setup

We evaluated the performance of each model using Leave One Image Out (LOIO) cross-validation. This means that models are trained using examples (windows) from all images but one, and are tested using the instances from the image excluded in the training process. The process is repeated several times, and each time a different image is used to test the models' performance. Since one of the faceplates did not have any errors on its surface, windows from that image were never used to test models, instead they were always used for training. In summary, all the models are evaluated using a 4-fold LOIO cross-validation.

4.2 Evaluation Metric

In this work, we use F1-score with macro averaging as the metric for the evaluation of the models. In particular, we use (macro) F1-score to determine the model's ability to classify segmented windows. The choice to use (macro) F1-score rather than accuracy was made because of the class imbalance in our data. A significant difference between accuracy and (macro) F1-score comes from the fact that accuracy reports a higher value, even in many false positives. For example, a high accuracy score will be reported when a classifier predicts only positive values on a test set containing many positive examples, even though the classifier completely misclassifies the negative instances.

To fully understand the classification results, aside from the F1-score metrics, we also visually represent how the predictions look once all windows have been rearranged in their initial positions. This representation overlays windows in their original places but changes their pixels' value to all white or black based on their predicted values. An example of this representation is shown in the middle image in the triplet on Figure 4. The top image in that same figure changes the pixels' values based on the ground-truth rather than prediction value. Finally, the figure's bottom image represents a color-coded version of the difference between the top two images. Windows in green represent windows which have been predicted as **containing** a fault, when in fact they **do** contain a fault (True Positive - TP). Windows in red represent windows which have been predicted as **not containing** a fault, when in fact they **do** contain a fault (False Negative -FN). And finally, windows in blue, represent windows which have been predicted as **containing** a fault, when in fact they **do not** contain a fault (False Positive - FP).

This view is especially useful for our evaluation since it allows us to filter out wrongly classified windows which surround green

clusters. This dismissal is possible because finding the exact margins of the imperfections is not of great importance in our use case.
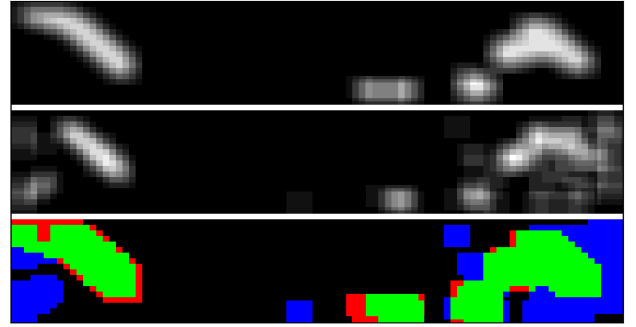
Figure 4: Example of the custom visualisation metric. The top image has the colors of the windows selected based on the groundtruth, while the middle one has them selected based on the predictions of the classifier. The bottom image represents a color-coded version of the difference between the top two images.

5 RESULTS AND DISCUSSION

Table 1 shows the average (macro) F1-scores that each of the models achieved when performing 4-fold LOIO cross-validation.

Architecture	Simple-CNN	VGG16	InceptionV3	ResNet101V2
(Macro) F1-score	~9.8%	~13.0%	58.75%	60.75%

Table 1: Average model F1-score after 4-fold LOIO cross-validation.

In all of our experiments, the Simple-CNN and VGG16 architectures produce very low results. It is our opinion that perhaps, a simple stacking of convolutional layers is not enough for this particular use case, since both networks are unable to learn and instead predict every example as an example with an error. On the other hand, InceptionV3 and ResNet101V2 produce good results in comparison to the other two architectures. A head to head comparison of the per image F1-scores of the two best models can be found in Table 2.

	IMG_8334	IMG_8319	IMG_8327	IMG_8323
InceptionV3	52.48%	64.80%	49.16%	74.04%
ResNet101V2	59.62%	62.02%	51.14%	71.41%

Table 2: Per image F1-scores for the InceptionV3 and ResNet101V2 models.

Although there is only a small difference between the F1-scores of InceptionV3 and ResNet101V2, only 2% as seen on Table 1, there is a large difference in how they predict the same images, as we can see in Figure 5 and Figure 6.

As is clearly visible, ResNet101V2 produces a lot more false positives in comparison to InceptionV3. However, if we consider
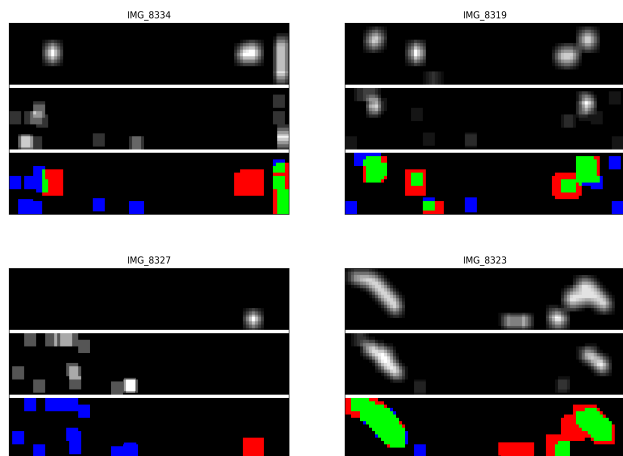
Figure 5: Visual representation of the predictions produced by the InceptionV3 model.
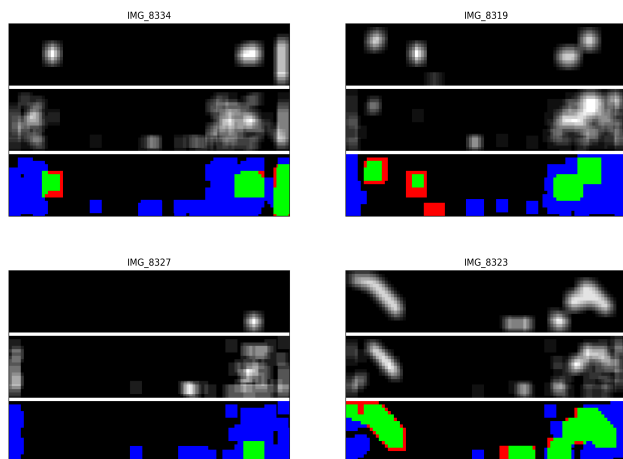
Figure 6: Visual representation of the predictions produced by the ResNet101V2 model.

each cluster of same colored pixels as an error, we can see that ResNet101V2 produces far better results when it comes to the number of true positives and false negatives. So, even though ResNet101V2 produces a lot of false positives, it only manages to miss one error from all four images, whereas InceptionV3 manages to miss four errors. These results can be seen on Table 3. When counting the clusters, we do not consider red clusters surrounding green clusters as a false negative.

	TP	FN
ResNet101V2	11	1
InceptionV3	8	4

Table 3: A sum of the number of true positives and false negative clusters for each of the models across the four test images.

6 CONCLUSION AND FUTURE WORK

In this paper we presented a deep transfer learning approach to quality control in the case where imperfections on metallic surfaces should be detected. Based on the results it seems that transfer learning is a suitable tool for use when the target dataset is really small, even in the case when the source and target problems are vastly different. Furthermore, it seems like more complex architectures produce better results compared to more traditional ones. When more examples of faceplates with imperfections become available, we plan on exploring the effects of fine tuning some of the convolutional layers in these models rather than freezing all of them during training. Another possible path to take in the future includes using GANs in order to generate realistic looking samples of windows with imperfections and further augmenting our training set. Finally, it is important to note that exploring more appropriate lighting solutions might produce better results.

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Fall Detection and Remote Monitoring of Elderly People Using a Safety Watch

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ABSTRACT

As seniors age, the risk of unforeseen accidents that affect their well-being increases. Therefore, monitoring the day-to-day routine of elderly people is an important precaution to undertake, especially when they are living alone. Due to the rapid demographic change and aging of the population, the development of remote monitoring systems has become the center of attention for both researchers and industries. In this paper, we present the design of a safety watch integrated in a comprehensive health monitoring system capable of observing the elderly remotely. It integrates low-power hardware architecture and energy-efficient software configuration, which significantly extend the battery autonomy of the device. One of the major modules running on the safety watch is the automatic detection of falls and similar dangerous situations. For that purpose, several machine learning methods were tested, among which the Random Forest method achieved the highest accuracy in detection of falls on data recorded from 17 participants, and was implemented on the actual device.

KEYWORDS

Safety watch, remote monitoring, energy efficiency, fall detection

1 INTRODUCTION

More than 90% of the elderly desire to live in their own homes for as long as they possibly can [1]. However, as seniors age, the risk of unforeseen accidents that affect their well-being increases. For example, the lives of elderly people are very often affected by falls, which lead to not only physical injuries but also psychological consequences that further reduce their independence and decrease the quality of their life [2][3]. The lack of independence causes them to no longer feel comfortable with living alone, forcing them to move into nursing homes. It puts a burden on the health-care system with over-crowded nursing homes and hospitals, and causes higher health-care expenditures [4]. Therefore, monitoring the day-to-day routine of the elderly who live alone is an important precaution to undertake.

Remote health monitoring systems are essential for enhancing care in a reliable manner and allow the elderly to remain in their home environment rather than in expensive nursing homes [5]. Such systems also allow communication with remote healthcare facilities and caregivers, thus allowing healthcare personnel to keep track of the elderly's overall condition and respond, if necessary, from a distant centralized facility [6]. Due to the rapidly increasing aging population, such technologies have become a subject of interest for both researchers and industries.

One of the first remote monitoring systems presented in the literature are camera-based systems. They are capable of recognizing complex gait activities, but restrict the movement of the user within a specific range. Apart from that, they are complex, expensive and often related to privacy concerns. A recent survey gives an insight to the studies carried out in vision-based patient monitoring [7]. In the last few years, wearable motion sensors have gained in popularity for monitoring human activities in real time. They can monitor and record real-time information about one's physiological condition and motion activities. Wearable sensor-based health monitoring systems may comprise different types of sensors that can be integrated into textile fiber, clothes, and elastic bands or can be directly attached to the human body. One such system in presented in [8], which uses mobile phone as an intermediary to get vital data from various sensors and transmit data to a server for further processing. The main limitation of this system is the fact that the analysis is not performed in the place where the signal is acquired, and there may be a loss of efficiency in the wireless network when physiological signals are sent. Another wearable personal healthcare system is presented in [9]. It employs a number of wearable sensors to continuously collect users' vital signals and uses Bluetooth devices to transmit the data to a mobile phone, which can perform on-site vital data storage and processing. After local data processing, the mobile phone periodically report users' health status to a healthcare centre. Apart from such systems, various wearable commercial products are available on the

market, for example the biometric shirt by Hexoskin, and fitness trackers by Fitbit and Jawbone. However, many current solutions either provide insufficient functionalities at a reasonable price or are advanced but too expensive, too energy demanding or too invasive [10].

The aim of the HomeCare2020 project was to provide a comprehensive solution for a smart healthcare monitoring system, capable of observing the elderly remotely, while eliminating the problems mentioned before. The system aimed to enable the elderly to live home independently until later age and to make them feel safer and more confident in performing everyday tasks and activities. The developed system integrates two interconnected devices: advanced touch-screen care-phone (HomeTab) and a multifunctional safety watch. In this paper, the design of the safety watch is presented.

2 SAFETY WATCH DESIGN

The safety watch is a custom-made wristband device meant to be carried by seniors to provide 24/7 security, inside or outside of the home.

Its core part, from a hardware perspective, is an ARM-based low-power Bluetooth module by Nordic [11]. The priority on choosing the processors and other hardware components was given to how much energy they consume, since a device that requires everyday charging is strongly undesirable, especially for the elderly, who might have problems remembering when or how to charge the device. The safety watch integrates a low-power LSM6DSL system-in-package featuring a 3D digital accelerometer and a 3D digital gyroscope. As well as that, it contains a low-power Quecktel module that integrates NB-IoT and GPS functionality. Since GPS and NB-IoT consume a lot of power, these two functionalities are disabled for most of the time and programmatically enabled only when needed (i.e., when an emergency call is made and the device is out of Bluetooth range of HomeTab). The Quecktel module is connected to a SIM card, which is required for NB-IoT functionality. These components are connected to a rechargeable Li-ion battery, which can be recharged using a wireless (induction) charger. The diagram of the safety watch circuit can be seen in Figure 1.
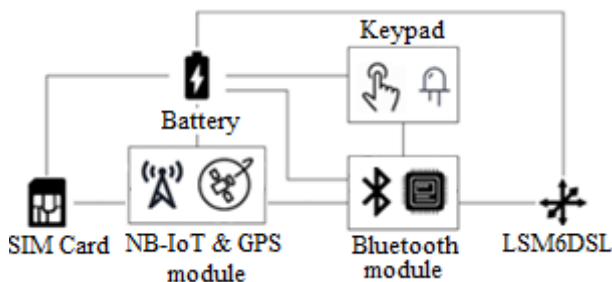
Figure 1: Diagram of safety watch circuit

The outer side of the safety watch housing is comprised of a membrane keypad used for manual alarm triggering (e.g. if the individual is in a dangerous situation). The keypad also integrates a small LED, used to provide a feedback to the users (e.g., alarm triggered, low battery alerts). Its appearance is shown in Figure 2.

Figure 2: Safety watch appearance

From a software perspective, the design principle behind the safety watch is to preserve the battery autonomy of the device. Therefore, the main processing unit is intended to sleep whenever possible and only wakes up when certain events happen, i.e., when there is an immediate danger for the user. The safety watch has two working modes, depending on whether the user wears the watch or not. If the watch is not worn, all working modes are disabled, since there is no need of motion monitoring, and only the device status (worn or not worn) is checked in 1-minute intervals. If the watch is worn, it monitors motion, accumulates the number of steps, and sends data over Bluetooth to the HomeTab. Once the battery of the device drops to 30% or lower, the sleeping time of the main processor increases from 5 to 10 minutes and the user is notified about the low battery level. The software design of the safety watch is illustrated in Figure 3.

The safety watch monitors users behaviour (activity levels), providing incentives to the users (through HomeTab) to move more and at the same time allow to determine unusually low activity (due to sickness). The integrated LSM6DSL step-count functionality enables the number of steps to be detected throughout the day and to be sent in regular 15-minutes intervals via Bluetooth to the HomeTab. This gives information about the user's activity levels, which the system later analyses to detect possible irregularities in the user's behaviour (which can be caused by an undetected disease). For example, if a user is feeling ill (has a flue), he will likely stay in bed significantly longer than when healthy, so the lack of movement can be detected, and caregivers notified.

2.1 Fall Detection

Automatic fall detection is one of the most important modules running on the safety watch. A machine learning method that can automatically detect falls and similar dangerous situations was developed and implemented in the final software of the safety watch.

For training of machine learning models, we used a publicly available dataset that contained acceleration data from a wrist-worn device from 17 subjects [12]. It comprised 11 daily-life activities, including 5 types of falling, namely: walking, standing, sitting, picking up an object, laying, jumping, falling backwards, falling sideward, falling forwards using knees, falling forwards using hands, and falling sitting in an empty
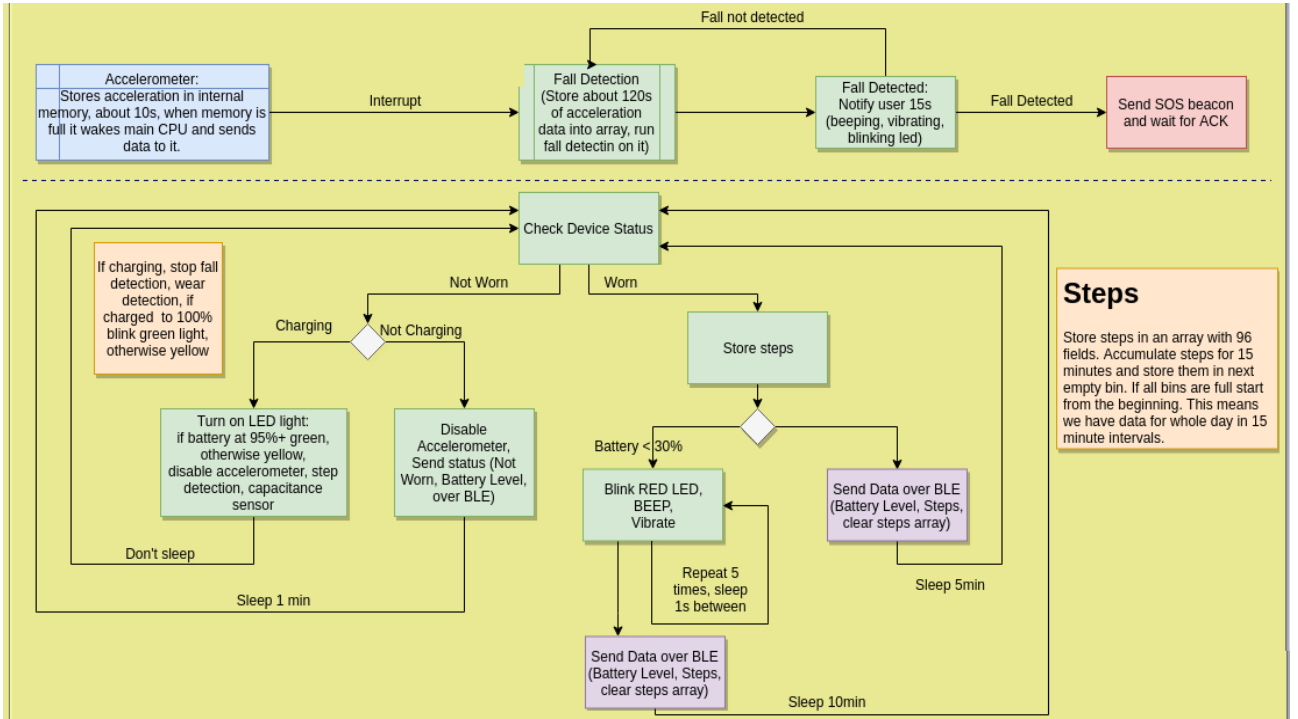
Figure 3: System software design

chair. Since our aim was to only detect falls in general, we grouped all fall-related activities as one class, and all other activities as another class. The non-fall activities were additionally under sampled, in order to adjust the class distribution of the dataset. The data were further segmented using a sliding window technique, with a window size of 2 seconds and 50% overlap between consecutive windows. To train the machine learning models, several statistical features were extracted from the acceleration signals, including mean, standard deviation, median, maximum, minimum, mean absolute change, variance, kurtosis, skewness, and similar. The window size and the optimal feature set was chosen based on our previous work [13].

Various machine learning algorithms were tested – Decision Tree (DT), Random Forest (RF), k-nearest neighbors (kNN). The different algorithms performances were evaluated using the leave-one-subject-out cross-validation technique. With this technique, the data is divided into N-number of folds (where N is the number of subjects in the dataset). Each fold is comprised of data from a single subject. In each iteration of the LOSO cross-validation, data from one subject is used for testing the method, and the training data is comprised of the remaining N-1 subjects. Among the tested algorithms, RF proved to have the best accuracies per watt of power consumed processing the data. RF is an ensemble classifier that fits a number of decision trees on various sub-samples of the dataset and outputs the majority class label from the constructed trees. It utilizes two random steps in the process of creating trees – a random sampling of the training data points and a random choosing of a splitting feature, which make it robust to noise and outliers [14]. The results achieved on the laboratory data with the best-performing RF

model, the kNN model and the DT model can be seen in Table 1, Table 2, and Table 3, respectively.

Table 1: Summed and normalized (per row) confusion matrix. LOSO evaluation with Random Forest model.

	Non-fall	Fall
Non-fall	97	3
Fall	2	98

Table 2: Summed and normalized (per row) confusion matrix. LOSO evaluation with Decision Tree model.

	Non-fall	Fall
Non-fall	91	9
Fall	8	92

Table 3: Summed and normalized (per row) confusion matrix. LOSO evaluation with kNN model.

	Non-fall	Fall
Non-fall	87	13
Fall	17	83

Since the aim of the system is to offer a great degree of accuracy in detecting actual fall, as well as in filtering false alarms, two metrics were analyzed: (i) sensitivity – capacity to detect actual fall, defined as the ratio between the number of falls correctly detected (true positives) and the falls that actually happened; (ii) specificity – capacity to filter false alarms,

defined as the ratio between properly discarded activities (true negatives) and the total number of discarded activities. From the confusion matrix presented in Table 1, it can be seen that the model has a very high sensitivity score – 98%, and specificity score – 97%. They are both very important for a real-life implementation of the model – it means that the model accurately detects falls, without triggering too many false alarms, which can be detrimental to users.

The implementation of the fall detection functionality on the hardware was also properly managed to extend the battery life. The most significant battery saving is done by processing the acceleration data in batches. The accelerometer stores acceleration values in its internal memory while the main processor sleeps. The accelerometer's buffer fills in 10 seconds, and when it is full, it wakes the main processor, and the collected data is sent to it for further processing. The main processor stores for about 120 seconds of acceleration data before running the fall detection algorithm. Once the 120-seconds of data is stored, the required features are calculated from the acceleration signals, and the pre-trained RF model (stored in the RAM of the safety watch) is run. If no fall is detected in the two-minute segment, the main processor goes back to sleep, otherwise, an alarm procedure is triggered. The alarm is sent via Bluetooth to the HomeTab device, which forwards it to the server for further processing. If the safety watch is out-of-range of the HomeTab, it uses NB-IoT network for alarm transmission. In this case, it also tries to get the user's location using a GPS signal.

3 Conclusion

This paper presented the design of a safety watch integrated into the HomeCare2020 comprehensive solution for a smart healthcare monitoring system, primarily targeted at elderly people. The main purpose of the safety watch is to help the elderly to live home independently until later age and to make them feel safer and more confident performing everyday tasks and activities. One of the most important modules running on the safety watch is fall detection, which makes the users able to call for emergency treatment in the case of a dangerous situation. For this purpose, different machine learning models were tested and compared. Among them, RF classification model proved to have the highest performance per watt of power consumed processing the data, which makes it the most suitable choice for implementation.

Overall, the software design of the system is highly energy-efficient and significantly extends the service time of the wearable device, which makes it convenient for use by elderly people. The system is easily operated and therefore shows great promise for providing long-term and continuous monitoring of the elderly in an unobtrusive way. We believe that it can efficiently contribute to improving remote healthcare services.

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Machine Vision System for Quality Control in Manufacturing Lines

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ABSTRACT

In manufacturing, quality control is a process that oversees the aspects of production and ensures that only products that conform to industry standards and quality criteria leave the production line. Automation of the quality control process significantly reduces the time spent on products' testing, hence reducing the overall manufacturing costs. In this paper, we present a brief overview of the algorithms adopted to the aim of detection of one possible fault in the production of ovens – non-working oven fan. The detection is performed through visual data. In the initial experiments, several image processing algorithms were used, and the preliminary results are encouraging.

KEYWORDS

machine vision, image processing, fault detection

1 INTRODUCTION

Quality control is becoming an increasingly important aspect of today's manufacturing processes [1]. For efficient and successful production, manufacturers rely on quality control systems integrated into the manufacturing process. The traditional quality control process requires vast capacities of specialized labor. High utilization of the specialists may lead to human errors, low reliability of the process, and a negative impact on the quality of production. Compared to manual quality control, automated quality control systems offer a reliable control process with various other advantages, including the ability to work 24 hours a day and, in some tasks, perform faster measurements with higher accuracy and consistency compared to humans [2]. Such systems are also a practical choice when the test cases need to run regularly over a significant amount of time. Machine vision quality control systems play a growing role in modern manufacturing quality control systems. These systems rely on digital sensors inside

industrial cameras with specialized optics to acquire images [3]. After an image is acquired, computer hardware and software process, analyze, and measure various characteristics of the image for automated decision-making.

Development of an integrated system for comprehensive quality control in production with an intelligent process control system is the main aim of the ROBKONCEL project [4]. One of the objectives of this project is the detection of faults in the production of ovens. In this paper, we present the initial experiments in the detection of one of the possible faults – non-working oven fan.

2 PROBLEM DEFINITION

The quality control of the ovens is intended to take place in a factory environment, where products moving on a conveyor belt are visually observed, i.e., a machine vision system acquires videos of the ovens. These videos are segmented into image frames (at a 30 fps rate), and the obtained image frames are further processed to detect if the fan is working or not. For the initial experiments, we collected a few videos in a laboratory setting, with various lightings and camera positions, resulting in approximately 7200 images (~4000 working fan and ~3200 non-working fan). Additionally, the visual data of the ovens' fans were acquired through a closed door, which makes the fault detection more challenging (Figure 1). This is preferred as the process of opening and closing the door in a manufacturing environment would be too slow.

Figure 1: Image of an oven's fan acquired through a closed oven door.

3 IMPLEMENTED TECHNIQUES

The image processing steps for the oven fault detection, i.e., non-working fan detection, are as following:

1. Object detection
2. Glare reduction
3. Image thresholding

Each of these steps and the image processing algorithms implemented in them are explained in the following sections.

3.1 Object Detection

In order to detect and isolate the circle area of the oven fan, we made use of the Hough Gradient Method [5], which is an extension to the standard Hough Transform technique [6] for isolating features of a particular shape within an image. The Hough Gradient Method is based on gradient information of edges and is used to improve the speed of the circle detection in order to meet real-time implementation requirements. The calculation steps of the Hough Gradient method are as follows: (i) detect edges in the image; (ii) calculate the local gradient for the edge points using a Sobel operator; (iii) use an accumulator to count the possible circle center on the normal direction of edge points' tangent; (iv) choose the peak circle center and circle radius for the general circle equation.

The implementation of the Hough Gradient method in OpenCV requires a single channel image, so the first step in the detection of circles was to convert the acquired images from the RGB color space to grayscale. Furthermore, two parameters of the circle detection function were tuned, namely: the minimum distance between the center coordinates of the detected circles and the ratio of the resolution of the original image to the accumulator resolution [5]. Before running the circle detection function, a simple median filter [7] was applied to the images for noise reduction. This helped in reducing the effects of various reflections in the glass part of the oven door. In general, without blurring, the algorithm tended to extract too many circular features, resulting in false circles detection. Therefore, this preprocessing step was crucial for successful circle detection. The circled detection algorithm resulted in a single circle detected in every image; however, with a varying radius. Since the further analyses require images with the same dimensions, the mean value of the detected circles' radius was calculated and used to isolate the fan area on the images. (Figure 2).

Figure 2: Detected oven's fan area.

3.2 Glare Reduction

A common problem in image processing is the occurrence of specular reflections on the images. In our case, since the videos of the fan were recorded through a glass, a significant amount of specular reflections, or glare, was produced during the recording. To reduce the effects of the glare, a glare reduction algorithm was applied. The basic glare reduction procedure consisted of 3 steps: (i) decomposition of the original image into a color, saturation and brightness component (HSV); (ii) finding particularly bright areas in the image; (iii) inpainting of these areas with the values of the surrounding pixels.

Each image was first converted into HSV color space, which describes the image by its hue (H), saturation (S) and brightness (V) component (Figure 3).
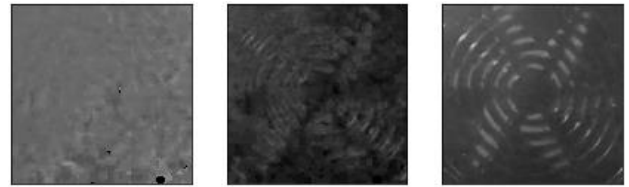
Figure 3: Image decomposition into hue, saturation and brightness component.

With such decomposition, a general rule for pixels that are subject to specular reflections can be derived; namely, an image can only contain glare if its color is not saturated, and it has high brightness. Since light reflections are white, any pixel containing glare cannot have saturation (since white has no color or saturation). Accordingly, we first filtered out the areas that have low saturation. Next, the area of the non-saturated pixel was reduced by an erosion operation, and the brightness values of the saturated pixels were set to 0. By filtering out the very bright pixels (e.g., all pixels that have a value larger than 130), we obtained the final glare mask (Figure 4).

Figure 4: Original image and the obtained glare mask.

The glared pixels were then interpolated with an inpainting operation. This operation fills the masked pixels with the values that stem from the adjacent non-masked pixels. The original image and its corrected version after the reduction of the glare can be seen in Figure 5. There is a significant amount of glare on the original image, which was effectively removed in the corrected image. The corrected image is a good approximation of the original image when no glare is present.
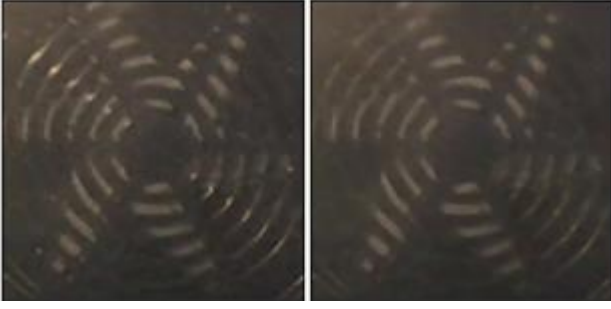
Figure 5: Original image and its corrected version.

3.3 Thresholding

If the two figures representing working and non-working fan in Figure 6 are analyzed, it can be seen that lighting allows the oven fan parts to stand out and be clearly seen behind the grid when the fan is not working. On the other hand, when the fan is working, the fan area behind the grid is blurred. Therefore, a simple thresholding method was utilized to distinguish working and non-working fan.

Figure 6: Working and non-working oven fan.

Thresholding is one of the simplest methods for image segmentation and creation of binary images [6]. The main goal of the utilized binary thresholding was to enhance the parts of the oven fan when it is not working. For that purpose, the images were firstly converted from RGB color space to grayscale. Next, with the binary thresholding method, each pixel in the images was replaced with a black pixel if its intensity was less than a chosen constant (T=90), or a white pixel if its intensity was greater than the chosen constant. This results in the illuminated parts of the oven fan becoming completely white (when the fan is not working), while the grid and the moving fan become completely black, as can be seen in the examples in Figure 7.

As a final step, the number of white pixels in the final binary-threshold images, which present only the non-working fans, was calculated. Then, the 5th percentile of these values was calculated and set as a threshold value when deciding if a given image represents a working or non-working fan. Basically, if the image contains more than X white pixels, where X is the previously calculated value of the 5th percentile, it is classified as a non-working oven fan; otherwise, it is classified as a working oven fan.

In the last post-processing step, the class for each image frame was taken as the majority class of the last 20 frames. It

helped in eliminating quick 1-frame changes from working to non-working, or vice versa.

Eventually, the implemented image-processing method resulted in 95% of correctly classified images, on four different videos. The confusion matrix of the method is presented in Table 1.

Table 1: Confusion matrix for the proposed method.

	Non-working	Working
Non-working	3117	82
Working	280	3720

As the main purpose of the system is to offer a high accuracy in detection of oven faults, while filtering false alarms, we additionally analysed two metrics: (i) sensitivity, i.e., method's capacity to detect actual faults (non-working fans), defined as the ratio between the number of non-working fan images correctly identified (true positives) and the total number of non-working fan images; (ii) specificity, i.e., method's capacity to filter false alarms, defined as the ratio between properly discarded images (true negatives) and the total number of discarded images. The method has a very high sensitivity score of 97%, and specificity score of 93%.

Figure 7: Non-working and working oven fan – thresholded images

4 CONCLUSION

In this paper, we presented an image processing pipeline adopted for the aim of detection of a possible fault in production of ovens – non-working oven fan. The image processing steps contain object detection (for isolating the oven fan area from the images), glare reduction (for reducing the effects of specular reflections), and image thresholding (for final decision-making). The preliminary results show that a quality control system that exploits image processing algorithms could be used in an automated manufacturing environment. In the future, we plan to employ reflection removal algorithms, which can significantly facilitate the object detection process, such as Sparse Blind Separation with Motions (SPBS-M) [8], Superimposed Image Decomposition (SID) [9], Ghosting Cues [10] and similar. However, the utilization of such algorithms may significantly impact the time performance of the method, so an acceptable trade-off between method's accuracy and time performance should be explored in future analyses.

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Abnormal Gait Detection Using Wrist-Worn Inertial Sensors

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ABSTRACT

Falls are a major health problem among elderly people and often lead to serious physical and psychological consequences. Identification of elderly people who are at risk of falling helps for the selection of effective preventative measures that minimize the likelihood of falls. The occurrence of gait abnormalities is one of the most significant fall precursors. Wearable sensors enable continuous monitoring of gait during daily routines, and therefore offer the possibility of early detection of gait changes. In this paper, we analyze the ability of machine learning models to detect gait abnormalities using data from inertial sensors integrated into a smartwatch and how they perform on the dominant and non-dominant wrist.

KEYWORDS

Gait analysis, abnormal gait, fall risk assessment, smartwatch, wearable sensors

1 INTRODUCTION

Falls present a major health problem among elderly people. One-third of the population aged over 65 years experience at least one fall per year [1]. Falls greatly affect the quality of life and restrict the independence of those affected. They not only lead to severe physical consequences but also result in high health care costs. Due to the rapid aging of the population, this problem will further increase in the near future [2]. Therefore, there is an urgent need for reliable screening tools to identify those at risk and to target effective fall prevention strategies.

Falls are a consequence of several intrinsic and extrinsic fall risk factors, among which balance and gait disorders are the most common ones [3]. Gait is a sensitive indicator of an individual's overall health status, so the occurrence of abnormal gait patterns usually represents an early indication of an underlying neurodegenerative disorder. Clinical research has

shown that these disorders carry a high risk for falls, with an annual fall rate of 60–80% in patients with Alzheimer's, Parkinson's or similar diseases [4][5]. However, there is substantial evidence that falls can be prevented if individuals at increased risk of falling are identified and enrolled in targeted fall prevention programmes [6]. Therefore, identification of balance impairment and gait abnormalities is an essential step in fall prevention.

Camera-based 3D motion capture systems and instrumented walkways are considered as the gold standard in gait analysis in terms of accuracy. However, these systems are only suitable for hospitals or hospital-like settings, such as specialized gait analysis clinics, due to their size and the need for qualified professionals to operate them. Moreover, current clinical evaluation of gait is costly and time-consuming, and thus cannot be performed frequently. Even though the completeness and the accuracy of the clinical measurements are unquestionable, a mobile and pervasive gait analysis alternative suitable for non-hospital settings is a necessity. Recent technological advancements in wearable sensors offer means for analyzing gait during everyday-life living. Among wearable devices, wristbands and smartwatches are increasingly popular because people find the wrist placement one of the least intrusive placements to wear a device.

In this paper, we analyzed the ability of inertial sensors integrated into smartwatches to detect human gait abnormalities that are related to fall risk. Moreover, we studied how the performance of machine learning models on the non-dominant wrist compares to the performance on the dominant wrist.

2 RELATED WORK

The recent advancements in sensor technology have led to applications of wearable sensor devices in gait analysis for fall risk assessment. Several studies have been carried out by combining wearable devices with inertial sensors and machine learning methods. The general pipeline in these studies consists of signal acquisition while the person performs everyday-life activities or pre-defined functional tests, signal processing and feature engineering, and lastly training a machine learning classifier that produces an output that depends on the application.

Howcroft et al. [7] have presented insightful accounts of features, classification models and validation strategies related to sensor-based fall-risk assessment. They have found large heterogeneity in terms of sensor-based features and sensor placement. Regarding the features, the existing studies most often use features from the time and frequency domain, which include mean, variance and energy of the windowed inertial data, as well as spectral components such as dominant frequency and harmonic ratio [8]. As well as that, some biomechanical gait features, such as stride length, clearance, stance and swing time for each stride, cycle time, cadence and similar, have been revealed as effective predictors of falls [9].

In terms of the location of the sensors, the most exploited body positions are the shanks, waist, pelvis, and feet. In [10], the authors made use of wearable devices incorporating accelerometer and gyroscopes, worn on the shanks and waist. They proposed a general probabilistic modeling approach for classification of different pathological types of gait through the estimation of spatiotemporal features. They showed that a Support Vector Machine (SVM) classifier can identify mobility impairment in elderly people, with an accuracy of 90.5%. In [11], the authors showed that with assessment of walking quality during a six-minute walk test with accelerometers attached to their lower leg and pelvis, prospective fallers and non-fallers can be successfully differentiated with a Random Forest (RF) classificator. Similar findings were confirmed also for inertial sensors attached at the sternum, in [12]. However, these body locations may be found obtrusive for wearing a device for longer periods of time. On the other hand, the wrist is considered as the most unobtrusive and widely accepted position to wear a device, which does not affect everyday-life activities of the user. Still, sensors worn on the wrist are affected by frequent movements, as the hand is generally the most active part of the body. It makes the analysis of the gait very challenging, and thus wrist-worn devices have not yet been utilized for gait abnormalities detect for fall risk assessment. Considering the lack of evidence supporting the feasibility of fall risk assessment with sensors worn on the wrist, in this paper we analyze the performance of several machine learning methods that utilize inertial sensor data from a wrist-worn device.

3 DATASET

For this study, we collected a dataset comprised of recordings from 18 subjects (8 males, 10 females, aged 19-54). Each subject wore two smartwatches Mobvoi TicWatch E [13], one on the left, and one on the right wrist (Figure 1). The two smartwatches had an Android application that collected data from the inertial sensors integrated into the devices, namely: accelerometer, gyroscope, and magnetometer, at a sampling frequency of 100 Hz.

The subjects were walking back and forth along a 15-meters straight line and performed two scenarios – normal walk and simulated abnormal walk. In the normal gait scenario, subjects walked at a comfortable pace and performed a natural gait, while in the simulated abnormal walk scenario, subjects walked while wearing impairment glasses [8]. The glasses were used to simulate the effects of impairment, including reduction of

peripheral vision, visual distortion, balance deficit, and similar. These effects alter the gait and are highly correlated with an increased risk of falls [3]. Both scenarios (normal and abnormal walk) were repeated by each subject five times, resulting in ten walking sessions per subject. An example of two motion samples from the sensors in the smartwatch worn on the right wrist of one subject is shown in Figure 2.

Figure 1: Equipment for data collection

4 METHOD

The machine learning method that we developed for this study consists of several steps: preprocessing of the acquired sensor signals – filtering and data segmentation, feature engineering and extraction from signal segments, and training of a classification model. In the first step, the raw IMU signals were filtered with a band-pass filter with cut-off frequencies in the range of 0.5 to 3.5 Hz [14], which allowed for reducing the frequencies outside of the range of frequencies related to human walking activity [15]. After the filtering step, the sensor signals were segmented using a sliding window. Since window size and the sliding parameter have to be tuned correctly for the task at hand, the windowing parameters were determined empirically. Eventually, we chose a window size of 8 seconds, with 50% overlap between consecutive windows.

To train a classification model, we extracted several features from the time and frequency domain, for each sensor signal. The tsfresh python package [16] allows general-purpose time-series feature extraction, which we exploited in generating more than 100 features per sensor stream. These features included the minimum, maximum, mean, variance, the correlation between axes, their covariance, skewness, kurtosis, the number of times the signal is above/below its mean, the signal's mean change, and its different autocorrelations, among others. Additional subset of frequency-domain features was also calculated using the signal's power spectral density (PSD), which is based on the fast Fourier transform (FFT), and included PSD energy, entropy, and binned distribution, the largest magnitude from the PSD (of the dominant frequency in the signal), and first four statistical moments of the PSD (mean, standard deviation, skewness, and kurtosis) [17][18].

We compared several different ML models that have all previously been proven suitable for human activities analysis:

1) Decision tree (DT) [19] is an algorithm that learns a model in the form of a tree structure with decision nodes with two or more branches, each representing values for a tested feature, and leaf nodes which represent a decision on the target class. In other words, it predicts the target class by learning decision rules from the training features.

2) Random forest (RF) [20] is an ensemble of decision tree classifiers. It creates multiple decision trees, each trained on a
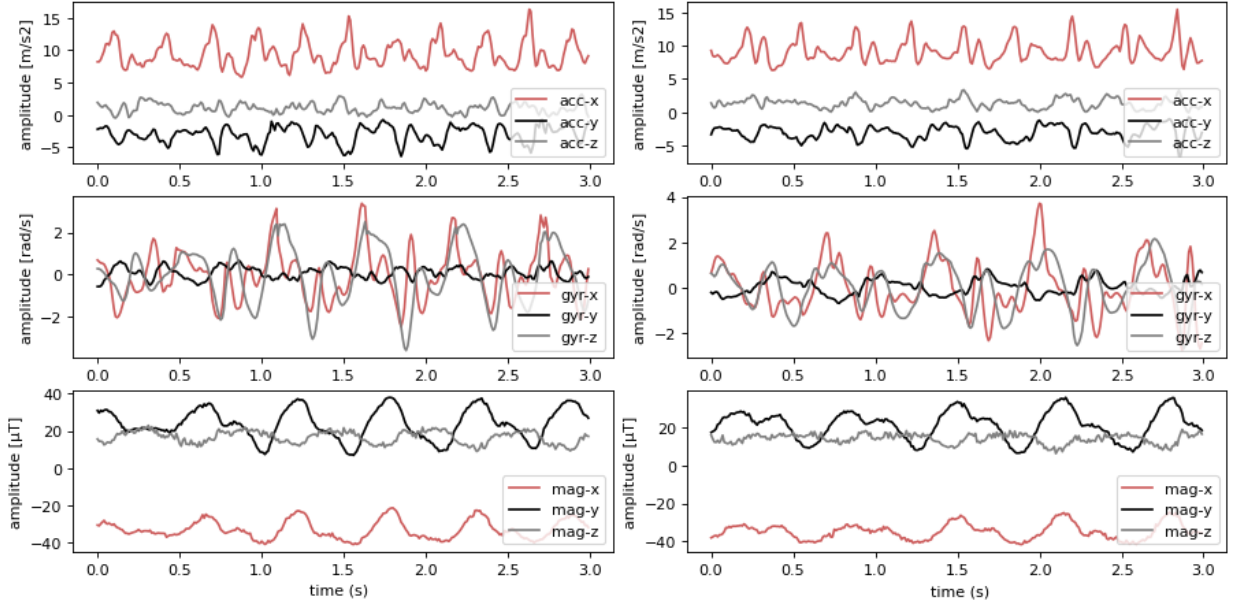
Figure 2: IMU sensors signals from normal walking session (left) and abnormal walking session (right)

bootstrapped sample of the original training data, and searches only across a randomly selected subset of features to determine a split. For the decision on the target class, each tree outputs a prediction, and the final prediction of the classifier is determined by a majority vote of the trees.

3) Support vector machine (SVM) [21] is an algorithm that is characterized by the use of kernel functions. They are used to transform feature vectors into higher dimensional space, in which a separation hyper-plane is learned to best fit the training data.

4) K-nearest neighbors (kNN) [22] is an algorithm that uses feature-vector similarity, i.e., for each feature vector in the test data, it finds the k-nearest neighbors in the training set. The final prediction of the classifier is determined by a majority vote of the chosen neighbors.

To estimate the generalization accuracy of the models, we utilized the leave-one-subject-out cross-validation technique. With this approach, the data is repeatedly split according to the number of subjects in the dataset. In each iteration, one subject is selected for testing purposes, while the other subjects are used for training the model. This procedure is repeated until data from all subjects have been used as test data.

5 EXPERIMENTAL RESULTS

To observe the performance of the models in real-life scenarios, we carried out several experiment. In fact, we observe the performance of the models on the left and right wrist separately, to see if they achieve similar result on both wrists.

Since real-life poses many challenges that should be taken into account, we considered three different training scenarios for each wrist. Namely, we test the accuracy of the models for six train-test combinations: training on the left wrist and testing on the right wrist (L - R), training on the right wrist and testing on the right wrist (R - R), training on both wrists and testing on the right wrist ((L+R) - R), training on the left wrist and testing on the left wrist (L - L), training on the right wrist and testing on the left wrist (R - L), and training on both wrists and testing on the left wrist ((L+R) - L). With these combinations, we want to see if training a model with data from only a particular wrist or both wrists combined leads to higher accuracy. Moreover, another challenge that we took into account is a device with a model developed for the right (left) wrist to be worn on the left (right) wrist, hence the "switching wrists" combinations [23]. The results from these experiments can be seen in Table 1. The performance of the machine learning models is additionally compared with the performance of a baseline method - majority vote classifier.

From the presented results, it can be seen that the RF algorithm significantly outperforms the other algorithms for each train-test combination, while the kNN achieves the lowest accuracy in detection of gait abnormalities. Moreover, the results show that the right-left combination achieves 72.2% accuracy, which is significantly lower than the left-left combination, which achieves 83.9% with the RF model. On the other hand, the difference between the left-right and right-right combinations is minor – only 1.5 percentage point. These results suggest that models trained with data from the left wrist could perform well on both wrist, but the data acquired from the right wrist does not bring enough information to train a reliable model that could perform well on the left wrist, as well.

However, the problem of "switching wrists" could be overcome if the models are trained with data from both wrists. In fact, the models trained with data from the left and right wrist combined, outperform the other two combinations for both wrists, achieving the highest accuracy of 84.3% for the left wrist, and 82.3% for the right wrist with the RF model.

Overall, the results suggest that the models perform better for the left wrist. Since all subjects included in the dataset were right-handed, we can conclude that the non-dominant hand brings more information regarding the walking patterns of the subjects.

Table 1: Gait abnormality detection accuracy of individual classifiers.

Classifier	L - L	R - L	(L + R) - L	R - R	L-R	(L + R) - R
Baseline – Majority Classifier	61.4	61.4	61.4	61.4	61.4	61.4
DT	75.1	51.2	78.0	74.5	65.6	76.6
RF	83.9	72.2	84.3	82.8	81.3	84.3
SVM	68.3	61.0	72.4	64.4	66.4	71.4
kNN	63.2	57.3	63.8	61.2	62.6	63.0

6 CONCLUSION

In this paper, we analyzed the ability of machine learning algorithms to detect gait abnormalities using data from inertial sensors integrated into a smartwatch. Among the compared machine learning algorithms, Random Forest achieved the highest accuracy. The analysis of the performance of the models on the left and right wrist showed that they perform better on the left wrist, which was the non-dominant for the subjects included in the dataset. The experiments with the "switching wrist", i.e., training the models with data collected from one wrist and testing on the other showed that the accuracy of the models significantly drops. However, when the models were trained with data from both wrists and applied on each wrist individually, the accuracy increased, outperforming even the models that were trained and tested on the same wrist. Therefore, the best practical solution is to deploy a model trained with data from both wrists. Overall, the results are satisfactory and show that data generated by wrist-worn inertial sensors is sufficient for gait abnormalities detection and can be used for fall risk assessment in non-clinical environments.

ACKNOWLEDGMENTS

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Avtomatska detekcija obrabe posnemalnih igel

Automatic Wear Detection of Broaches

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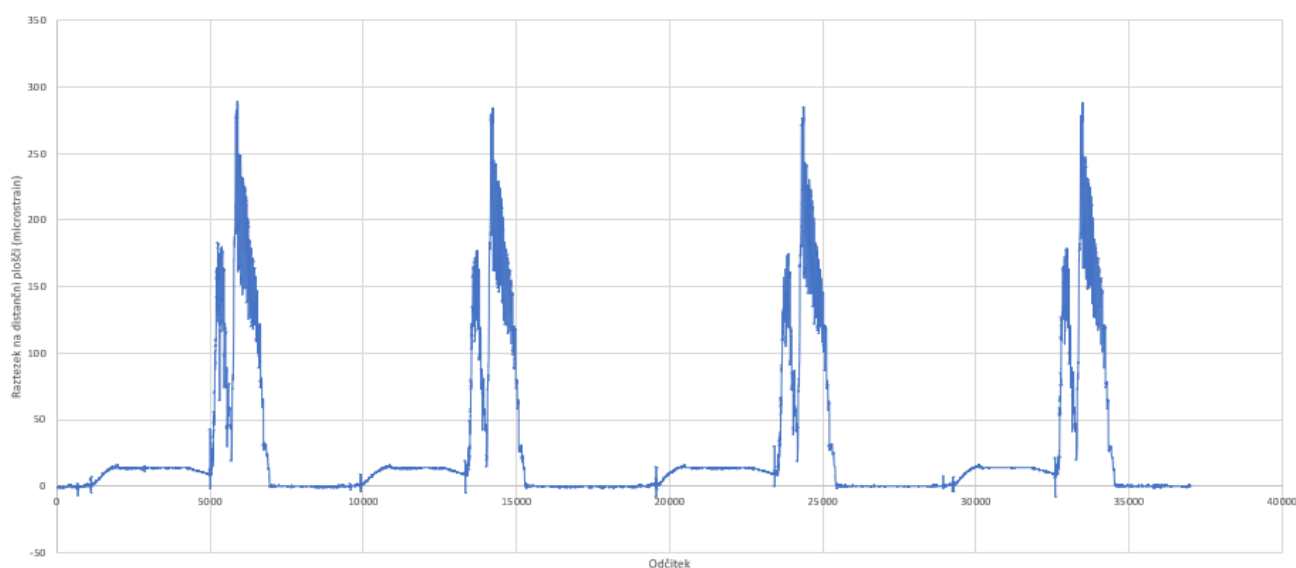
Slika 1: Odčitki signala posnemalne igle

POVZETEK

Posnemanje materiala je ena izmed metod strojnega obdelovanja izdelkov, ki jih dosežemo s t.i posnemalno iglo. V grobem ločimo zunanje posnemanje in notranje posnemanje materiala. V prispevku se posvečamo notranjemu posnemanju, pri katerem se v začetku naredi manjšo luknjo v obdelovanec, nato pa postopoma oblikuje profil. To se doseže z različnimi premeri rezil tako, da je na začetku premer manjši, nato pa se postopno povečuje. Tako se lahko oblikuje poljuben krožni ali n-kotni profil. Zaradi obrabe rezil pri posnemanju se morajo le-ta redno menjati. V prispevku je opisan pristop napovedovanja obrabe posnemalne igle glede na cikel posnemanja. Glavna značilka, uporabljena za napovedovanje, je t.i mikroraztezanje (ang. microstrain), ki pove, za koliko se spremeni obremenitev na merilnem mestu v delcih na milijon. V prispevku je predstavljenih več metod strojnega učenja za reševanje omenjenega problema. Povprečna napaka

najboljše metode je 27 posnemanj oz. 1,8% glede na povprečno število posnemanj, ki se opravijo pred menjavo.

KLJUČNE BESEDE

Posnemalne igle, avtomatsko zaznavanje, regresija, strojno učenje

ABSTRACT

Broaching is one of the methods in metalworking, which is performed with the so-called broach. We distinguish between external broaching and internal broaching. In this paper, an internal broaching is presented, where a small hole is initially made in the workpiece, and then the broach gradually forms a profile. This is achieved with different blade diameters so that initially the diameter is smaller and then it gradually increases. Thus, any circular or polygon shape can be formed. Due to the wear during broaching, the blades must be replaced regularly. In this paper, an approach for predicting how many broaching processes or the number of work cycles can still be done before replacing the broach are presented. We did this by measuring and monitoring the microstrain parameter by the cut time, which tells how much the strain changes in parts per million. Thus, with regression

machine learning procedures, we learned a model that missed an average of 27 cycles or 1.8 %.

KEYWORDS

Broaches, automatic detection, regression, machine learning

1 UVOD

Posnemanje materiala je zelo natančen postopek obdelovanja kovinskih izdelkov. Cena posnemalnih igel je relativno visoka (nekaj tisoč EUR), zato se posnemanje v industriji uporablja le v primerih, ko imamo dovolj veliko število obdelovancev. Uporaba obrabljene ali uničene posnemalne igle zaradi množične proizvodnje privede do visokih stroškov za proizvajalca, zato se igle trenutno menjajo po 1500 posnemanjih, ne glede na njihovo obrabo. S pomočjo strojnega učenja je mogoče natančneje napovedati, kdaj bo določena igla preveč obrabljena, s tem pa pridobimo boljši izkoristek igel ter takojšnje zaznavanje morebitne okvare igle. Avtorji prispevka so za razne industrijske aplikacije dobili več nagrad (prof. dr. Matjaž Gams [1]), medtem ko se je prvi avtor ukvarjal s procesiranjem časovnih signalov v svoji diplomski nalogi [2]. Nekateri raziskovalci so se lotili obdelave s pomočjo kombinacije strojnega vida in učenja [3], [4], [5] ter merjenja sil [6], [7]. Na sliki 2 je primer signala posnemanja enega cikla oziroma enega obdelovanca. Na abscisni osi je čas, medtem ko je na ordinatni osi obremenitev oziroma raztezek na distančni plošči (angl. microstrain) [8]. Distančna plošča je kovinska plošča, ki zagotavlja ustrezen odmik med kovinskim izdelkom in posnemalno iglo. Tu merimo naš raztezek.
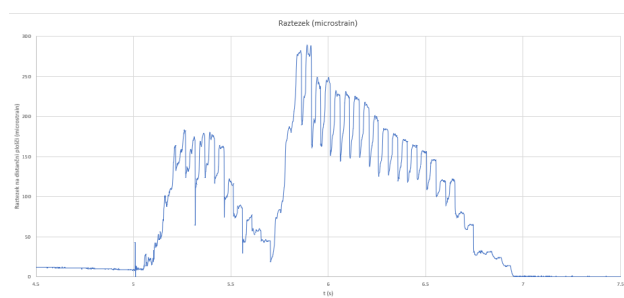
Slika 2: Primer povečave enega reza igle poljubnega signala

Opazimo, kako se raztezek (ki ga lahko interpretiramo kot silo) na distančni plošči spreminja, ko se spreminja premer zob posnemalne igle. Na sliki 3 je primer posnemalne igle (splošno), z rdečo barvo je označen obdelovanec. Smer puščice nakazuje pomik.
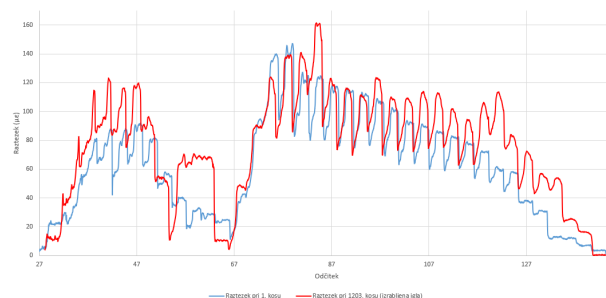
Slika 4: Primerjava raztezkov med obrabljeno in novo posnemalno iglo
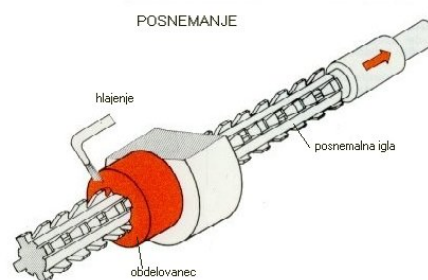
Slika 3: Primer posnemalne igle [9]

2 DEFINICIJA PROBLEMA

Rezila se med uporabo obrabljajo (postanejo topa), zaradi česar je potrebna večja sila za posamezen rez. S povečevanjem sile se veča verjetnost, da bo rez nepravilen, oz. se bo rezilo poškodovalo (npr. odlomil rezilni zob). Ko so rezila preveč obrabljena, jih je mogoče nabrusiti, kar je veliko ceneje od nakupa novega rezila v primeru nepopravljivih poškodb (npr. zloma zoba). Trenutno je postopek v proizvodnji tak, da se vsa rezila po 1500 posnemanjih zamenjajo, saj je verjetnost za napako po tem številu posnemanj previsoka. Problem je, da se rezilo zaradi različnih zunanjih dejavnikov (npr. mazivne tekočine, temperature itd.) obrablja hitreje ali počasneje, kar privede do okvar na izdelku ali slabšega izkoristka rezila.

Na sliki 4 je prikazana primerjava signala iz nove igle (modra) ter obrabljene igle (rdeča). Vidimo lahko, da ima posnemalna igla predstavljena z rdečim signalom v splošnem večji integral (površino pod krivuljo), to pomeni, da je sila večja. Razlikuje se tudi po številu ter jakosti posameznih vrhov, npr. v nekaterih primerih določeni vrhovi manjkajo (rezilo (nož) je popolnoma izrabljen).

3 REŠEVANJE PROBLEMA

Iz slike 4 lahko vidimo, da sta število in višina (integral) vrhov eden pomembnejših faktorjev pri prepoznavi okvare, sekundarni faktor pa je oblika vrhov. Avtomatskega prepoznavanja vrhov smo se lotili tako, da smo zaznali, kdaj se signal dvigne od standardne deviacije (šuma) signala. Med posameznimi rezi je igla v mirovanju, kar je razvidno iz slike 1. Na ta način smo dobili okno, ki vsebuje le signal, ki nastane med rezanjem. Poiskali smo okrog 1000 različnih atributov, ki opisujejo signal s pomočjo knjižnice Tsfresh [10]. Ti atributi so npr. minimalna in maksimalna vrednost signala, frekvence in vzorci, ki se pojavljajo v signalu. Nato smo atribute filtrirali z ozirom na relevantnost (prav tako
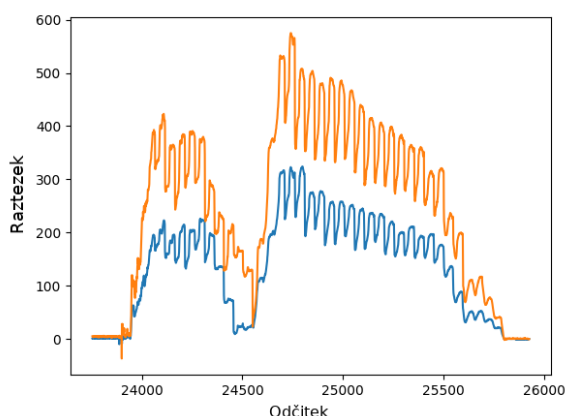
Slika 5: Primerjava odčitkov raztezka z leve in desne posnemalne igle

Slika 6: Integral signala glede na število rezanj posnemalne igle

z omenjeno knjižnico), ki za vsak atribut izračuna p-vrednost oz. statistično stopnjo značilnosti. V zadnji fazi se nad množico p-vrednosti požene Benjamini-Yekutieli algoritem, ki se odloči katere značilke obdržimo in katere izločimo. Izkazalo se je, da so najpomembnejši atributi ploščina, maksimalna vrednost ter število vrhov, torej le trije atributi. Z izbranimi atributi smo s pomočjo strojnega učenja napovedali, v kakšnem ciklu oz. kako blizu okvari je določena igla. Uporabili smo naslednje pristope z učnim okoljem Sci-kit learn [11], [12]:

- linearno regresijo (Linear Regression) [13],
- gradientno ojačitev za regresijo (Gradient Boosting) [14],
- klasifikator AdaBoost (AdaBoost Classifier) [15],
- K najbližjih sosedov (K Nearest Neighbours) [16].

Obdelovalni oz. posnemalni stroj, s katerega smo pridobili meritve, ima levo in desno posnemalno iglo, pri čemer obe delujeta istočasno, torej obe posnemata (režeta) material hkrati. Na sliki 5 je primer meritev leve in desne posnemalne igle za posnemanje ob določenem času. Opazimo, da ima ena igla večji integral, kar pomeni, da bi morali na začetku merilnega cikla kalibrirati iglo/senzor. S tem bi zagotovili enako izhodišče za nadaljnjo statistično obdelavo podatkov. Da bi se izognili tej težavi smo v tem prispevku primerjali le posnemalne igle, ki so na isti strani (leva ali desna).

4 REZULTATI

Na sliki 6 je prikazana primerjava integralov signala po določenem številu rezov (ordinata). Vidimo lahko (še posebej na desni igli), da se z večanjem števila rezov vrednosti integralov povečujejo, kar je skladno s pričakovanji, da je za enak rez s topim nožem potrebna večja sila.

Podobno, čeprav manj izrazito, lahko ugotovimo za maksimalno silo, ki nastane med rezom, kar je razvidno iz slike 7.

Na sliki 8 je prikazano število vrhov, ki jih algoritem prepozna. Po pričakovanjih je število vrhov obratno sorazmerno s številom rezov. Rezila na posameznih iglah se obrabljajo, zato te igle ne režejo več, torej je sila na rezilu nizka, saj igla ne postruži nič materiala. Nato sledi naslednja igla, ki ni obrabljena, ker predhodna igla ni opravila svojega dela, mora ta igla odstraniti večjo količino materiala, kar privede do večje sile ter obrabe na tem igli.
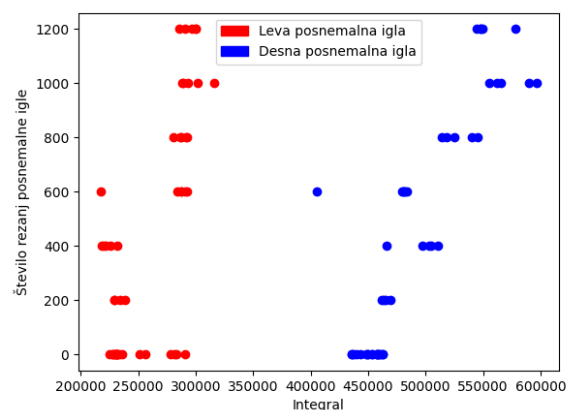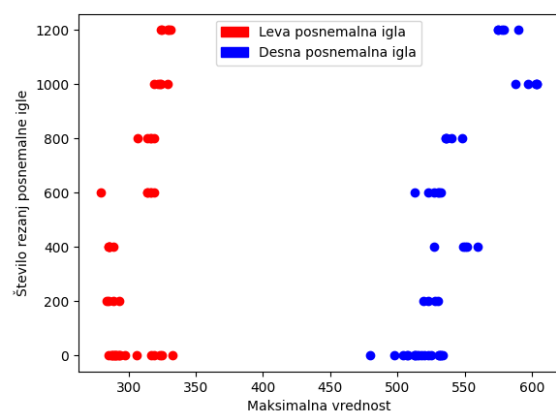
Slika 7: Maksimalne vrednosti signala glede na število rezanj posnemalne igle

Za napovedovanje zvezne vrednosti ciljne spremenljivke (regresija) uporabljamo metriko MAE (angl. Mean Absolute Error) in RMSE (angl. Root Mean Squared Error). Razlika je v tem, da metrika absolutne napake vrne le razliko absolutne napake, medtem ko RMSE vrne kvadrat te napake, s čimer kaznujemo večje razlike, torej primere, ko se napaka razlikuje za večje število ciklov. V našem primeru smo uporabili le vrednost MAE, ki je definirana z enačbo (1).

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - x_i| \qquad (1)$$

V tabeli 1 so prikazani rezultati napovedovanja cikla za posamezno metodo strojnega učenja.
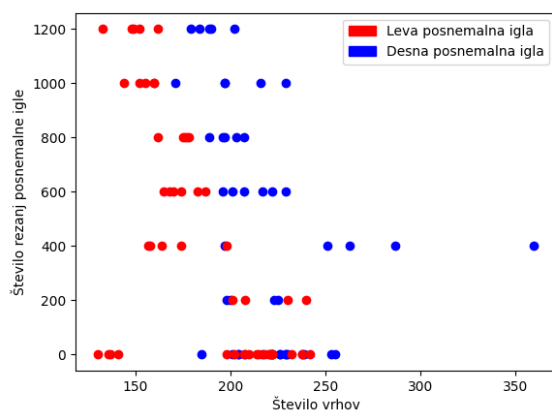
Slika 8: Število vrhov signala glede na število rezanj posnemalne igle

Tabela 1: Regresorji in njihove pripadajoče metrike MAE

Regresor	MAE
Linearna regresija	101,25
Gradient boost	27,58
AdaBoost	165,44
KNN	74,16

5 ZAKLJUČEK

Način merjenja mikroraztezka na distančni plošči ter analize časovnega signala s pomočjo strojnega učenja je naš prispevek na tem področju. Z navedenimi pristopi smo dobili povprečno absolutno napako (MAE) 27,58 kar pomeni, da se naš model v povprečju zmoti za 27,58, pri napovedovanju cikla trenutnega reza. Vrednosti (število ciklov) gre od 0 do 1500 [1]. To pomeni, da model s točnostjo 98,16 % napoveduje v katerem ciklu je posnemalna igla, oz. kdaj je iglo potrebno zamenjati. V nadaljevanju raziskave, se je potrebno osredotočiti na optimizacijo hiperparametrov posameznega regresorja. Končni cilj raziskave je implementacija tovrstnega primerjanja na podlagi signala v proizvodni proces.

ACKNOWLEDGMENTS

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[1]Model privzame, da je iglo potrebno zamenjati, ko signal izgleda, kot izgleda na igli s 1500 rezi. Če bi želeli točno izvedeti, kdaj je "točka preloma", torej ko je igla okvarjena, bi bilo potrebno izvesti še nekaj meritev/posnetkov, kjer bi se igla uporabljala dokler ne bi prišlo do napak na izdelku.

Povečevanje enakosti (oskrbe duševnega zdravja) s prepričljivo tehnologijo

Increasing Equality (in Mental Health Care) with Persuasive Technology

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POVZETEK

Neuspešno spopadanje z naraščajočimi težavami z duševnim zdravjem močno ovira blaginjo posameznika in družbe. Kljub temu so ovire do dostopa in enakosti v oskrbi na področju duševnega zdravja, ki jih je veliko, znane, obsegajo pa od osebnih stigm do socialno-ekonomske neenakosti. Tehnologija, predvsem pa umetna inteligenca, ima ob takšnem stanju priložnost, da s svojim razvojem poskuša ublažiti obstoječi položaj z edinstvenimi rešitvami. Multi- in interdisciplinarne raziskave na področju prepričljive tehnologije, katere cilj je spreminjanje vedenja ali mentalnega stanja brez zavajanja in prisile, kažejo uspeh pri izboljšanju počutja pri ljudeh s tovrstnimi težavami. V prispevku so predstavljeni takšni sistemi s kratkim pregledom področja, glavni doprinos pa je analiza potencialnih težav in rešitev, ki jih prepričljiva tehnologija nudi na področju oskrbe duševnega zdravja. Zdi se, da prepričljiva tehnologija lahko dopolni obstoječe rešitve za pomoč pri duševnem zdravju, s tem pa zmanjša težave v dostopnosti in enakosti zdravstvene oskrbe kot tudi v enakosti nasploh.

KLJUČNE BESEDE

Digitalno duševno zdravje, prepričljiva tehnologija, umetna inteligenca, dostopnost in enakost zdravstvene oskrbe.

ABSTRACT

The inability to cope with increasing mental health issues among the populace severely hampers the well-being of both the individual and society. Barriers to access and equality in mental health care, many of which are well known, range from personal stigmas to socio-economic inequality. This offers technology, especially artificial intelligence, the opportunity to try to alleviate the existing situation with unique solutions. Multi- and interdisciplinary research in the field of persuasive technology, which aims to change behavior or mental states without deception and coercion, shows success in improving well-being of people with mental health issues. This paper presents such systems with a brief overview of the field, with the main contribution being an analysis of potential problems and solutions that persuasive technology offers in the field of mental health care. Persuasive technology seems to be able to complement existing mental health care solutions, thereby reducing unequal access to and inequality in mental health care as well as reducing inequality in general.

KEYWORDS

Digital mental health, persuasive technology, artificial intelligence, mental health care access, equality.

1 UVOD

Težave na področju duševnega zdravja so že desetletja v porastu, uničujoč učinek tega pa so pripoznali tudi svetovni odločevalci, saj so Združeni narodi izboljšanje na tem področju uvrstili med svoje cilje trajnostnega razvoja [42]. Med temi težavami izstopajo predvsem stres, anksioznost in depresija (SAD). Beležijo, da se v nekaterih skupinah z akutnim stresom spopada 74% ljudi [24], z anksiozno motnjo 28% ljudi [5] in z depresijo 48% ljudi [36]. Kar se zdi še bolj problematično, je dejstvo, da v državah z nizkim in srednjim dohodkom okoli 80% ljudi ni deležno zdravljenja zaradi svojih duševnih težav, v državah z visokim dohodkom pa ta številka dosega okoli 35% [33]. Težave z duševnim zdravjem povzročijo daljnosežne in večplastne posledice, ki jih občutijo bolniki, njihova neposredna okolica (družina, skrbniki) in širša družba [41]. Bolniki se soočajo s slabšo kakovostjo življenja, nižjimi izobraževalnimi rezultati, nižjo produktivnostjo, potencialno revščino, socialnimi težavami in dodatnimi zdravstvenimi težavami. Skrbniki se soočajo z večjimi čustvenimi in fizičnimi izzivi, pa tudi z zmanjšanim dohodkom in povečanimi finančnimi stroški. Družba se vsako leto sooča z izgubo več odstotnih točk BDP in milijardami dolarjev na državo skupaj s poslabšanjem zaupanja v inštitucije javnega zdravja in s krhanjem socialne kohezije. Vse to vodi v čedalje močnejšo pozitivno povratno zanko – SAD ohranja in krepi SAD. Težave z duševnim zdravjem prepogosto vodijo tudi v izgubo človeškega življenja, saj se številne države spopadajo z visoko stopnjo samomorov [8]. Razlogi za višanje simptomov SAD vključujejo močno pomanjkanje strokovnjakov in predpisov za duševno zdravje [39] ter neenak dostop do oskrbe

na področju duševnega zdravja [9]. Zato se zdi, da tehnološke in druge znanstvene terapevtske intervencije lahko pomagajo pri izboljšanju trenutnega stanja sistema, zlasti ker imajo posamezniki z duševnimi težavami terapije raje kot zdravila [2].

Zaradi napredka vedenjskih ved na področju človekovega odločanja in sorodnih pojavov [34] ter prihodom digitalnih tehnologij, umetne inteligence in velikega podatkovja se je razvoj usmeril v ustvarjanje tehnologij, ki bi pomagale, motivirale in usmerjale ljudi, da izboljšajo sebe in svet. Prepričljiva tehnologija (PT) je eden izmed rezultatov tovrstnih prizadevanj. Gre za tehnologijo, ki "spreminja stališča ali vedenja ali oboje (brez uporabe prisile ali zavajanja)" [12, str. 20]. Sprememba vedenja velja za pojav začasnega ali trajnega učinka na vedenje, odnos in druga duševna stanja posameznika v primerjavi s preteklostjo [12]. PT se že uporablja za pomoč pri duševnem zdravju [25, 27], kar prispeva k enakosti in omogoča lažji dostop do zdravstvene oskrbe [37].

Prispevek ima sledečo strukturo: poglavje 2 nudi pregled področje PT za pomoč pri duševnem zdravju, poglavje 3 analizira težave in rešitve, ki jih nudi PT, poglavje 4 pa poda nekaj zaključnih misli in idej za prihodnje delo.

2 PREGLED PODROČJA

Pričujoče poglavje vsebuje pregled področja PT in področja sprememb vedenja.

Sprememba vedenja je pojav, za katerega velja, da pri posamezniku povzroči začasen ali trajen učinek na njegovo vedenje v primerjavi s tem, kako se je vedel v preteklosti [12]. Ne vključuje le vedenja, temveč tudi duševna stanja. Intervencije za spremembo vedenja so velik del PT, ki se že pogosto uporablja na zdravstvenih področjih. Obstoječi sistemi s pomočjo umetne inteligence spremljajo vedenje ljudi ter njihova fiziološka in duševna stanja z namenom, da jih motivirajo in vplivajo na njihovo počutje, vse to pa lahko počnejo v naravnem jeziku [27].

Eden najpogosteje uporabljenih okvirjev prepričevanja in sprememb vedenja, ki jih uporabljajo takšne tehnologije, so Cialdinijeva načela prepričevanja (CPP) [6]. Obstajajo tudi drugi okviri [25, 27], vendar je za namene tega dela opisan samo CPP. Njegova glavna ideja je, da ne obstaja splošna strategija prepričevanja, ki bi delovala na vse ljudi. CPP zato opiše več strategij prepričevanja, saj so različni ljudje različno dovzetni za različne strategije.

CPP predvideva 7 strateških podlag za prepričevanje: 1) avtoriteta, ki cilja na ljudi, ki so bolj nagnjeni k temu, da jih motivira legitimna avtoriteta; 2) zavezanost in doslednost, ki sta namenjena ljudem, ki se bolj pogosto zavežejo k nečemu, če so se tako vedli že prej; 3) družbeni dokazi, ki ciljajo na ljudi, ki se ponavadi vedejo tako, kot se vedejo drugi; 4) všečnost, ki cilja na ljudi, za katere je bolj verjetno, da jih motivira nekdo, ki jim je všeč; 5) recipročnost, ki cilja na ljudi, ki so nagnjeni k vračanju uslug; 6) pomanjkanje, ki cilja na ljudi, ki menijo, da so redke stvari bolj dragocene; 7) enotnost, ki vpliva na ljudi, na katere vplivajo pozivi, ki se tičejo njihove skupinske identitete. Na različne ljudi vplivajo različne strategije, interaktivna tehnologija pa nudi orodje za učinkovitejšo izbiro tistih strategij, ki delujejo za določene ljudi.

Za izbiranje najučinkovitejše strategije se PT pogosto opira na osebnostne modele, kot je velikih pet faktorjev osebnosti [31], in vprašalnike za posamezne domene, kjer se PT uporablja (npr.

duševno zdravje). Osebnost se meri na različnih dimenzijah (odprtost, vestnost, ekstravertnost, sprejemljivost, nevroticizem), ki poskušajo opisati posameznikove tendence, povezane z njegovimi psihološkimi lastnostmi, kot so duševna stanja in odločanje. Prepričevanje na področju duševnega zdravja je hkrati bolj uspešno, če PT dostopa do podatkov o posameznikovem duševnem zdravju. V ta namen lahko uporabimo vprašalnike SAD [21] za kategorizacijo ljudi s simptomi SAD.

Okvirji prepričevanja so lahko implementirani v različne tehnološke platforme. Nedavni pregledni članek PT za zdravje in dobro počutje [27] je ugotovil, da so najpogosteje uporabljene platforme mobilne naprave (28%), sledijo igre (17%), spletna in socialna omrežja (14%) ter druge specializirane naprave (13%), namizne aplikacije (12%), senzorji in nosljive naprave (9%) ter zasloni v javnem prostoru (5%). Vrst aplikacij, ki delujejo kot PT, je na tem področju več, inteligentni kognitivni asistenti (IKA; znani tudi kot pogovorni roboti ali pogovorna umetna inteligenca) pa so najbolj napredni in razširjeni [4, 18, 26, 27, 30, 37, 44]. IKA izkazujejo številne človeku podobne sposobnosti, saj lahko do neke mere razumejo kontekst, se prilagajajo, se učijo, komunicirajo, sodelujejo, napovedujejo, zaznavajo, razlagajo in utemeljujejo. Najpomembneje je, da se IKA lahko pogovarjajo v naravnem jeziku in jih je zato mogoče ustvariti tako, da nudijo terapevtsko pomoč. Rezultati različnih preglednih člankov [4, 18, 26, 27, 30, 37] kažejo, da so IKA učinkovito sredstvo za lajšanje simptomov SAD. Izvedli smo kratek pregled prispevkov o najsodobnejših IKA za duševno zdravje in tri na kratko predstavljamo za ponazoritev tovrstne tehnologije. Vsi trije IKA [11, 14, 43] delujejo podobno, tako da z uporabo skriptiranih pogovorov in osnovnih sposobnosti procesiranja naravnega jezika nudijo pomoč. Ta je odvisna od uporabniškega modela, ki vsebuje podatke o čustvih uporabnikov in ravni SAD. Vsi IKA se v eksperimentih izkažejo za 15–20% uspešnejše pri lajšanju SAD od uradno priporočenega gradiva za samopomoč.

Takšna tehnologija nudi številne prednosti na področju duševnega zdravja: lahko je brezplačna in omogoča pomoč socialno-ekonomsko prikrajšanim ljudem; na voljo je 24 ur na dan, 7 dni v tednu, kar pomeni, da bolnikom ni treba čakati na naslednjo terapijo; veliko ljudi s simptomi SAD lažje zaupajo računalniku kot osebi [10, 22]; tehnologija je na voljo na oddaljenih lokacijah itd. Tehnologija lahko tako zmanjša obremenitev zdravstvenega sistema in njegovih izvajalcev ter zmanjša ovire za dostop do oskrbe duševnega zdravja na splošno. Pomembno je poudariti, da tehnologija deluje komplementarno in ne nadomešča strokovnjakov [16, 18, 37]. Prednosti rabe tovrstne tehnologije in morebitne težave so podrobneje obravnavane v naslednjem poglavju.

3 PREDNOSTI IN MOREBITNE TEŽAVE

Pričujoče poglavje obravnava posledice uporabe PT za duševno zdravje na področju spodbujanja enakosti in dostopnosti oskrbe duševnega zdravja, dotakne pa se tudi posledic na splošno. Posledice so razdeljene na tiste, ki ponujajo potencialne rešitve obstoječih težav in ovir za enakost in dostopnost, in tiste, ki se kažejo kot problemi te tehnologije pri doseganju enakosti. Na koncu poglavja so na kratko obravnavani tudi drugi problemi, ki na videz niso povezani z enakostjo, a so ključnega pomena, da PT doseže svoj potencial.

Kategorije, v katerih PT ponuja potencialne rešitve:

Stroški: Cena storitev, ki jih nudijo strokovnjaki za duševno zdravje (od psihoterapevtov do kliničnih psihologov in psihiatrov) se od države do države razlikujejo in so predvsem odvisni od državnih predpisov in subvencij. Neposredni stroški za bolnika so večinoma odvisni od števila strokovnjakov, ki so na voljo v določeni državi. Neodvisno od njihove višine pa stroški velikokrat ovirajo dostopnost do oskrbe ljudi iz nižjih socialno-ekonomskih okolij [23]. Dostop do PT za duševno zdravje je lahko brezplačen (in velikokrat je [11]) zaradi veliko nižjih stroškov, povezanih z izdelavo. K temu prispevajo trije glavni dejavniki: 1) razširljivost, kar pomeni, da lahko en sistem PT teoretično nudi pomoč neomejenemu številu ljudi (edini strošek, ki ga prinaša razširljivost, so stroški strežnika, ki so obrobni v primerjavi s človeškim delom) – nasprotno pa je en strokovnjak za duševno zdravje omejen na določeno število ljudi; 2) zmožnost, da učinkovit PT lahko ustvari veliko ljudi, predvsem zaradi obstoječih raziskav, ki temeljito poročajo o učinkovitih sistemih; in 3) količina ljudi, ki je sposobna proizvajati takšne sisteme, je veliko večja, kot je strokovnjakov, ki lahko ponudijo psihoterapevtsko in podobno pomoč.

Razpoložljivost: Problem razpoložljivosti lahko ločimo v tri podkategorije: 1) razpoložljivost na podlagi lokacije, 2) razpoložljivost na podlagi časa in 3) razpoložljivost na podlagi stroškov. Razpoložljivost na podlagi lokacije se nanaša na ljudi s težavami v duševnem zdravju na lokacijah, ki nimajo neposrednega dostopa do strokovnjakov za duševno zdravje (ali pa celo nimajo računalniškega dostopa do terapije na daljavo) [15]. Uporaba PT za duševno zdravje je ena redkih potencialnih rešitev v takih primerih. Razpoložljivost na podlagi časa se nanaša na ljudi z duševnimi težavami, ki potrebujejo terapevtsko pomoč v času, ko njihov izbrani strokovnjak ni na voljo. PT za duševno zdravje je na voljo 24 ur na dan, zato se njihova uporaba dopolnjuje z izbranim strokovnjakom za duševno zdravje. Bolniki nenehno poročajo o teh potrebah in take dopolnilne uporabe že obstajajo [29]. Razpoložljivost, ki temelji na stroških, se nanaša na ljudi z duševnimi težavami, ki potrebujejo terapevtsko pomoč, vendar nimajo sredstev za dostop, ki bi bil obsežnejši od najmanjše priporočene količine ur na teden [13] – ta se ocenjuje na eno uro na teden. Raziskave [13, 32] kažejo, da pogostejše terapije prinašajo boljše rezultate, dopolnilna uporaba PT za duševno zdravje pa lahko premosti to vrzel pri ljudeh, ki si ne morejo privoščiti več terapije. Razpoložljivost na podlagi stroškov je hkrati tesno povezana s širšim problemom stroškov, omenjenim v prejšnji kategoriji.

Stigma: Samostigma, predsodki, ki jih ljudje z duševnimi težavami imajo o sebi zaradi svojih težav, in javna stigma, odziv splošne populacije na ljudi z duševnimi boleznimi, predstavljata eno poglavitnih težav v boju proti duševnim težavam [7]. Težava je dvojna: zaradi javne stigme se posamezniki bojijo, kaj si bo družba mislila o njih, če bodo iskali zdravljenje, medtem ko se zaradi samostigme bojijo interakcije s strokovnjakom in dvomov, da si njihove težave pomoč sploh zaslužijo. Ta dvojnost prispeva k temu, da se posamezniki z duševnimi težavami odločijo, da se ne bodo zdravili pri strokovnjakih za duševno zdravje. Do 96% ljudi s SAD ne išče zdravljenja [35]. Raziskave o PT za duševno zdravje, zlasti o IKA za zdravljenje SAD, so pokazale, da ljudje v splošnem lažje zaupajo svoje težave računalniškemu ali mobilnemu sistemu kot osebi [22]. To je zato,

ker se ne bojijo, da bi jih obsojali, pridobijo pa zasebnost za razkrivanje svojih občutkov in misli na splošno. To pomeni, da se lahko število ljudi, ki se izogibajo stikom s strokovnjaki, zmanjša z uvedbo terapevtskih možnosti, za katere bolniki menijo, da so zanje varnejše in brez stigme.

Vendar pa takšna tehnologija potencialno prinaša tudi težave, ki jih je potrebno izpostaviti in resno obravnavati, da bi PT dosegel potencial, ki ga ima na področju duševnega zdravja:

Izključitev ranljivih skupin: Tehnološko usmerjene rešitve oskrbe duševnega zdravlja lahko vodijo v izključevanje nekaterih ranljivih skupin. Mednje spadajo starostniki, najnižji socialno-ekonomski razred in kulturno specifične skupine. Zdi se, da je skupina, ki jo je uvedba tehnologije najbolj prizadela, skupina starostnikov [1]. Njihova nižja sposobnost vključevanja tehnologije v vsakdanje življenje lahko vodi v globlje razlike med njimi in drugimi generacijskimi skupinami. Druga skupina ljudi, ki je lahko izključena iz koristi PT za duševno zdravje, so ljudje iz najnižjega socialno-ekonomskega razreda, kjer jim PT morda sploh ne bo na voljo [28]. Poglabljanje že tako velikih razlik bi skupini povzročilo še bolj katastrofalne socialno-ekonomske življenjske razmere. Skupine, ki jih posvojitev tehnologije prizadene zaradi kulturnih razlik, so ključnega pomena pri razmisleku o napredku enakosti. Raziskave kažejo, da kulture z manj sodobnimi družbenopolitičnimi nagnjenji kažejo manjšo tendenco po posvajanju tehnologije [19]. Vseeno se zdi, da se večja prisotnost področja raziskovanja PT pojavlja tudi v nekaterih državah z nizkimi dohodki [40].

Pristranost v raziskovanju: Zaradi pomanjkanja standardov evalvacije PT za duševno zdravje je raziskovalno področje bolj dovzetno za pristranost v raziskovanju. Možnih težav je veliko: 1) sistemov PT, za katere se trdi, da so uspešni, ne preučujejo vedno v empiričnih poskusih (npr. randomizirana kontrolirana raziskava), temveč v kvazi eksperimentih [43] ali sploh ne; 2) metrika, na podlagi katere bi lahko ocenili takšne sisteme, ni jasna (običajno izhaja posredno iz njihove učinkovitosti v raziskavi, kjer je cilj lajšanje simptomov SAD [37]); 3) ni soglasja o tem, kateri podatki so potrebni, da sistem razume uporabnika in mu s tem nudi učinkovito pomoč, s čimer je izbira vrste podatkov zaenkrat večkrat odvisna od predpostavk raziskovalcev kot pa od obstoječih spoznanj.

Uporaba PT za duševno zdravje ima tudi težave, ki se ne nanašajo samo na doseganje enakosti in dostopnosti. Čeprav so izjemno pomembni, je njihova poglobljena analiza izven okvirjev tega dela. Vseeno jih nekaj omenimo: 1.) problem varstva osebnih podatkov [3]; 2) problem pomanjkanja longitudinalnih raziskav o spremembah vedenja s PT [20]; 3) etičnost uporabe osebnih podatkov za prepričevanje [17]; in 4) potencialni problem avtomatizacije in izgube zaposlitve strokovnjakov za duševno zdravje. Zagotovo obstajajo tudi druge težave in pomisleki, vendar smo želeli, da je ta seznam kratek in da z njim pokažemo, da obstajajo tudi druge težave s PT in da se jih zavedamo.

4 ZAKLJUČEK IN PRIHODNJE DELO

Pričujoče delo raziskuje, kako lahko prepričljiva tehnologija, ki poskuša brez prisile vplivati na vedenje ljudi, poveča enakost in dostopnost oskrbe duševnega zdravja, s čimer bi okrepila enakost

na splošno. Delo, ki se nadalje osredotoča na stres, anksioznost in depresijo, preučuje, zakaj je duševno zdravje precejšnja ovira za enakost in zakaj imajo ljudje z duševnimi težavami ovire pri dostopu do zdravstvene oskrbe. Nato poda svoje argumente za uporabo prepričljive tehnologije v tej domeni. Sledi predstavitev prepričljive tehnologije v njeni multi- in interdisciplinarni sestavi vedenjskih znanosti in računalništva ter umetne inteligence. Predstavljeni so primeri implementacije prepričljive tehnologije za duševno zdravje v inteligentnih kognitivnih asistentih, vključno z njihovo učinkovitostjo za lajšanje simptomov stresa, tesnobe in depresije. Delo nazadnje raziskuje potencialne rešitve, ki jih taka tehnologija ponuja na področju duševnega zdravja, in morebitne težave, ki bi jih lahko ustvarila. Prihodnje delo vključuje nadaljnje raziskovanje problemov in rešitev, poglobitev v tehnično zasnovo tovrstnih tehnologij, še posebej tistih, ki uporabljajo umetno inteligenco, ter ponujanje novih konceptualnih in tehničnih smernic za PT za duševno zdravje pri zmanjševanju neenakosti oskrbe duševnega zdravja in neenakosti na splošno.

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Analiza glasu kot diagnostična metoda za odkrivanje Parkinsonove bolezni

Speech Anlysis as a Diagnostic Method for the Detection of Parkinson's Disease

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POVZETEK

Parkinsonova bolezen je nevrodegenerativna bolezen, ki povzroča težave v delovanju mišic zaradi pomanjkanja dopamina v možganskem deblu, poleg tega vpliva tudi na glas. Slednji postane bolj monoton, hripav in šibek. Zaradi naštetih sprememb se za diagnosticiranje Parkinsonove bolezni vse pogosteje uporablja analiza glasu z metodami umetne inteligence. V tej raziskavi smo s pomočjo metod strojnega učenja primerjali zvočne posnetke glasu zdravih oseb in bolnikov s Parkinsonovo boleznijo. Za izboljšavo klasifikacijske točnosti smo dodatno uporabili pristop zmanjševanja razsežnosti. Najbolj točen klasifikator smo zgradili z uporabo metode naključnih gozdov, s katerim smo dosegli 73 % točnost. Dobljeni rezultati nakazuje na povezavo med Parkinsonovo boleznijo in karakteristično spremembo glasu. Ocenili smo pomembnost posameznih zvočnih posnetkov in pripadajočih atributov. Izsledke raziskave lahko uporabimo za nadgradnjo obstoječe metodologije s predlogi za dodatne posnetke, ki vsebujejo več informacij o prisotnosti Parkinsonove bolezni.

KLJUČNE BESEDE

Parkinsonova bolezen, analiza glasu, strojno učenje, naključni gozdovi, pomembnost atributov

ABSTRACT

Parkinson's disease is a neurodegenerative disorder that causes impaired muscle function because of a lack of dopamine in the brain stem. Parkinson's disease also affects speech ability. The voice becomes monotone, hoarse and feeble. For this reason, one of the emerging ways to diagnose Parkinson's disease is speech analysis using artificial intelligence. In this paper, we use machine learning to connect voice samples to the presence of Parkinson's disease. To improve the classification accuracy, we additionally use a dimensionality reduction approach. The most accurate classifier was built with random forest, with an accuracy of 73 %. The experimental results indicate the correlation between the voice changes and the presence of Parkinson's disease. Additionally, we estimate the importance of individual voice samples and corresponding features. The results can be used to improve the current methodology by proposing additional voice samples, that contain more information on the presence of Parkinson's disease.

KEYWORDS

Parkinson's disease, speech analysis, machine learning, random forest, feature importance

1 UVOD

Parkinsonova bolezen je nevrodegenerativno in izčrpavajoče bolezensko stanje, ki vpliva na osrednje živčevje. Bolezen prizadene približno 1 % ljudi, starejših od 60 let. Bolnik s Parkinsonovo boleznijo se pogosto trese, ima težave s hojo in ravnotežjem, njegovo gibanje postane počasno, pojavi se rigidnost. Pojavijo se lahko tudi duševne motnje, kot so anksioznost, depresija ter težave s spanjem, razmišljanjem in obnašanjem.

Parkinsonova bolezen vpliva tudi na glas. Večina bolnikov ima govorne težave, kot so šibek, zadihan, hripav, višji in monoton glas. Za bolnika so značilne hripavost, zmanjšana jakost glasu, težava s pravilno artikulacijo fonemov in brbljanje [5].

Diagnostične metode, ki bi stoodstotno dokazala prisotnost Parkinsonove bolezni, še ne poznamo. Diagnoza temelji na vidnih in razpoznavnih simptomih, preteklem zdravstvenem stanju, fizičnem ter nevrološkem pregledu in bolnikovi anamnezi [13]. Po kriterijih mora biti za dokaz Parkinsonove bolezni prisotna akineza ter še vsaj ena druga lastnost (npr. tremor rok pri mirovanju, rigidnost ali posturalne motnje). Po teh kriterijih se Parkinsonovo bolezen lahko identificira z 90 % točnostjo, vendar diagnoza lahko traja več let [12]. Pri diagnosticiranju se uporablja tudi slikanje možganov z magnetno resonanco, pozitronsko emisijsko tomografijo in računalniško tomografijo. Vse naštete diagnostične metode so drage ter zahtevne, zato se išče cenejše in preprostejše metode [13].

V diagnostične namene se vse pogosteje uporablja analiza zvočnih posnetkov glasu z uporabo metod umetne inteligence (npr. strojno učenje, procesiranje signalov itd.). Tovrsten način diagnostike je povsem varen, preprost, hiter in ne zahteva dragocenih namenskih naprav [8], vendar je to področje v primeru Parkinsonove bolezni še v razvoju. Večina raziskovalcev se namreč ukvarja le z doseganjem čim večje klasifikacijske točnosti [1, 7, 10, 11], pri tem pa zanemarjajo pomemben vidik analize, in sicer da bi skušali identificirati pomembne posnetke in pripadajoče glasovne atribute. Taka dognanja bi pripomogla k boljšemu razumevanju problematike in omogočila oblikovanje natančnejših testov.

V tem prispevku poročamo o testiranju uporabnost analize glasu z metodami strojnega učenja za diagnosticiranje Parkinsonove bolezni. Opravljena študija temelji na zvočnih posnetkih 40 oseb (20 bolnikov s Parkinsonovo boleznijo) pridobljenih v raziskavi [10]. Na teh podatkih smo testirali pet različnih algoritmov strojnega učenja. Za izboljšanje rezultatov smo dodatno uporabili metodo za zmanjšanje razsežnosti in izboljšamo klasifikacijsko točnost za približno 5 %.

V nasprotju z večino sorodnega dela smo ocenili tudi pomembnost posameznih posnetkov in pripadajočih atributov. V ta namen smo uporabili metodo naključnih gozdov, saj ta dosega najvišjo točnost. Na ta način lahko ugotovimo, kateri atributi in posnetki vsebujejo več informacij o prisotnosti Parkinsonove bolezni.

Prispevek je organiziran na sledeči način. V drugem poglavju predstavimo podatke, v tretjem poglavju opišemo metodologijo. V četrtem in petem poglavju predstavimo rezultate in pridobljena dognanja. V zadnjem poglavju naredimo zaključek in orišemo nadaljnje delo.

2 PODATKI

Podatki so bili zbrani na Istanbulski fakulteti za medicino (Istanbul Faculty of Medicine, Istanbul University) leta 2014 [10]. Zbrali so zvočne posnetke 40 ljudi, 6 žensk ter 14 moških s Parkinsonovo boleznijo in 10 zdravih žensk ter 10 zdravih moških. Vsaka oseba je posnela 26 posnetkov, ki vključujejo samoglasnike, kratke stavke in besede. Natančneje, posnetki 1–3 predstavljajo trajajoče samoglasnike "a", "o" in "u", posnetki 4–13 predstavljajo števila od 1 do 10, posnetki 14–17 predstavljajo krajše stavke in posnetki 18–26 predstavljajo besede. Vsi posnetki so v turščini, posneti so bili z mikrofonom Trust MC-1500[1].

Vsaki osebi pripada 26 zvočnih posnetkov in vsakemu posnetku 26 linearnih ter frekvenčnih atributov, zgrajenih z uporabo programske opreme za akustično analizo Praat [2]. Vsi atributi so numerični in se jih običajno izračuna za analizo glasu [2, 10]. Povzeti so v Tabeli 1. Skupno je v množici podatkov 676 atributov in ciljni razred. Slednji je binaren in predstavlja prisotnost (pozitiven = 1) oziroma odsotnost (negativen = 0) Parkinsonove bolezni. Imena nekaterih atributov uporabljamo v angleščini, saj pripadajoči slovenski izrazi ne obstajajo.

3 METODOLOGIJA

Klasifikatorje smo gradili s petimi algoritmi za strojno učenje: odločitveno drevo (C4.5), naivni Bayes (NB), metoda najbližjih sosedov (kNN), metoda podpornih vektorjev (SVM) ter metoda naključnih gozdov (RF). Za vse navedene algoritme smo uporabili privzete vrednosti parametrov, saj uglaševanje ni signifikantno izboljšalo klasifikacijske točnosti.

Število atributov močno presega število primerkov, zato smo se odločili za uporabo metode zmanjševanja razsežnosti in s tem uspešno izboljšali klasifikacijsko točnost za 5 %. Za izbor atributov smo uporabili široko poznano metodo, imenovano rekurzivna odstranitev atributov (ang. recursive feature elimination, RFE) [4], ki temelji na vzvratni odstranitvi nepomembnih atributov. Metoda RFE spada med metode po principu ovojnice (ang. wrapper) in smo jo uporabili v kombinaciji z zgoraj naštetimi algoritmi za strojno učenje. Končno število atributov, ki v RFE nastopa kot parameter, smo ocenili z 10-kratnim prečnim preverjanjem.

Za strojno učenje smo uporabili knjižnico caret [6], implementirano v programskem jeziku R [9].

4 REZULTATI

Za evalvacijo in izbor najboljšega algoritma smo uporabili pristop po metodi "izpusti enega" (ang. leave one subject out, LOSO). Najprej smo na učni množici z 10-kratnim prečnim preverjanjem ocenili končno število atributov, ki nastopa kot parameter metode RFE. Nato smo z uglašeno metodo RFE izbrali najboljše atribute in pripadajoči klasifikator. S slednjim smo klasificirali izpuščen primerek in opisan postopek ponovili za vse primerke.

[1]https://www.trust.com/en/product/14896-design-microphone-mc-1500

Tabela 1: Glasovni atributi, uporabljeni za strojno učenje: frekvenčni, pulzni, amplitudni, glasovni ter harmonični.

Skupina	Atribut
Frekvenčni	Jitter (local)
	Jitter (local, absolute)
	Jitter (rap)
	Jitter (ppq5)
	Jitter (ddp)
Pulzni	Število glasovnih pulzov
	Število nihalnih dob
	Povprečna perioda
	Standardna deviacija period
Amplitudni	Shimmer (local)
	Shimmer (local, dB)
	Shimmer (apq3)
	Shimmer (apq5)
	Shimmer (apq11)
	Shimmer (dda)
Glasovni	Delež nezvenečih časovnih oken
	Število lomljenj glasu
	Delež lomljenj glasu
Harmonični	Srednja vrednost višine glasu
	Povprečna višina glasu
	Standardna deviacija višine glasu
	Najvišja višina tona
	Najnižja višina tona
	Avtokorelacija tona
	Razmerje šum-harmonik
	Razmerje harmonik-šum

Tabela 2: Rezultati klasifikatorjev v obliki točnosti, senzitivnosti in specifičnosti. Najvišja vrednost posamezne metrike je odebeljena.

Algoritem	Točnost	Senzitivnost	Specifičnost
C4.5	0,63	0,65	0,60
NB	0,63	**0,80**	0,45
kNN	0,48	0,55	0,40
SVM	0,68	0,70	0,65
RF	**0,73**	0,75	**0,70**

Tabela 3: Matrika zamenjav za klasifikator, zgrajen z metodo RF.

Napoved / Pravi	Negativen (0)	Pozitiven (1)
Negativen (0)	14	5
Pozitiven (1)	6	15

V Tabeli 2 so prikazani rezultati v obliki povprečne točnosti, povprečne senzitivnosti in povprečne specifičnosti. Vidimo, da je najbolj točen klasifikator, zgrajen z metodo RF, najmanj točen pa z metodo kNN. Najvišjo senzitivnost je dosegel klasifikator, zgrajen z metodo NB, specifičnost pa klasifikator, zgrajen z metodo RF. V Tabeli 3 so prikazani rezultati za klasifikator, zgrajen z metodo RF v obliki matrike zamenjav. Klasifikator je pravilno klasificiral 29 primerkov, zmotil pa se je v 11 primerih.

Zanimala nas je pomembnost posameznih posnetkov in pripadajočih atributov. V ta namen smo postopek izbora atributov ponovili za RF, a tokrat na celotnih podatkih brez izpusta primerkov. Pomembnost izbranih posnetkov in atributov smo izračunali s postopkom, imenovanim permutacijska pomembnost (ang. *permutation importance*), ki ga lahko neposredno vključimo v metodo RF [3]. Za vsako drevo posebej izračunamo točnost na izpuščenih primerkih (naključno izpuščenih za gradnjo drevesa). Nato ponovimo izračun točnosti po permutaciji določenega atributa. Pomembnost tega atributa je povprečje razlik v točnosti pred in po njegovi permutaciji. Pri tem poudarimo, da pri metodi RF ni težav s koreliranimi atributi, saj postopek uporabimo na posameznem drevesu, ki je po načinu izgradnje nekoreliran.

Na ta način izberemo 27 izmed 676 atributov. Med njimi se najpogosteje pojavljajo frekvenčni atributi (Slika 1), medtem ko so ostale skupine atributov podobno zastopane. Med posnetki se najpogosteje pojavljajo števila, nato kratki stavki. Najslabše zastopani so trajajoči samoglasniki (Slika 2).

Slika 3 in Slika 4 predstavljata zaporedoma pomembnost izbranih atributov (agregirano čez posnetke) in pomembnost posnetkov (agregirano čez atribute) za metodo RF. Atributi in posnetki so razvrščeni od manj pomembnih do bolj pomembnih. Iz rezultatov je razvidno, da so za metodo RF najpomembnejši frekvenčni atributi. Najmanj pomembni pa so harmonični atributi in atributi, izpeljani iz tona glasu. Najpomembnejši posnetek je število "4". Opazimo, da števila in kratki stavki vsebujejo več informacij od ostalih posnetkov.
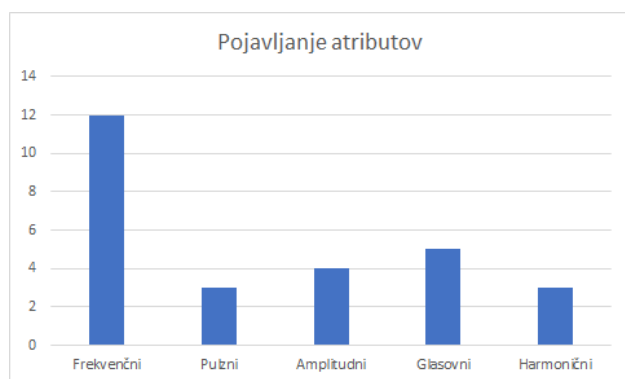
Slika 1: Število izbranih atributov za posamezne skupine po uporabi metode RFE v kombinaciji z metodo RF.

Slika 2: Število izbranih posnetkov za posamezne skupine po uporabi metodo RFE v kombinaciji z metodo RF.

5 DISKUSIJA

Podobno kot sorodne raziskave [1, 7, 10, 11] tudi naši rezultati nakazujejo na povezavo med glasovnimi atributi in prisotnostjo Parkinsonove bolezni. Najbolj točen klasifikator zgradimo z uporabo metode RF, s katerim dosežemo 73 % točnost. Za primerjavo nekatera sorodna dela poročajo o točnosti okoli 80 %.

Pri tem so najpomembnejši in pogosti frekvenčni atributi (Slika 1 in Slika 3). Sklepamo, da zaradi karakteristične deviacije frekvence glasu pri Parkinsonovi bolezni. Med posnetki izstopajo števila in kratki stavki (Slika 2 in Slika 4). O prisotnosti bolezni nam več povedo zahtevni ter daljši posnetki.

Kljub temu je tak način diagnoze nezadosten. Najbolj točna metoda zgreši 25 % bolnikov, kar je za medicinsko prakso nesprejemljivo [13]. Pri tem moramo poudariti, da smo imeli opravka z omejenim številom primerkov (posnetih je bilo le 40 oseb). V primeru, da bi zbrali več zvočnih posnetkov obolelih in zdravih oseb, bi lahko klasifikator izboljšali z uporabo naprednejših metod strojnega učenja, ki jih na tako malem številu primerkov ni bilo moč uporabiti.

Morda ne bo nikoli moč stoodstotno določiti prisotnost Parkinsonove bolezni iz analize glasu z uporabo metod strojnega učenja, vendar bi tovrstne metode lahko uporabili bodisi komplementarno za nadgradnjo obstoječih metod bodisi kot presejalni test. Pri tem poudarimo, da je analiza glasu poceni in za bolnika povsem nemoteča ter varna preiskava.

6 ZAKLJUČEK

V prispevku smo z metodami strojnega učenja primerjali zvočne posnetke zdravih oseb in bolnikov s Parkinsonovo boleznijo. Namen študije je bil preveriti, ali lahko iz analize glasu sklepamo o prisotnosti Parkinsonove bolezni in ali je možno zgraditi klasifikator za uporabo v praksi. Dodatno smo tudi ocenili pomembnost posameznih posnetkov in pripadajočih glasovnih atributov.

Rezultati nakazujejo, da pri bolnikih s Parkinsonovo boleznijo pride do poslabšanja zvočne artikulacije, saj smo s klasifikatorjem, zgrajenim z metodo naključnih gozdov, uspešno zaznali 73 % bolnikov. Ne glede na to klasifikator še ni primeren za uporabo v praksi, saj je njegova točnost prenizka. Sedanji klasifikator lahko uporabimo kot komplementarni test že obstoječim. Za najpomembnejše zvočne posnetke se izkažejo števila in kratki stavki. Pri tem so najmanj pomembni trajajoči samoglasniki in besede. Med atributi izstopajo frekvenčni in amplitudni.

Trenutno raziskujemo možnost, da bi zbrali več sorodnih zvočnih posnetkov. Na ta način bi lahko uporabili kompleksnejše metode, ki omogočajo odkrivanje zagonetnih zakonitosti, ki jih na tako majhnem naboru primerkov ni bilo mogoče odkriti.

Naš dolgoročni cilj je izgradnja klasifikatorja, ki bi uspešno identificiral večino bolnikov tudi za ceno nekoliko nižje točnosti (nekatere zdrave osebe bi klasificiral za bolne). Klasifikator bi lahko uporabili kot presejalni test in na ta način olajšali sedanjo diagnostiko Parkinsonove bolezni. Poskusili bomo tudi razbrati, zakaj so ravno posnetki števill vsebovali več informacij o prisotnosti Parkinsonove bolezni, in z dobljenim znanjem skušali predlagati celovitejši nabor izrazov, besed in fonemov.
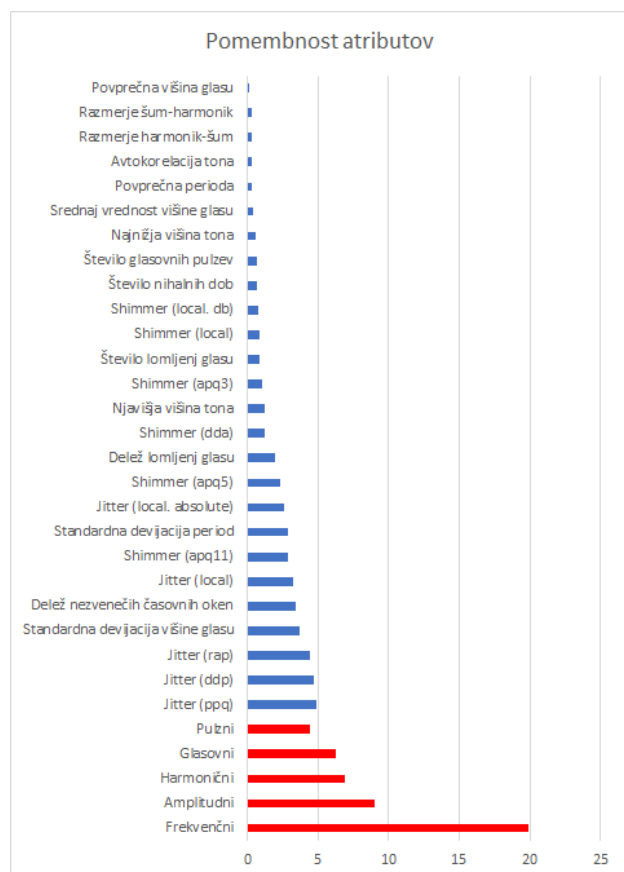
Slika 3: Pomembnost izbranih atributov za klasifikator, zgrajen z metodo RF. Pomembnost posamezne skupine je agregirana pomembnost pripadajočih atributov.
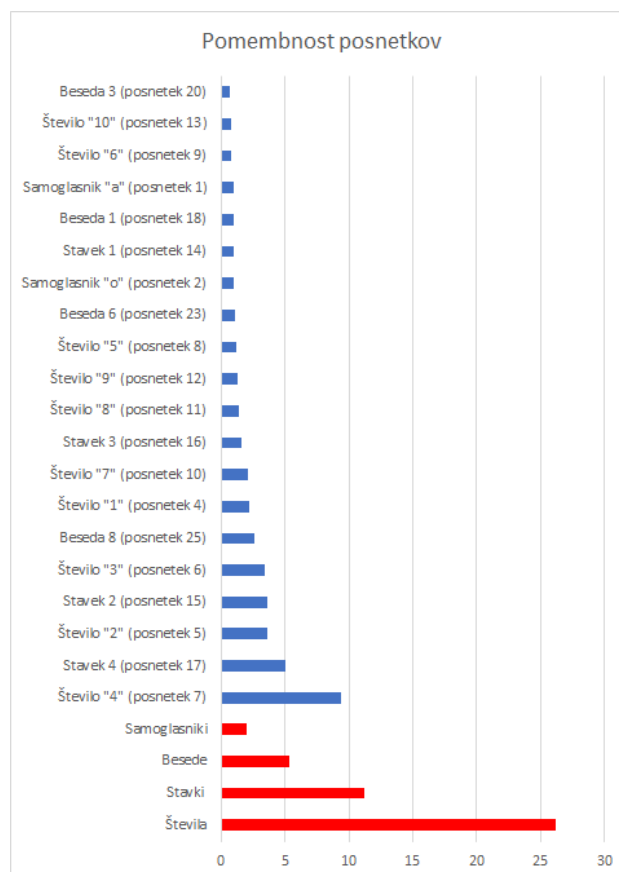
Slika 4: Pomembnost izbranih posnetkov za klasifikator, zgrajen z metodo RF. Pomembnost posamezne skupine je agregirana pomembnost pripadajočih posnetkov.

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STRAW Application for Collecting Context Data and Ecological Momentary Assessment

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ABSTRACT

To study stress at the workplace and relate it to user context and self-reports, we developed an application based on the AWARE framework, a mobile instrumentation toolkit. The application serves two purposes: of passively collecting data about user's environment and offering questionnaires as means of ecological momentary assessment. We implemented methods to import the questionnaires into the phone's database and trigger them at the right times. We also considered privacy implications of collecting such data and took additional measures to conceal the identity of our study's participants wherever we evaluated it was under the risk of exposure. Finally, we had to establish a server application to handle receiving and storage of collected data and implemented a rudimentary login process to additionally secure our servers.

KEYWORDS

context detection, application development, privacy, ecological momentary assessment

1 APPLICATION OVERVIEW

The best machine learning models for stress detection and affect recognition are multimodal [1, 17]. Combining data from different modalities is especially effective, such as using physiological, behavioural or contextual, and psychological (self-reported) data. Collecting such data in the real-world setting presents a challenge, however.

In the project called *Stress at work* (STRAW), the main objective is to analyse the relationship between psychosocial stress experiences in the workplace, work activities and events, and peripheral physiology. To facilitate integration of various data sources, an application was designed to run continuously and monitor their environment and specific phone-related events.

The application's purpose is two-fold. The primary mode of operation is silent and continuous: the user context (such as their

phone use and location) is monitored without user intervention or interaction. The second mode of operation are prompts or questions for the user, where some information about the context and the participant's mental state is gathered by asking for it explicitly.

As a starting point for writing the STRAW application, we used AWARE, a mobile instrumentation toolkit which had the initial purpose of inferring users' context [5]. It enables logging of data as reported by the phone's operating system and a wide variety of hardware sensors. At several points, this toolkit was adapted to better suit our needs, and additional capabilities were added on top of it.

We also developed two modular functionalities of the application: Bluetooth integration with an Empatica E4 wristband [23] to enable simultaneous collection of physiological data and voice detection and speaker diarization capabilities [15]. We already reported on these developments elsewhere, whereas in this paper, we give an overview of the app's capabilities.

1.1 Data Types

An important aspect of the STRAW application are prompts, called EMAs. The users can be prompted to make a diary entry at a specific time which is called Experience Sampling Method [ESM; 3] or, more broadly (when data other than experience are noted), Ecological Momentary Assessment [EMA; 20]. Diary methods increase the reliability of collected self-reports as they are less prone to recall bias [14].

EMAs are the main mode of user interaction in the STRAW application. The content of specific questions is beyond the scope of this paper, but in general, the questions are based on existing psychological questionnaires measuring stressors, stress, and related responses. The implementation of EMAs is described in Section 2.

In addition to this, we selected a subset of data that might help us determine users' context. Below is a list of sensors that are used in the STRAW application together with the description of data they collect. Data availability from some of these sensors is dependent on phone's hardware and the version of operating system.

– **Acceleration:** There are several sources (i.e. virtual sensors) of acceleration data in a smartphone. Accelerometers measure acceleration magnitude in various directions and report either linear acceleration (without gravity effects), gravity, or combined acceleration. This is used further in Google's activity recognition API [10].
– **Barometer:** Ambient air pressure.
– **Light:** Luminance of the ambient light captured by the light sensor.
– **Temperature:** Temperature of the phone's hardware sensor.
– **Bluetooth:** This sensor logs surrounding Bluetooth-enabled and visible devices, specifically their hashed MAC addresses, and received signal strength indicator (RSSI) in decibels.
– **Location:** Device's current location (latitude, longitude, and altitude, which are masked as described in Section 3) and its velocity (speed and bearing). This uses various methods, such as GPS and known Wi-Fis in vicinity resulting in different degrees of accuracy. Location category is also acquired with Foursquare API.
– **Network:** Network availability (e.g. none or aeroplane mode, Wi-Fi, Bluetooth, GPS, mobile) and traffic data (received and sent packets and bytes over either Wi-Fi or mobile data).
– **Proximity:** Uses the sensor by the device's display to detect nearby objects. It can either be a binary indicator of an object's presence or the distance to the object.
– **Timezone:** Device's current time zone.
– **Wi-Fi:** Logs of surrounding Wi-Fi access points, specifically their hashed MAC addresses, received signal strength indicator (RSSI) in decibels, security protocols, and band frequency. The information on the currently connected access point is also included.
– **Applications:** This includes the category of the application currently in use (i.e. running in the foreground) and data related to notifications that any application sends. Notification header text (but not content), the category of the application that triggered the notification and delivery modes (such as sound, vibration and LED light) are logged.
– **Battery:** Battery information, such as current battery percentage level, voltage, and temperature, and its health, as well as power-related events, such as charging and discharging times are monitored.
– **Communication:** Information about calls and messages sent or received by the user. This includes the call or message type (i.e. incoming, outgoing, or missed), length of the call session, and trace, a SHA-1 encrypted phone number that was contacted. The phone numbers themselves or the contents of messages and calls are not logged.
– **Processor:** Processor load in CPU ticks and the percentage of load dedicated to user and system processes or idle load.
– **Screen:** Screen status: turned on or off and locked or unlocked.
– **Voice activity:** A classifier, trained using Weka [7]. The features are calculated using openSMILE [4] and the output is an indicator of human voice activity [15].

The data described in the list above are collected automatically and continuously. The application is run as a foreground service, which means that the data collection continues even while the application is not actively used (i.e. it is minimized). Despite this, there exists software that is specific to the operating system

version and phone manufacturer which tries to close applications for energy efficiency. We attempted to whitelist this application in the most common battery-saving software.

2 ECOLOGICAL MOMENTARY ASSESSMENT

As mentioned, one of the main functions of the STRAW application is to collect users' answers to questionnaires. AWARE already implements a 'sensor' for experience sampling method, which shows `DialogFragments` as the one in Figure 1, but it was too rudimentary for our study protocol. The main upgrades we had to make were the mechanism of triggering EMAs and management of the database of available questions (items) to include in the questionnaires.
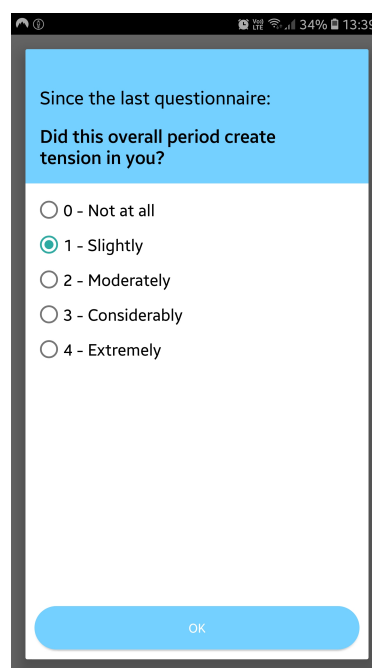
Figure 1: An example of an ecological momentary assessment prompt.

2.1 EMA Triggering

Originally, AWARE provides a couple of ways to trigger EMAs: at a specific time, by a certain context (i.e. taking into account values from other sensors) or on demand (manually). In our study, time is the most important trigger of EMAs, but we needed finer control.

The EMAs in our studies are divided into three types: a) morning EMAs with questions about sleep quality, b) work-hour EMAs with questions about momentary affect, job characteristics, work activities, and similar, and c) evening EMAs with questions about the whole workday and after-work activities. The first EMA is triggered in the first hour after the start of the workday as set by the user. The rest of the EMAs during work hours trigger approximately every 90 minutes, but not closer than 30 min apart. The time is dependent on the last answered EMA rather than set in advance, and additional reminders are scheduled in the case of user inactivity. The final EMA of the day is triggered in the evening at a time set by the user.

Each of these types of EMA is implemented as a separate `IntentService` [11] and handled by a `JobScheduler` [18]. This enabled us to enforce the requirements outlined above such as setting the minimum latency with which the job can start and making use of periodic jobs.

2.2 Question Database

In the original AWARE implementation, questions are queued into a questionnaire directly in the code of the application by using their custom `ESMFactory` class. For our study, we use a pool of more than 200 questions per language from which a subset is sampled for every EMA. We therefore needed a more systematic way of storing them within the application.

To ease the insertion of individual items, we prepared a spreadsheet template which is meant to be human-readable and filled out manually. Individual items from this spreadsheet are later converted into JavaScript Object Notation (JSON) and stored in an SQLite database [13] in phone's internal storage. This implementation enabled us to adapt the content of EMAs without touching the source code of the application. It also simplified the final selection of questions, such as selecting one language (English, Dutch, or Slovenian) and grammatical gender.

3 PRIVACY ENHANCEMENTS

The data collected by the STRAW application have different degrees of risk to the users' privacy. Their privacy would be threatened if an outsider gained unauthorized access to the data. These possible external threats are considered in Section 5.

Even when the data are safely communicated and stored, however, an involuntary exposure of users' identity might still be possible. Assuming the data are well protected from unauthorized external access, these risks will in turn be treated as internal in this section.

Some of the data collected by the STRAW application are personal data, so even when storing them securely and after pseudonymization, some risk of a privacy breach remains. Since AWARE is widely used in scientific studies it already implements some privacy enhancing mechanisms. We performed a thorough application vulnerability analysis and identified several further threats to privacy that we wished to address. While the data are safely communicated and stored, an involuntary exposure of users' identity might still be possible. The types of data that deserve special attention are applications, communication, location, and voice activity.

As mentioned in Section 1, the notifications that other applications send are monitored in the STRAW application. The content of the notification, such as that of an instant messaging application or calendar notification, is never actually stored. We deemed even the application names to be sensitive, so we chose to only save application categories. This process is further described in Section 4.

The content of calls or messages is never logged, but the phone numbers tied to them can be. Since we wanted to keep track of recurring contact with the same person, but not reveal their real phone number, we decided to encrypt them using the SHA-1 algorithm. While it would be possible to decrypt a phone number by a brute-force attack, the AWARE implementation offers the option of adding a salt. Thus by using the username (further described in Section 5) as a salt, the phone numbers are sufficiently protected from inadvertent disclosure risk, while the hashed value is retained even across different application installations.

The MAC addresses of detected WiFi and Bluetooth devices are hashed in the same way.

The location data in their raw form are highly revealing of a user's identity [2]. Instead of storing the actual geographic coordinates provided by this sensor, the Foursquare Places API [6] is used to extract the category (venue) of a location. This API enables saving general categories such as 'bookstore' or 'gas station' near the user's location. But since we wanted to keep the option to analyse users' movements, we also implemented a transformation of coordinates. We converted longitude and latitude into spherical coordinates, applied a stochastic rotation (but constant within a specific user) and converted these back to transformed longitude and latitude. This enabled us to keep the distances between the locations faithful to original data, but transformed to another place on Earth.

As described in our previous work [15], voice activity recognition is performed on the phone in its entirety. This means that raw audio recordings can be discarded immediately after processing and only the calculated features are saved to the database. Alternatively, only the final binary prediction of human voice presence can be retained, but this makes any post-hoc analysis (such as speaker diarization) impossible.

4 SERVER APPLICATION

For the purpose of storing the data on a server, a Python application was implemented in Flask [21], which accepts the data in a JSON format and saves it in a PostgreSQL [22] database. In addition to receiving the data and managing credentials (as described in Section 5), it also performs a couple of additional functions.

As mentioned in Section 3, instead of saving application names we only log their category as classified in Google Play Store. To reduce the number of queries, we implemented this as a part of the server application. As part of the upload process, the application name is received in plain text, but only retained until query returns its category. After that, the application name is hashed to enable comparisons with later records and the name in plain text is discarded. In this way, we could build a database of application name hashes and their corresponding categories on the server, while not keeping a record of what applications individual users use.

The server application also provides a simple UI for administrators, where some metadata about the data collection itself are shown in forms of tables and charts. We can access data on last upload, number of days of participation, and number of data points for each individual user. This enables us to detect any problems with data collection and troubleshoot them early.

5 CLIENT-SERVER COMMUNICATION AND LOGIN

The STRAW application and other sensing applications are not special in the degree they could be subject to external attacks [2]. An attacker might want to expose identity of a user or try to reveal their personal data such as location. There are three points of entry for an external attacker: local storage, transmission of data, and the servers.

While the data reside on the device they are saved locally in the phone's storage. According to Android's documentation, this database is exclusive to the STRAW application [9]:

> Other applications cannot access files stored within internal storage. This makes internal storage a good

place for application data that other applications shouldn't access.

Additionally, once the data are transmitted to the server, the local database is periodically deleted. This reduces the privacy risk of the database being exposed, while also decreasing the local storage requirements.

It is therefore the transmission of data where we had to secure the data. They are transmitted over encrypted HTTPS connection, which eliminates the risk of exposure during this part of communication. The data are received by an application server residing at Jožef Stefan Institute (JSI), with a dedicated port listening for incoming transmissions.

The application server communicates with another, database server, also residing at JSI. This second server can only be accessed from within the JSI local area network. The database itself is also protected with a password and the user accessing it via the application server does not have administrator privileges.

Since the STRAW application is a part of a wider study, it is disseminated to recruited participants only. In addition to the data from this application, other data are collected, such as responses to questionnaires in baseline screening and physiological data from wristbands. It was therefore necessary that the data can be linked back to an individual in order to join the data from various sources. We developed a login method to enable this.

Using OkHttp [19] client-side and Flask-HTTPAuth [12] server-side, we implemented basic access authentication and token authentication [16]. The login credentials are disseminated to registered participants in our study and are input upon the installation of the STRAW application. This serves multiple purposes: by requiring login, we only accept data from actual participants of our study, while we can also use the assigned username to pseudoanonymously link data from various sources.

6 CONCLUSION

The application used in the STRAW project serves a dual purpose: to collect users' answers to questionnaires and passively collect data about their environment and phone usage. While the application was tailored to requirements of our study, this paper outlined the main issues and possible solutions when developing an application for research purposes.

The AWARE framework provided a solid foundation and especially eased sensor data collection, there are additional challenges that researchers need to face when trying to use an application like this in a scientific study. The data gathered using this application will help us develop improved models of stress recognition [8], which will help us integrate physiological data with more detailed contextual data and more reliable self-reports.

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URBANITE H2020 Project
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ABSTRACT

URBANITE (Supporting the decision-making in URBAN transformation with the use of dIsruptive TEchnologies) is a H2020 project with the goal to provide an ecosystem model that articulates the expectations, trust and attitude from civil servants, citizens and other stakeholders in the use of disruptive technologies. This model will be supported with the provision of a data management platform and algorithms for data – driven decision – making in the field of urban transformation. One of the main output of the project will be a Decision-Support System including (AI based) predictive algorithms and simulation models for mobility that support the decision–making process by analyzing the current situation, the trends that occurred in a certain time frame and allowing to predict future situations, when changing one or more variables. URBANITE will analyze the impact, trust and attitudes of civil servants, citizens and other stakeholders with respect to the integration of disruptive technologies such as Artificial Intelligence (AI), Decision Support Systems (DSS), big data analytics and predictive algorithms in a data–driven decision-making process. The results of the project will be validated in four real use cases: Amsterdam, Bilbao, Helsinki and Messina. This paper overviews the current state of the project's progress.

KEYWORDS

AI, Big Data, DSS, disruptive technologies, URBANITE project

1 INTRODUCTION

In recent times, the cities and urban environments are facing a revolution in urban mobility, bringing up unforeseen consequences that public administrations need to manage. It is in this new context that public administrations and policy makers need means to help them understand this new scenario, supporting them in making policy–related decisions and predicting eventualities. The traditional technological solutions are no longer valid for this situation and therefore, disruptive technologies such as big data analytics, predictive algorithms as well as decision support systems profiting from artificial intelligence techniques to support policy – makers come into place.

The main technical objective of the URBANITE project is the development of advanced AI algorithms for analysis of big data on mobility. The developed methods and tools will provide substantial support for policy-makers to tackle complex policy problems on the mobility domain and will enable their validation

on case-specific models. The goal of the activities will be to implement novel tools and services in order to enable policy-makers to use advanced data analysis and machine learning methods during the design of novel policies for a specific city

URBANITE will allow the analysis of the traffic flows that are currently happening and have happened up until that moment. In addition to the visualization of the traffic, usage of economy sharing vehicles and other aspects, URBANITE will analyse which are the bottlenecks and critical points, based on a set of parameters to be determined by the civil servants. Due to the fact that historic data is stored, trends can be determined by URBANITE by big data algorithms. These trend analyses can entail the understanding of, for instance, the use of a certain transportation system (e.g. bikes) in a certain neighbourhood of the municipality, or the peak hours in which a street is blocked. URBANITE will also provide means to simulate the effect of different situations such as opening a pedestrian street at certain times, location of electric charging stations, or bike sharing points through the implementation of artificial intelligence algorithms. To achieve that, URBANITE will build first generic models from the data across all the cities and then provide adaptation mechanisms to apply these models to the different use cases. From the data available, URBANITE will extract and formalize knowledge and then, through a combination of classification, regression, clustering, and frequent pattern mining algorithms, conclude into some decisions and actionable models that will enable city policy-makers to simulate and assess the outcomes and implications of new policies.

2 SYSTEM'S ARCHITECTURE

The URBANITE project will combine various data sources, algorithms, libraries and tools that provide the best solutions to the scope of the project. The technical "core" of the project has to fulfill the following objectives:

- Deploy tools for big data exploration with the active involvement of policy-makers.
- Design methods for the detection of important events that need to be addressed.

In order to provide the desired functionalities, several state-of-the-art technologies are currently examined and tested in order to be adapted, customized and integrated into the platform. A simplified preliminary architecture is presented in Figure 1.

2.1 Data Analysis Module

One of the first tasks involves the development of various methods for exploratory data analysis and user interaction. Multimodal methods, tools and services for big data on urban mobility will be implemented that will provide exploratory analysis capabilities and enable the policy-makers to actively search for causal relations in the data will be provided by the platform.
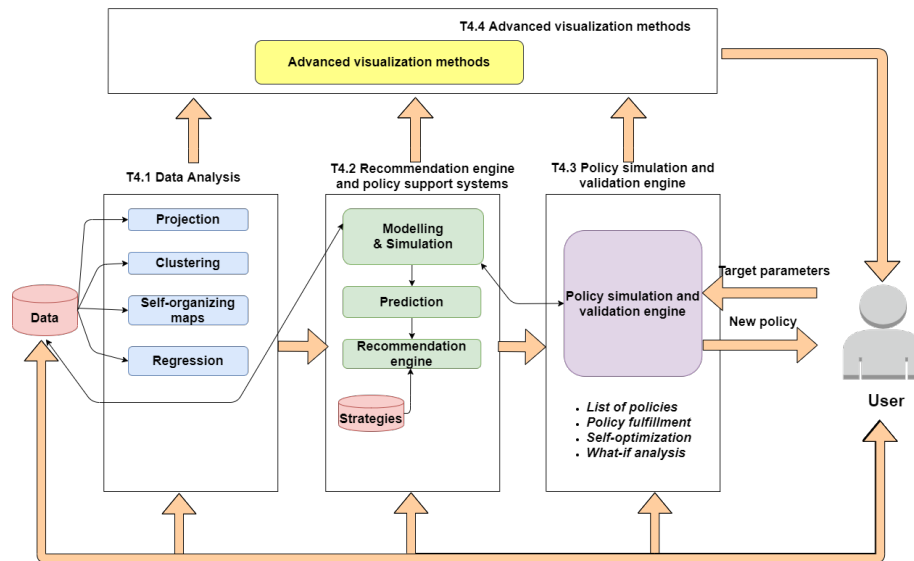
Figure 1: High Level Architecture of the URBANITE Platform.

The methods to be included in the platform can be segmented in four main groups:

- clustering, where the main goal is to reduce the amount of data by grouping together similar instances. The implemented method will provide mechanisms to group instances based on GIS data or any subset of attributes that users will define. For example, platform users might choose to cluster all instances based on the type of transportation used (shared bikes, electric cars, etc.)
- projection methods that will be used to reduce the dimensionality of the data items. The goal of these methods is to represent the data in a lower dimensional space in such a way that the key relations of the data structures are preserved. The results of the methods can be used to more clearly visualize the data or use the transformed data in the next rounds of analysis
- self-organizing map involves the use of a type of artificial neural network, trained in an unsupervised manner. The method can at the same time reduce the amount of data (similar to clustering) and nonlinearly projects the data into lower dimensionalities
- prediction/regression methods, or classification models, that will allow to exploit the data

2.2 Recommendation Engine

Recommendation engines (also known as recommender systems) are information filtering systems that deal with the problem of information overload [6] by filtering key information "chunks" out of large amount of dynamically generated information according to user's preferences, interest, or observed behavior about item [8][5]. Recommendation engines have the ability to predict whether a particular user would prefer an item or not based on the user's profile [5]. Recommendation engine is defined as a decision making strategy for users under complex information environments [4]. Recently, various approaches for building recommendation engines were developed, based on either collaborative filtering, content-based filtering or hybrid filtering [12], [11], [9].

The URBANITE recommendation engine will identify and predict important or problematic events related to mobility and will provide suggestions to tackle the issue. The policy support system will provide support to the policy-makers for identifying possible policies that tackle events based on specific criteria. The inputs will have to be aggregated for effective decision-making using hierarchical multi-criteria decision models.

2.3 Policy Simulation and Validation Engine

Simulation transparency is a vital feature of the decision making process when quantitative computer tools are used to justify some strategies [10]. Simulation predictions can play a catalytic role in the development of public policies, in the elaboration of safety procedures, and in establishing legal liability. Hence, given the impact that modelling and simulation predictions are known to have, the credibility of the computational results is of crucial importance to engineering designers and managers but also to public servants, and to all citizens affected by the decisions that are based on these predictions [10].

To create trust and increase the model's credibility and the simulation results delivered, it is crucial to deal with a validation strategy in which non-simulation-trained end-users could feel comfortable and trust the simulation model [10].

In the URBANITE project, the policy simulation and validation module will provide methods and tools to simulate the efficiency of specific policies in the target domain. Given a new policy, urban mobility model and the target parameters, the system can evaluate the performance of the new policy based on the observed parameters. The implementation of credible traffic simulations for the entire city has been addressed by various project; however, it is not yet adequately solved, due to its complexity. In URBANITE ,the constructed model will be used to predict and classify traffic flow changes based on the provided changes in the new policies. Policy-makers will select the defined KPI's that need to be evaluated by the validation engine and based on the scores the new policies achieve, policy-makers will be able to make an informed decision about which policies should be deployed in the city.

2.4 Advanced Visualization Methods

Another important task will be the implementation of advanced visualizations for mobility patterns, highlighting important events, and results of policy validations. The main visualization functionalities will present the information on a combination of map layers, describing where in the city specific events or a sequence of events occurred. Visualizations will involve the use of heat maps, traffic flow graphics, and other transportation clusters. Users will be able to change and interact with the visualization parameters. For example, select specific time ranges, zoom, highlight, display additional information, etc. Considering the variety and characteristics of the data, one concern is regarding the depicting multidimensional data in a human-perceivable manner. Several graphical methods are customarily used for a preliminary analysis of generic multivariate datasets [2]: scatter plots, pie charts and bar plots, histograms, box plots, violin and bean plots, spider/radar/star/polar plots, glyph plots, mosaic and spine plots, treemaps, and others.

Traffic datasets are generally high-dimensional or spatial-temporal [3], thus visualizing traffic data mostly employs information visualization and visual analytics.

Traffic data contain multiple variables, of which the most important ones are time and space. Several different types of visualisation are currently used for traffic data, among them: visualization of time, visualization of spatial properties and spatio-temporal visualization.

Location is the main spatial property of traffic data. Based on the aggregation level of location information, visualization of spatial properties can be categorized into three classes: point-based visualization (no aggregation) , line-based visualization (first-order aggregation), and region-based visualization (second-order aggregation) [3].

Heatmaps are the most used visualisation tools to show the integrated quantity of a large scale of objects in a map.

A preliminary user interface prototype is depicted in Figure 2.
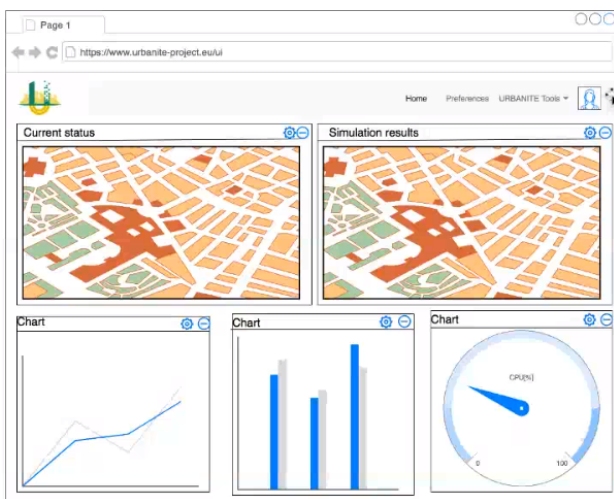
Figure 2: User Interface Mock up of the URBANITE Platform.

3 DATA SOURCES

There are several collection procedures of the traffic related data and they range from sensor readings to airborne imagery and

social media data [13]. The involvement of the municipalities of Bilbao, Helsinki, Amsterdam and Messina will provide a wide range of data sources related to the urban mobility, along with the public, open-source ones.

Several types of data sources were identified for the URBANITE project:

- geospatial data, e.g. maps (Open Street Maps [1], but also proprietary maps of the cities)
- additional info such as: car and lorry registration, information on parking lots, dynamic parking data, cadastre information, commercial register, care services, tourism accommodation
- demographics: statistical information on the number of inhabitants of different city districts, the number of households, population's age brackets, city boundaries, etc.
- public transportation: tram and metro lines, static and dynamic information about the public bus transport service, the GPS position of the buses
- traffic data: the count of car traffic and speeds, traffic status in real time, vehicle counts on the ring roads, etc.
- bicycle information: bike counters, bicycle collection points, calculated number of bikes in specific road segments, City-Bikes [2]
- pedestrian: manual counts of pedestrians
- electric charging stations
- taxi stops available
- harbour transport data, ferry traffic statistics
- geographic airport information
- air quality (OpenAQ [3])
- noise maps
- wheather data (OpenWeatherMap [4])

The format of this datasets varies from JSON, XML, CSV, XLSX, WMS , GEOJSO or GML. The main issue with the mobility related data sources it is related to the high level of heterogeneity, both in terms of data format and data availability. Most of the cities involved on the project have some data related to the traffic in the city, for example, but the format of the data, the level of granularity (how often is the data updated) and the availability of historical data (for how long does the city store historical data) varies greatly from one case to another.

Another special aspect that needs to be addressed is the impact of the COVID-19 on the mobility sector. Since COVID-19 has disrupted all of the social, economic and political aspects of life, the urban mobility area was also affected. Some analysis [1] revealed that the overall mobility fall was up to 76%, public transport users dropped by up to 93%, NO_2 emissions were reduced by up to 60%, and traffic accidents were reduced by up to 67% in relative terms. This phenomenon of experiencing unexpected change of concepts or data characteristics over time is referred to as concept drift [7] and is one of the key challenges that the URBANITE project will need to deal with when choosing the best way to proceed for making the most appropriate predictions regarding the impact of various traffic policies. The algorithms developed should take into consideration the stability-plasticity dilemma as a reference. Especially since it's still difficult to predict how the crisis derived from the pandemic will evolve and how the urban mobility will be afterwards.

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[1] https://www.openstreetmap.org/
[2] https://api.citybik.es/v2/
[3] https://openaq.org/
[4] https://openweathermap.org/
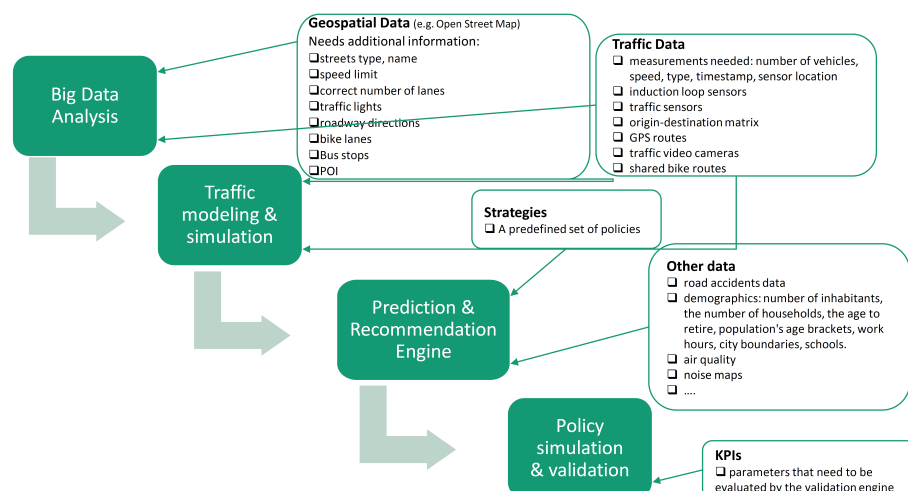
Figure 3: Data Sources for the URBANITE Platform.

4 CONCLUSIONS

The technical core in the URBANITE project focuses on the development of advanced AI algorithms for analysis of big data on mobility. The developed methods and tools will provide substantial support for policy-makers to tackle complex policy problems on the mobility domain and will enable their validation on case-specific models. The goal of the activities is to implement novel tools and services in order to enable policy-makers to use advanced data analysis and machine learning methods during the design of novel policies for a specific city.

One underlining factor in URBANITE is the adaptation of everything that it is created to civil servants, citizens and interesting parties that may or not be digitally literate. The use of big data techniques and artificial intelligence algorithms, up till now, is not a common skill among public servants and this is one of the reasons the data analysis processes and user interaction mechanisms described in this work are developed with the abilities of the non-experts in mind too.

ACKNOWLEDGMENTS

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Towards End-to-end Text to Speech Synthesis in Macedonian Language

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ABSTRACT

A text-to-speech (TTS) synthesis system typically consists of multiple stages: text analysis frontend, an acoustic model and an audio synthesis module. Building these components often requires extensive domain expertise and may contain brittle design choices. The paper presents an end-to-end deep learning approach to speech synthesis in Macedonian language. The developed model uses the Google's Tacotron architecture and is able to generate speech out of text from multiple speakers using attention mechanism. It consists of three parts: an encoder, an attention-based decoder and a post-processing network. The model was trained on a dataset recorded by five, mixed gender speakers, resulting in 25.5 hours of data, or 13,101 pairs of text-speech segments. The results show that the model successfully generates speech from text data, which was empirically shown using a quantitative questionnaire answered by 42 subjects.

KEYWORDS

text-to-speech, deep learning, tacotron, multi-speaker, seq2seq, text, audio, attention

1 INTRODUCTION

Modern TTS pipelines are complex [1]. For example, statistical parametric ones have a text frontend, extracting various linguistic features, a duration model, an acoustic feature prediction model and a complex signal-processing-based vocoder [2][3]. These components usually require extensive domain expertise, are laborious to design and must be trained independently. Consequently, errors from each component may compound. Otherwise, implementing an integrated end-to-end TTS system offers many advantages. First, it can be trained on <text, audio> pairs with minimal human annotation. It also alleviates the need for laborious feature engineering. Further, it allows rich conditioning on various attributes, such as speaker or language, or high-level features like sentiment. Similarly, adaptation to new data might also be easier. Finally, a single model is likely to be more robust than a multi-stage. All these advantages imply that an end-to-end system allows training on huge amounts real world data. But knowing that TTS is a large-scale inverse problem and due to existence of different pronunciations or speaking styles, decompressing a highly compressed source text into audio may cause difficulties in the learning task of an end-to-end model. The main problem is coping with large variations at the signal level for a given input. Moreover,

unlike end-to-end speech recognition [4] or machine translation [5], TTS outputs are continuous, and much longer than input sequences. Mainly referring to the advantages of end-to-end systems, this paper proposes an implementation of Google's Tacotron model as a TTS system for Macedonian language. Tacotron is an end-to-end generative TTS model based on the sequence-to-sequence model (seq2seq) [6] with attention paradigm [7]. This model takes characters as input and outputs raw spectrogram. We implemented our own version of Tacotron, based on few published articles. What we kept is their deep learning architecture, but made some changes in model's hyper parameters and other utilities (like known symbols, numbers etc.). That way the model was adapted to work with Cyrillic. Given <text, audio> pairs, our Tacotron model was trained completely from scratch only on our dataset. It does not require phoneme-level alignment, so it can easily scale to using large amounts of acoustic data with transcripts.

2 RELATED WORK

WaveNet [8] is a powerful, non end-to-end, generative audio model which works well for TTS synthesis. It is used as a replacement of the vocoder and acoustic model of the system. It can be slow due to its sample-level autoregressive nature. It also requires conditioning on linguistic features from an existing TTS frontend.

Deep Voice [9] is a neural model which replaces every component in a typical TTS pipeline by a corresponding neural network. However, each component is independently trained, and it's nontrivial to change the system to train in an end-to-end fashion.

Wang et. al [10] presents one of the first studies of end-to-end TTS using seq2seq with attention. However, it requires a pre-trained hidden Markov model (HMM) aligner to help the seq2seq model learn the alignment and a vocoder due to predicting vocoder parameters. Furthermore, the model is trained on phoneme inputs with possibilities of hurting the prosody and producing limited experimental results.

Char2Wav [11] is an independently developed end-to-end model that can be trained on characters. However, it still predicts vocoder parameters before using a SampleRNN neural vocoder [12] and their seq2seq and SampleRNN models need to be separately pre-trained.

MAIKA [26] is a Macedonian TTS project that was made public few months ago. However, there is no documentation of how it works. Therefore, it is technically challenging to

compare with a system that only has web interface which generates sound.

eSpeak [27] is an open source TTS project that also supports Macedonian language. The documentation states that the Macedonian model is based on the Croatian - which has its limitations since the Macedonian language is quite different, especially the pronunciation and the grammar.

3 MODEL ARCHITECTURE

The backbone of Tacotron is a seq2seq model with attention [7][13]. Figure 1 illustrates the model, which includes an encoder, an attention-based decoder, and a post-processing net. At a high-level, this model takes characters as input and produces spectrogram frames, which are later converted to waveforms. These components are described below.
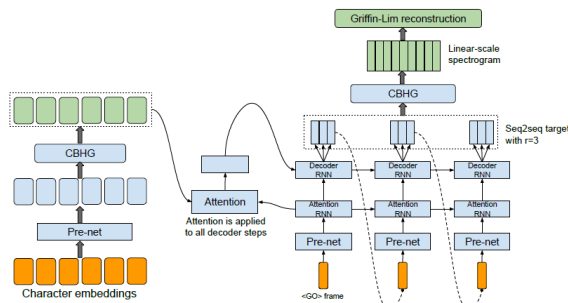
Figure 1: Model architecture

3.1 CBHG Module

CBHG is a module for extracting representations from sequences. It consists of bank of 1-D convolutional filters, followed by highway networks [14] and a bidirectional gated recurrent unit (GRU) [15]. The input sequence is first convolved with k sets of 1-D convolutional filters. These filters explicitly model local and contextual information (creating unigrams, bigrams, up to k-grams). Next the convolution outputs are stacked together and max pooled along time to increase local invariances. Further the processed sequence is passed to a few fixed-width 1-D convolutions, whose outputs are added with the original input sequence via residual connections [16]. Batch normalization [17] is used for all convolutional layers. Moreover, the fixed-width convolution outputs are fed into a multi-layer highway network to extract high-level features. Finally, a bidirectional GRU RNN has been stacked on top, extracting sequential features from both forward and backward context.

3.2 Encoder

The encoder extracts robust sequential representations of text. The input to the encoder is a character sequence, with each character represented as a one-hot vector and embedded into a continuous vector. Onto each embedding is applied a set of non-linear transformations, known as "pre-net". The "pre-net" is represented as a bottleneck layer with dropout, helping convergence and improving generalization. A CBHG module transforms the "pre-net" outputs into the final encoder representation used by the attention module. Moreover, CBHG-based encoder reduces overfitting and makes fewer mispronunciations than a standard multi-layer RNN encoder.

3.3 Decoder

Tacotron model uses a content-based *tanh* attention decoder [18], where a stateful recurrent layer produces the attention query at each decoder time step. The input of decoder's RNN is formed by concatenating the context vector and the attention RNN cell output. Decoder's internal structure is a stack of GRUs with vertical residual connections [5], used for speeding up convergence. A simple fully-connected output layer is used to predict the decoder targets. Its target is 80-band mel-scale spectrogram, later converted to waveform by a post-processing network. It predicts multiple, non-overlapping, output frames at each decoder step. Predicting r frames at once divides the total number of decoder steps by r, which reduces model size, training and inference time and increases convergence speed. This is likely because neighboring speech frames are correlated and each character usually corresponds to multiple frames, plus emitting multiple frames allows the attention to move forward early in training. For defining the input of the next decoding step "teacher forcing" mechanism is used, pointing that on each time step, decoder's input is the ground-truth value of the previous predicted decoder output.

3.4 Attention Mechanism

Attention mechanism is applied in order to "learn" mappings between input and output sequences through gradient descent and back-propagation. It is used as a way for the decoder to learn at which time step, which internal state of the encoder deserves more attention when generating its current output. The whole process of calculating the attention weights and using them to form the decoder input has been illustrated in Figure 2.
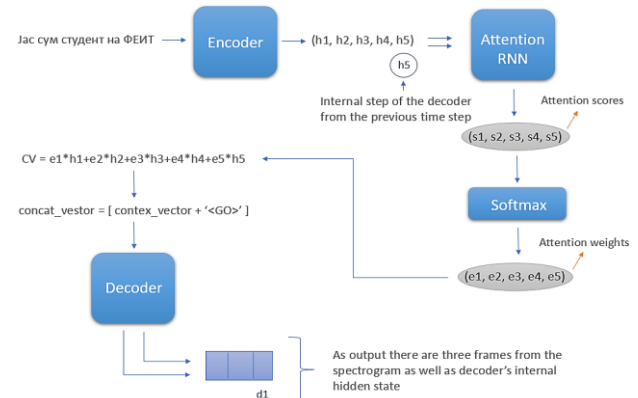
Figure 2: What is behind the attention mechanism

3.5 Post-processing Net and Waveform Synthesis

The post-processing net is converting the seq2seq target to a form that can be synthesized into waveforms [20][21]. Since Griffin-Lim has been used as a synthesizer, the post-processing net learns to predict spectral magnitude, sampled on a linear-frequency scale. The Griffin – Lim algorithm allows convergence towards estimated phase layer. Phase's quality depends on the number of iterations applied. Although more iterations may lead to overfitting, better audio is produced. Within our setup, Griffin-Lim converges after 50 iterations even though 30 iterations seems to be enough.

3.6 Model Parameters

The log magnitude spectrogram is obtained using Hann windowing with 50 ms frame length, 12.5 ms frame shift, and 2048-point FT. 24 kHz sampling rate has been used for all experiments. For both seq2seq decoder (mel-scale spectrogram) and post-processing net (linear-scale spectrogram) a simple L1 loss with equal weight has been used. The model has been trained using a batch size of 4, where all sequences are padded to a max length.

4 DATASET

There is no public dataset of audio data in Macedonian language, therefore we had to create one. We used publicly available books in Macedonian from the website of the National Association of the Blind of the Republic of North Macedonia. The books have been recorded by 5 speakers, 3 male and 2 female. They are segmented using an algorithm which separates input audio based on silence length and threshold. Silence length varies between 700 – 1000 ms. The audio clips were additionally padded with 700 ms at both beginning and end to avoid sudden cut offs.

Next, the audio files were transcribed manually, aided by the written version of the audio book. The transcriptions are void of any punctuation, capitalization, or any special characters, including numbers. They include only the 31 letters from the Macedonian alphabet and the space character to separate between words. The reason for this is that the initial dataset was also used for another task (Speech Recognition) and the researchers removed the punctuations. In this phase we could not retrieve the original raw data that includes the punctuation. The final dataset contains 13,101 audio files and transcripts in Macedonian language [25]. Additional statistics about the dataset are listed in Table 1.

To be mentioned, the goal of the dataset is not the dataset itself, but how we can develop a deep learning, end to end, multi-speaker TTS for Macedonian language. Detailed language analysis of the dataset is planned for another study, in which the focus will be more on the linguistically part of the dataset.

Table 1: Dataset statistics

Total Clips	13 101
Total Words	188 521
Distinct Words	28 791
Total duration	25:36:20
Mean Clip Duration	7.04 sec
Min Clip Duration	0.73 sec
Max Clip Duration	97.6 sec (1.37 min)

5 TRAINING AND EVALUATION

5.1 Training

During the training phase there is an output produced on every 1000th step. It takes few seconds for an output to be produced. Each output contains five files, three of which give information about the model formed up to that step, while the other two are an alignment plot and an audio file synthesized by that mode. The synthesized audio file is used for checking the quality of the current model. The alignment plot shows if the decoder has learned which input state of the encoder is important for producing its current output. That means if there is an "A" on input, "A" should be produced as sound for output. As a good alignment plot is considered the one who looks like a diagonal line. This system was trained for 5 days, reached 412 000 steps and got 412 different models. The system started showing a good alignment on 63 000th step. The last model was chosen as referent one. Its training and test results sound much better and were more understandable than those generated from the other models.

5.2 Evaluation

To estimate the model's performance, we used 10, out of 14 random sentences as test examples. The results show that more than half of the synthesized audio files [22] were successfully representing the input sequence of the model. This was empirically shown using a quantitative questionnaire [23] answered by 42 subjects, 10 IT experts and 32 general public volunteers. The questionnaire was made up of 10 stages, for each of the 10 audio files. The reason for choosing 10 test examples was to make the questionnaire more compact, smaller and quicker for the evaluators. Each stage contains 3 sub questions for the currently observed audio file. The Mean Opinion Score (MOS) [24] was used as a measure for answering i.e. scoring each one of it. MOS is a measure of audio quality. It is a subjective measurement used to test the listener's perception of the audio quality and clarity. A group of 42 subjects were asked to do the questionnaire. Each audio file required to be scored with a score from 1-5 in terms of three criterions: naturalness, intelligibility and accuracy. Where naturalness stands for the similarity of produced audio file with the natural human speech, intelligibility or clarity of spoken words and accuracy or how much the spoken sequence corresponds with the original, required to be spoken text.

The results from the questionnaire are shown in Table 2. Each row of the table represents the MOS for one of the three criterions, calculated separately for experts and volunteers. The calculations are done by summing the scores for each criterion and consequently averaging it. By analyzing the results for each criterion is clear that, the experts score the model's performance better compared to the volunteers. Looking at the total score, experts evaluated the model's performance for 0.265 better than the volunteers. We speculate that the reason for this might be that when the experts are evaluating the model they also take into account the technical challenges and aspects of such system. On the other hand the volunteers simply evaluate the sound and its quality.

Additionally, in Figure 3 and Figure 4 we show the box-plots for the answers given by the experts and the volunteers respectively. The figures show that the accuracy is the characteristic that achieves the highest score, and the naturalness is the characteristic that achieved the lowest score. We speculate that the reason for low naturalness score is the presence of sudden pauses when words should be spoken or existence of mumbling instead of clear pronunciation. There are only few such occurrences.

Table 2: MOS Score results

	MOS Score	
	Experts	**Volunteers**
Accuracy	4.8	4.6
Intelligibility	4.5	4.2
Naturalness	4.1	3.9
Total	4.5	4.2
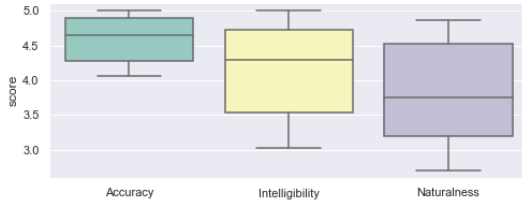
Figure 3: Box plot of all grades given by the volunteers
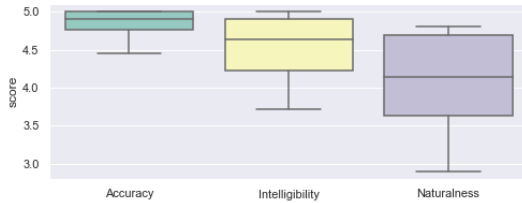
Figure 4: Box plot of all grades given by the IT experts

6 CONCLUSION

The paper presented an end-to-end deep learning approach to speech synthesis in Macedonian language. The developed model uses the Google's Tacotron architecture and generates speech out of text from multiple speakers using attention mechanism. The approach consists of three parts: an encoder, an attention-based decoder and a post-processing network. The model was trained on a dataset recorded by five, mixed gender speakers, resulting in nearly 25.5 hours of data. The results show that the model successfully generates speech from text, which was empirically shown using a quantitative questionnaire answered by 42 subjects.

To the best of our knowledge, this is the first end-to-end multi-speaker deep learning model for Macedonian language. We strongly believe that this will be a benchmark and motivation for future studies and finally to have a decent TTS system for Macedonian - which has significant societal impact.

Some of the limitations of the model are the gender diversity of speakers and the limited dataset. There is definitely room for improvement, and probably the dataset plays a crucial role in it. However, the data collection process is extensive and very time consuming task. With the given dataset we cannot estimate or empirically evaluate how much more data is needed to achieve state-of-the-art intelligibility and naturalness of artificially created speech. Additionally, in a few of the generated samples there are pauses at places where a word should be spoken. The reason for this is when the model generates sound, it uses character embeddings with specific ordering, learned during training. If those embeddings have never been seen during training, the model will not be able to properly pronounce them. Note that this is not the case with all of the words not being present in the training data, but in very rare occasions. Normally, the model will still generate speech even though a word is not present in the dataset.

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Improving Mammogram Classification
by Generating Artificial Images

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ABSTRACT

Training a deep convolutional neural network (DCNN) from the scratch is difficult, because it requires large amounts of labeled training data. This is a big problem especially in the medical domain, since datasets are scarce and data is often imbalanced. This can result in overfitting the model. Fine-tuning a model that has been pre-trained on a large dataset shows promising results. Another approach is to augment the dataset with artificially generated learning examples. In this paper, we augment the learning set with artificially generated images that are produced by conditional infilling GAN. The results that we obtained show that we can relatively easily generate realistically looking mammograms that improve the classification of benign and malignant mammograms.

KEYWORDS

data augmentation, transfer learning, CNN, ResNet-50, GAN, ciGAN

1 INTRODUCTION

Breast cancer is a cancer that is found in the tissue of the breast, when abnormal cells grow in an uncontrolled way. It can affect both women and men, though it is prevalent in women. Statistics show that it has the highest mortality rate of any cancer in women worldwide and that 1 in 8 women in the EU will develop breast cancer before the age of 85[1]. Screening mammography helps diagnose cancer at an early stage, which significantly increases the survival rates. However, the evaluation of mammograms performed by doctors and radiologists is tedious, lengthy and error prone, as it results in a high number of false positives.

New approaches in deep learning (DL), in particular convolutional neural networks (CNNs), have proven their potential for medical imaging classification tasks. This could relieve radiologists and give patients quicker and more accurate diagnosis. However, the performance of CNNs are dependent on large labeled datasets, which are hard to obtain in the medical

imaging field due privacy concerns of the patients and the time consuming expert annotations. Furthermore, the data is often imbalanced, meaning that pathologic findings are relatively very rare. This can result in overfitting the model and bad generalization ability.

So far, this problem has been addressed with transfer learning and data augmentation techniques. In this paper, we evaluate these techniques on the CBIS-DDSM dataset, which is a publicly available dataset that contains benign and malignant mammograms. We propose a novel approach of generating new images with Generative Adversarial Networks (GANs) combined with traditional data augmentation, such as horizontal flipping, rotations etc., and evaluate if increasing the dataset helped to achieve better classification. We also test if fine tuning a ResNet-50 model helps improve the results.

The paper is structured as follows. Section 2 presents the related work, Section 3 describes the data augmentation techniques used, Section 4 the training process, Section 5 the evaluation metrics used and the results, and in Section 6 we state our conclusions and discuss the prospective future work.

2 RELATED WORK

This section provides a brief review of past work that falls down to three categories:

1. improved classification with traditional data augmentation,
2. improved classification with generating synthetic images using generative adversarial network,
3. transfer learning and fine tuning.

The problem with small datasets, especially in the medical domain, is that models that are trained on them tend to overfit the data. There are a lot of approaches to reduce it, like batch normalization, dropout, data augmentation and also transfer learning. Traditional data augmentation based on affine transformations, such as translation, rotation, shearing, flipping and scaling, is the most widely used and very easy to implement. They are ubiquitous in computer vision tasks and show very promising results [1]. However, they do not bring any new visual features that could additionally improve the generalization of the CNN.

Synthetic image generation with GANs enables more variability to the dataset and further improves robustness of the

[1] https://www.europadonna.org/breast-cancer-facs/

classification network. GANs were inspired by game theory, where two neural networks are pitted against each other using a minmax strategy. They were first introduced in [2], and they have recently been applied to many different medical imaging applications, mostly for image to image translation and image inpainting. In [3], the authors used conditional infilling GAN to synthesize lesions on mammograms.

Transfer learning and fine tuning for mammography medical images was the main topic in [4] and [5]. In [4], they demonstrated that a whole image model trained on DDSM can be easily transferred to INbreast without using its lesion annotations and using only a small amount of training data. In [5], the authors showed that fine tuning ResNet-50 model pre-trained on ImageNet can be used to perform tumor classification in CBIS-DDSM dataset.

In this paper, we will first use traditional data augmentation techniques and later additionally augment the dataset with applying the ciGAN (conditional infilling GAN). We will evaluate the improvements with a fine tuned ResNet-50 model.

3 AUGMENTING THE DATASET

In this section, we first describe the dataset, then we explain the traditional data augmentation methods used and a GAN method for synthesizing new images.

3.1 The CBIS-DDSM dataset

CBIS-DDSM [6] is a publicly available dataset that contains digitized images from scanned films of mammogram images and it is a subset of the DDSM dataset that consists of only benign and malign cases, while the DDSM also contains normal. The data was acquired from 1566 patients and it contains both mediolateral oblique (MLO) and craniocaudal (CC) views of each breast. Images are grayscale, and they have corresponding binary masks that indicate mass and ROI images of that mass.

Images are in DICOM format, which is the standard for medical imaging information. The data is already split in the training and testing set. We used a part of the testing set as a validation set for the classification network.

3.2 Traditional data augmentation

To compensate for the lack of training images, we used classical data augmentation techniques, in particular horizontal flipping, rotations of up to 30°, and zoom range from 0.75 to 1.25 and test if this improved the performance of the CNN.

3.3 Data augmentation with GANs

To further augment and balance the dataset, we use a GAN variant, called conditional infilling GAN (ciGAN) [3]. GANs are a type of generative models, which means they are able to produce novel examples, based on the training data. They consist of two neural networks, a generator and a discriminator, which are pitted against each other. Generator tries to capture the data's distribution while the discriminator tries to distinguish real and generated examples. By training them simultaneously, the generator will get better at generating realistic data, while the discriminator gets better at distinguishing real and fake data. In the case of ciGAN, the generator is based on a cascaded refinement network (CRN) [8], where features are generated at multiple scales before being concatenated, which yields a more realistic image synthesis.

In our approach, we apply the ciGAN to sample a location on a healthy mammogram and then synthesize a lesion in its location, as shown in Figure 1. The input is a concatenated stack of:

- a corrupted image (one channel grayscale image with lesion replaced by uniform distribution of values between 0 and 1),
- a binary mask that marks lesion (1 representing the location of the lesion, and the zeros elsewhere), and
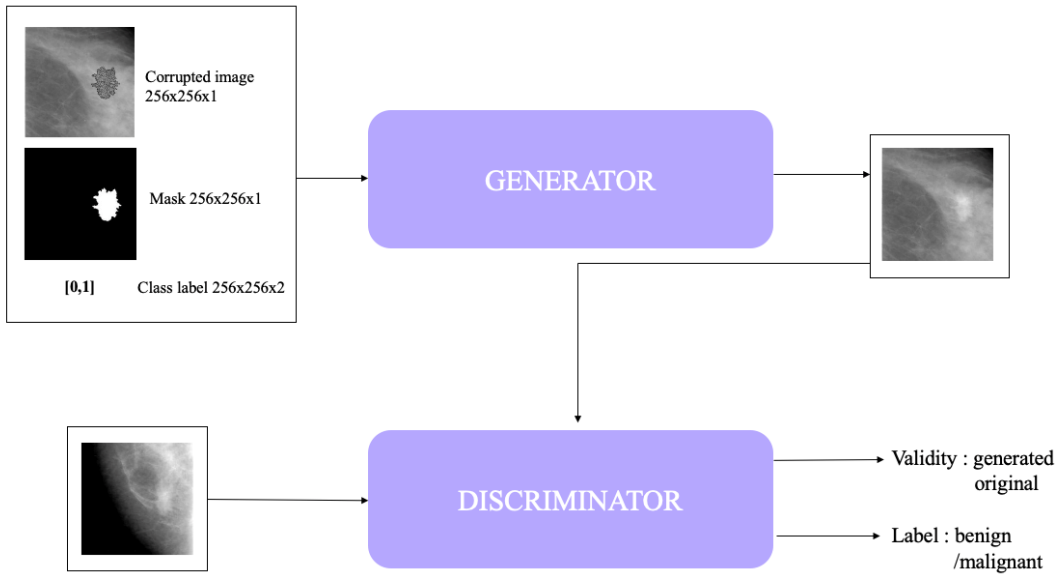
Figure 1: The ciGAN architecture. The input consists of two one channel images, and 2 class channels for indicating malignant/benign label. Output of the generator is, together with the real image fed into the discriminator, which predicts whether each image is either generated or original and also whether the image contains benign or malignant lesions.

- the class label ([1,0] representing the non-malignant class, and [0,1] representing the malignant class).

The generator is comprised of multiple convolutional blocks. The first convolutional block receives input stack, downsampled to the 4x4 resolution. Resolution is doubled between consecutive blocks. So the next convolutional block is fed with concatenation of the output from the first layer, upsampled to the 8x8 and an input stack resized to 8x8. This is repeated until resolution of 256x256 is obtained. The discriminator has similar, but inverse structure.

3.4 Differences to the related work

Our work is based on the before mentioned ciGAN [3], with a few improvements. While the former method was trained on non-malignant versus malignant cases, our approached uses benign and malignant cases, since we believe that the real hardship is distinguishing the lesions and not only noticing them. Images in the original work show that for acquiring synthetic non-malignant mammograms, the lesion was removed, making the picture a normal mammogram. Since we used a sliding window approach of extracting normal patches instead of the mask, we did not have to remove the malignant lesion, but we applied both masks independently, so we obtained only benign and malignant cases. All generated benign cases contain a lesion. We also applied zooming and rotation to lesions before generating new images, hence our generated images have more diverse tumors.

4 GENERATING ARTIFICIAL IMAGES

4.1 Preprocessing

To extract patches of 256x256 pixels that are fed into ciGAN, we used a sliding window technique. The program loops through the whole mammogram image with the stride of 128 and checks if the rectangular region overlaps the majority of the breast. It also checks whether the patch contains lesion or it shows only normal breast tissue, and labels it accordingly. This is done by comparing the same region of the corresponding binary mask. At the end the patch dataset contains 5466 images, 1743 of them are normal, 2198 benign and 1525 malignant.

After acquiring a dataset of patches, the program loops through all the patches containing only normal tissue. For each normal patch, it randomly chooses one patch that contains a lesion. The patch with lesion is then randomly zoomed in/out by a small factor, to obtain more diverse masses. Next, we check whether on the same location as is lesion, on the normal patch, is only breast tissue and not background. If not, the next random lesion patch is chosen and the whole process is repeated until a suitable match is found.

Once there is a suitable pair obtained, the normal image is corrupted, by replacing the area defined by the mask of the lesion with uniform distribution.

4.2 Loss functions

The ciGAN model is trained by utilizing three loss functions [3]:

- Perceptual loss: is a loss calculated between the ground truth and the output image. But unlike a per-pixel loss, which is based on differences between pixels, it measures the discrepancy between high-level perceptual features

extracted from pretrained networks [10]. It encourages the generator to output images with similar high level features as the original image. In this case, the VGG-19 [11] convolutional neural network is used, pretrained on the ImageNet dataset. It is defined as

$$L(R,S) = \sum_l \| \phi(L)_l - \phi(S)_l \|_1$$

where R denotes a real image, S a synthetic image and ϕ a feature function;

- Boundary Loss: is used to encourage smoothing between infilled components and the context of the generated image. It is a L1 difference between the real and generated images at the boundary and defined as

$$B(R,S) = \| w \odot (R-S) \|_1$$

where w denotes the mask with Gaussian filter of standard deviation 10 applied, and $\odot$ is the element wise product;

- Adversarial Loss: is the general GAN loss. It is defined as a distance between the true and the generated distribution at the current iteration. Its goal is to converge to the equilibrium in the minmax game between generator G and discriminator D, as follows:

$$\min_G \max_D L(D,G)$$
$$L(G,D) = E_{c,R}[\log D(c,R)] + E_R[\log(1 - D(c,S)]$$

where c denotes the class label.

4.3 Training

The ciGAN is first pretrained on perceptual loss for 300 epochs. Then the training of discriminator and generator are alternating, when loss for either drops below 0.3 for additional 2000 epochs. The ciGAN produces realistic images as shown in Figure 2.

1. Normal image   2. Random malignant mask

3. Corrupted image   4. Generated image
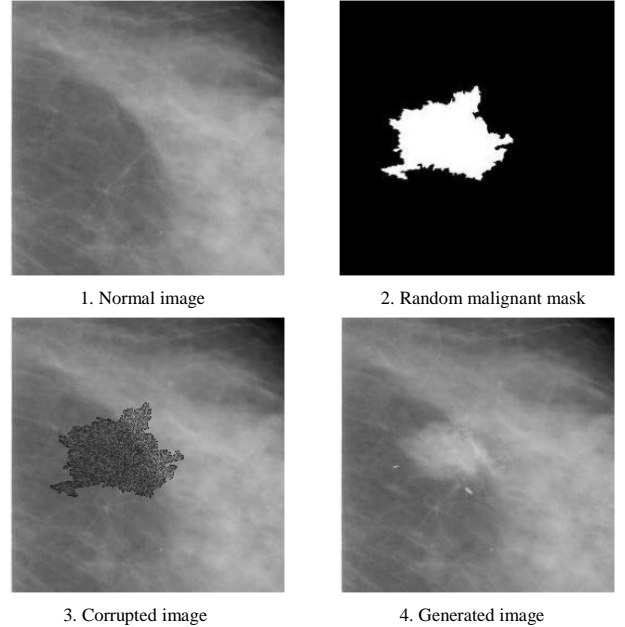
Figure 2: A generated sample from ciGAN. Image 1 is the normal image without a lesion, image 2 is the binary mask representing the random malignant lesion, image 3 is the corrupted image and image 4 is the synthesized image with malignant lesion.

5 EVALUATION AND RESULTS

For evaluation of results three metrics were used. The first one is accuracy, which tells us how many examples were correctly classified. The second one is recall/sensitivity, which is the fraction between true positives and the sum of true positives and false positives. It is the most important metric in this case, due to the risk of overlooking cancer. The third one is Area Under Curve (AUC), which measures area under the ROC curve. We evaluate the results by performing 4 experiments:

1. **Shallow CNN** [12]: we implement it as the baseline. The network is fed a patch and classifies it as either malignant or benign. It consists of three convolutional blocks, composed of 3x3 Convolutions, Batch Normalization, ReLU activation function and Max Pooling, followed by three Dense layers, and softmax function for binary classification.
2. **ResNet-50**: we classify the data using a ResNet-50 [13].
3. **ResNet-50** with finetuning: we check if transfer learning improves the results.
4. **ResNet-50 + Traditional** data augmentation,
5. **ResNet-50 + Traditional** data augmentation and generated **artificial** images.

As mentioned in [5], we fine-tuned the Resnet-50 [12] model with ImageNet weights. It is an extremely deep neural network with 150+ layers and consists of convolutional layers, pooling layers and multiple residual blocks. In the residual blocks, the layers are fed into the next layer and also directly into the layers about two to three hops away. The input to the ResNet-50 model is a patch of a size 224x224x3. Since mammograms have only grayscale channels, the color information is copied over all three channels. We used the Adam optimizer with an initial learning rate of 10^{-5}, $\beta 1 = 0.9, \beta 2 = 0.999, e = 10^{-8}$ and ImageNet weight initialization. We trained it for 50 epochs with batch size of 32 and a 0.9 learning rate decay every 30 epochs.

Table 1 shows the obtained results. We can see that already using only fine tuning using ResNet-50 improved the results. After combining ResNet-50 with traditional data augmentation, we obtained even better performance metrics. Nevertheless, by increasing the dataset with relatively small amounts of synthetic images while simultaneously balancing it, we improved accuracy and AUC even more, but obtaining a slight decrease in the recall.

6 CONCLUSION

In this paper we discussed overcoming the obstacle of small and imbalanced mammography dataset. We proposed an approach for artificial generation of images that are produced by a conditional infilling GAN (ciGAN). The results showed that we can relatively easy generate realistically looking mammograms that improve the classification of benign and malignant mammograms. Further, we evaluated the learning performance when using fine-tuning, classical data augmentation and synthetic examples. The results showed that each of these techniques improved classification, yielding the best results using all three together.

Comparing the results to previously developed method [3], we obtained worse results in terms of AUC, but we believe the reason behind it is the fact that all our images contain lesion, which must be harder for a neural network to distinguish, compared to distinguishing non-malignant and malignant images.

Testing these methods on different medical datasets shall be the subject of future work. As well, one may consider using these methods on bigger data sets and improve the current state of the art algorithms. Since the ciGAN's discriminator was also conditioned on class, we intend on extracting its features and using it for classification on other mammography dataset, for example on the INBreast dataset. We also plan on adding more synthetic images to the dataset, to see if we can further improve the classification.

Currently, the mammogram classification is performed by the doctors and radiologists, but we hope that improving the classification with the use of machine learning combined with these and similar techniques could relieve them of such tasks in the near future.

Table 1: The obtained accuracy, recall and AUC scores

	accuracy	recall	AUC
Shallow CNN	0.57267	0.44810	0.54943
Resnet-50 without finetuning	0.58295	0.53859	0.58634
ResNet-50	0.60155	0.55769	0.59443
ResNet-50 + traditional	0.67132	0.64231	0.66666
ResNet-50 + traditional + artificial	0.76145	0.61538	0.71638

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Mobile Nutrition Monitoring System: Qualitative and Quantitative Monitoring

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ABSTRACT
The WellCo project[1] aims to provide a mobile application featuring a virtual coach for behaviour changes aiming to achieve for healthier lifestyle. The nutrition monitoring module consists of two main parts - qualitative (Food Frequency Questionnaire) and quantitative (eating detection and bite counting). In this paper we present the nutrition monitoring module that connects both monitoring aspects as implemented in the virtual coach (mobile application).

KEYWORDS
nutrition monitoring, eating detection, FFQ

1 INTRODUCTION
Proper nutrition habits are beneficial for healthy lifestyle and help to prevent many chronic diseases, such as cancer, diabetes and hypertension. Automated monitoring has become really important i nutrition monitoring, but in only gives quantitative information (when is the user eating, how much did he eat...), while qualitative information (what is the user eating) is acquired by using 24 hour food recall diaries or by using Food Frequency Questionnaires (FFQs). In the WellCo project we aimed to developed a user friendly nutrition module, which monitors qualitative and quantitative aspects of users' nutrition. We combined the self-reported FFQ, Extended Short Form Food Frequency Questionnaire (ESFFFQ), developed and validated in the project project [5], with automated monitoring by using a commercially available wearable smartwatch. This paper describes the developed module and the improvements we made since our previous papers [5, 2, 7].

By using wrist-worn devices to collect data, it is possible to recognize eating gestures [4] or even count 'bites' or assess caloric intake [10]. Mirtchou et al. [3] explored eating detection by using several sensors and combining real-life and laboratory data.

Edison et al. [8] proposed a method that recognizes each intake gesture separately and later the intake gestures within 60 minutes interval are clustered.

For qualitative monitoring we evaluated both dietary recalls and FFQs as self-reporting methods. However, dietary recalls require typing or complex food item selection which can be cumbersome on mobile devices, so we opted for FFQ. FFQs are the most commonly selected tools in nutrition monitoring as they are efficient, cost-effective and non-invasive [9, 6].The developed FFQ covers all key aspects of healthy diet, and is modular, so that only questions pertaining to certain aspects can be asked. This is important in ubiquitous settings where one wishes to minimize the required inputs from the user.

To our knowledge the developed application module is the first one to combine qualitative (validated FFQ) and quantitative monitoring (bite counting method) and to provide recommendations based on data gathered by monitoring.

2 METHOD
2.1 Method Overview
The paper describes the nutrition monitoring module developed in the Wellco project.

The **qualitative monitoring** starts with a five-question questionnaire that provides essential information about the user's diet. Based on this, some goals to improve the user's nutrition can already be recommended. However, the users are invited to answer a more extensive questionnaire that paints a more complete picture and allows recommending more goals. This questionnaire is an extended version of a validated questionnaire, and the extension was validated by us [5]. How successful the users are at achieving their goals is monitored with goal-specific questions on a bi-weekly basis.

The **quantitative monitoring** uses the accelerometer and gyroscope in a smartwatch to detect micromovements related to eating (e.g., picking up food, putting it into the mouth). From a sequence of such micromovement, we then recognise whether the user has made one "bite" (taken the food to the mouth). The improved method uses a Convolutional neural network to recognise the micromovements and a LSTM neural network to recognise bites. The latter achieved higher accuracy so it was the one selected to be integrated into the WellCo system.

2.2 FFQ - Qualitative Monitoring

When choosing goals that would help users of the WellCo virtual coach towards behavioural changes for healthier lifestyle, we were leaning on national dietary recommendation and dietary recommendations for elderly, combined with expert knowledge by the nutritionist involved in the project. A summary of national dietary recommendations is presented in Table 1.

Guidelines specifically for the elderly are very similar to national dietary recommendations for all three countries involved in pilots (Italy, Spain and Denmark), but they put additional emphasis on dairy consumption, as this is a good source of proteins and calcium, which are beneficial and often under-consumed; drinking enough water, as dehydration is often a problem with elderly; and leucine consumption (in milk, peanuts, oatmeal, peanuts, fish, poultry, egg white, wheat sprouts, etc). Given these recommendations, we chose goals we will suggest WellCo users to follow and use in order to improve their diet: *fruit consumption*, *vegetable consumption*, *salt consumption*, *fat consumption*, *fibre consumption*, *protein consumption*, *salt consumption*, *fish consumption* and *water consumption*.

In our search for a comprehensive but still short FFQ we found a validated questionnaire named Short Food Frequency Questionnaire (SFFQ)[1], which consists of 23 questions and fully covers five of our chosen goals – *fruit* and *vegetable consumption*, *sugar consumption*, *fat consumption* and *fish consumption*. To cover the four missing goals (protein, fibre, salt and water consumption) we added additional 8 questions, turning the SFFQ into the so-called Extended Short Food Frequency Questionnaire (ESFFQ). The validation of the questionnaire is described in our previous paper [5].

2.3 Quantitative Monitoring

The main objective of the smartwatch-based nutrition monitoring is bite counting (counting the number of time the user takes food to the mouth).

The bite-counting algorithm described in [2] was used as the base for all of the following work. When deciding how to present the results of the developed algorithm to the users in the mobile application, we had to make some improvements to our model. As the number of bites does not really give much useful information to the users, we decided to join individual bites into meals and to recognize meals as *snack*, *small meal* or *big meal*.

2.3.1 Datasets. To construct the bite detection algorithm, we created the Wild Meals Dataset (WMD). It includes 51 sessions and 99 meals, with known starting and ending time points, belonging to 11 unique subjects, recorded 'in-wild'. For 68 of those meals we have also obtained the approximate number of the corresponding bites, since the subjects were asked to count them while eating. Additionally we used the publicly available The Food Intake Cycle (FIC) dataset and The Free Food Intake Cycle (FreeFIC). All datasets contains tri-axial signals from accelerometers and gyroscopes in wrist devices with the sampling frequency of 100 Hz.

2.3.2 Meal detection method. The algorithm for meal detection was comprised of two parts: in the first part probabilities that given time periods are part of eating were assigned, whereas in the second part these probabilities were grouped together to form a meal.

First we linearly interpolated all accelerometer and gyroscope measurements as well as the probabilities of bites to 4Hz frequency. Next, the normalization was applied to interpolated accelerometer and gyroscope data. We constructed 90 s long sliding windows with a 2.5s step. Each window contained 360 of the previously obtained accelerometer, gyroscope and bite probability values (obtained with CNN and LSTM networks as described in [2]). 4Hz frequency was used to achieve faster training and predicting, while also enabling us to construct longer windows. A window was labelled as a positive instance, if the majority of the window belonged inside a meal.

To solve this machine learning task, an inception-type neural network was constructed, with the added GRU layers at the end. The inception part of the network is mainly made of two types of inception blocks. Both types consist of convolutional layers and end with a filter concatenation. The B block includes also a max pooling operation. Each block in the network is succeeded by a max pooling layer. The entire architecture is presented in Table 1. The inputs were transformed in the (batch size,timestamps,1,7) shape. "Prep" (preparation) in Table 1 refers to the yellow convolutional layers in Figure 5, whereas "Pool proj" refers to 1x1 convolutional layer after 4x1 max pooling layer. The final model used approximately 130 K parameters.

With the intention of smoother and better learning, the ratio between positive and negative instances was fixed to 1:2. During the sampling, we actually focused more on problematic areas, by first predicting with the network and then selecting problematic instances to train on. Learning rate was set to keep decreasing every few epochs. Certain hyper-parameters were subject to optimization during cross-validation, with the help of hyperopt library. The function to minimize was categorical cross entropy.

In the next part, the outputs ∈ [0,1] of the neural network, which represent the probabilities that the given windows are eating instances, are taken to form possible/candidate meals. This is done in the following manner:

- **Round 1**: Find all probabilities, denoted as beacons, that are higher than a p1 threshold. Include also all probabilities that are closer than t1 seconds to any of the beacons. Set all the other probabilities temporarily to 0.
- **Round 2**: Find all probabilities that are higher than a p2 threshold and group them together, if they are immediately next to each other. For each group find the time distance to its nearest group. Finally remove all groups that have either 1 or 2 members and are more than t2 seconds away from the corresponding nearest group.
- **Round 3**: If there exist any two groups of the form [A,B] and [C,D], where $0 \leq C - B \leq t3$ (all in seconds), combine these two groups together to form a new group, [A,D]. This means that indices in [A,D] can now represent the probabilities of zero as well.
- **Round 4**: Similar as Round 3, but with a t4 parameter in place of t3.

At this point the probabilities of windows, previously temporarily set to zero, are switched back to their original values. For the final model, we obtained the following values of the above hyperparameters:

Since p2 > p1, this means that Round 1 in this particular case was not necessary, although in some other cases it could have been. Once the candidate meals have been obtained, the features are constructed for the ensemble of random forest, support vector machine, knn and gradient boosting algorithms. The ensemble

Table 1: Architecture of the network

Type	Units/Nodes	Kernel/stride	Output	1x1	4x1 prep	4x1	6x1 prep	6x1	Pool
Inception-A			360x1x128	32		64		32	
Max pool		3x1/2	180x1x128						
Inception-B			180x1x128	32	64	64	16	16	16
Max pool		3x1/2	90x1x128						
Inception-B			90x1x128	32	64	64	16	16	16
Max pool		3x1/2	45x1x128						
Inception-B			45x1x128	32	64	64	16	16	16
Max pool		3x1/2	23x1x128						
GRU			23x32						
GRU			32						
Dense	64		64						
Dropout(0.36)			64						
Dense	2		2						

Table 2: Hyperparameters.

p1	t1(sec)	p2	t2(sec)	t3(sec)	t4(sec)
0.46	61	0.87	120	63	61

makes the final decision whether a candidate meal is in fact a meal or not. The following features are created for each candidate meal:

- The mean, standard deviation, the 25th, 50th and 75th percentile of all the probabilities inside a given candidate meal.
- The mean and standard deviation of the first and second half of a potential meal, separately.
- The mass of all the future probabilities inside all the potential meals closer than 3 hours to a given candidate meal, divided by their time centre.
- The mass of all the past probabilities inside all the potential meals closer than 3 hours to a given candidate meal, divided by their time centre.

Hyper-parameters for each model in the ensemble, as well as p1, t1, p2 t2, t3 and t4 values, were calculated with a cross-validation, with the help of hyperopt library. The function to minimize was negative F1-score.

3 RESULTS

3.1 Bite Counting

In Table 4 we present the results of evaluation of our work. The analysis of the entire pipeline is based on Leave-One-Subject-Out double cross-validation. For calculation of the above statistics the following definitions were used:

- True positive prediction of a meal: any prediction of the respective meal for which the majority of the prediction laid inside the ground truth meal. If there was more than one prediction of eating for a certain meal, only one prediction is actually counted as a true positive, whereas all the others are not regarded as a false positive.. This is due to the possibility that the subjects didn't eat their entire recording time; as such it did not seem reasonable to penalize the pipeline for predicting more than one meal, however, only one true positive is counted in order not to encourage the algorithm to predict a bundle of eating instances.

Table 3: Results of bite recognition and meal detection algorithm.

	F1-score	precision	recall	cov_area	outside_area
Avg.	0.76	0.88	0.72	0.81	0.03

Table 4: Example of recommendations for qualitative monitoring (*goal_sugar*) and quantitative monitoring (*nutrition_number_of_meal*).

goal_sugar	It seems you don't eat enough vegetables. Vegetables are important sources of many nutrients, such as vitamins, minerals and dietary fibre. Try to eat 2 servings of vegetables per day. Serving is 1 cup of fresh or half cup of cooked vegetables.
nutrition_number_of_meal	Try to eat 3–5 meals per day (e.g. 3 bigger, 2 smaller). Avoid snacking between meals.

- For F1-score, precision and recall, def A was used, while cov_area and outside_area used def B. However, double cross-validation results show that all ground truth meals, with one exception, had at most one corresponding, true positive predicted meal.
- Covered area (cov_area): for a given ground truth meal, the length of the areas, which laid inside the ground truth meal, of the corresponding true positive meals, divided by the length of the ground truth meal.
- Outside area (outside_area): for a given predicted, true positive meal, the length of the area that laid outside the corresponding ground truth meal, divided by the length of the predicted meal.

3.2 Application Implementation

The application shows users the detected meals, number of bites and score quality for the chosen goals (see Figure 1). Based on the results we additionally show the user recommendations to follow in order to improve their nutrition. Example for recommendations for both, qualitative and quantitative monitoring is shown in table.
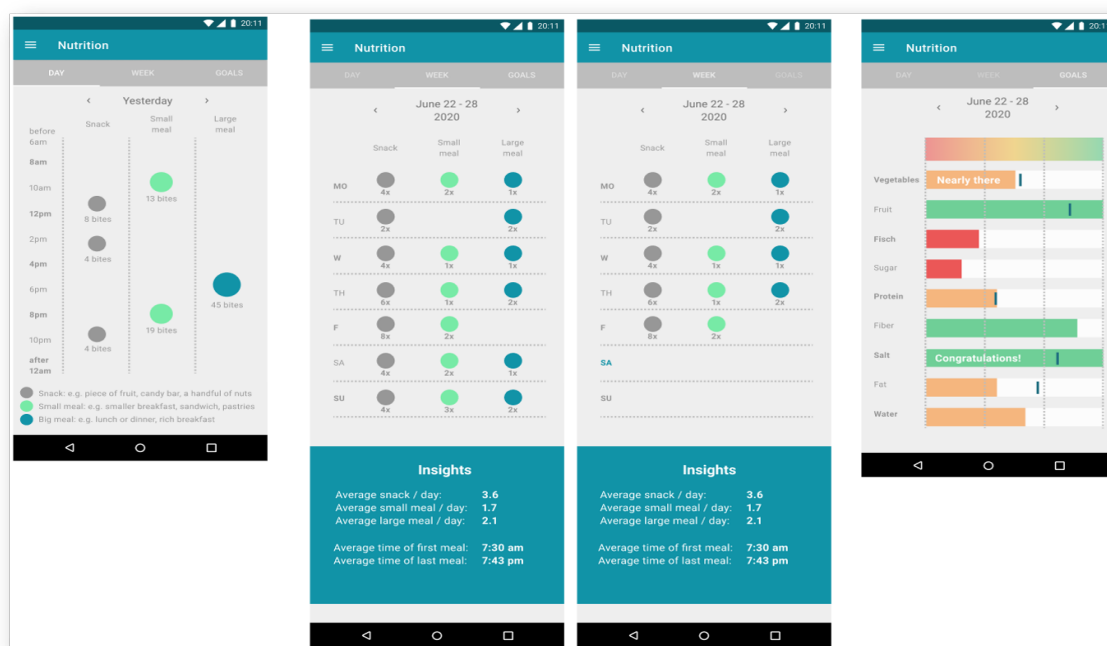
Figure 1: Application view for both monitoring tasks.

4 CONCLUSION

The developed nutrition monitoring module consists of two parts - qualitative monitoring and quantitative monitoring. Both of the developed modules are implemented in a mobile application. In our future work we would like to improve the developed eating detection and bite counting algorithms.

The developed FFQ (ESFFFQ) can be used to support a wide range of nutrition goals and minimizes the number of questions asked, so it is suitable for mobile nutrition monitoring. To make the application user friendly the questions from the FFQ will not be asked all at the same time, but separately during a course of fortnight. This means that some of the questions won't be asked, hence it is really important to ask the right questions. In our future work we will try to explore the problem of question ranking. With this we would be able to ask the questions in a specific order and loose as few information as possible.

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Recognition of Human Activities and Falls by Analyzing the Number of Accelerometers and their Body Location

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ABSTRACT

This paper presents an approach to activity recognition and fall detection using wearable accelerometers placed on different locations of the human body. We studied how the location and the number of wearable accelerometers influence on the performance of the recognition of the activities and the falls. The final goal was to build a machine learning model that can correctly recognize the activities and the falls using as few accelerometers as possible. The model was evaluated on a public dataset consisting of more than 850 GB of data, recorded by 17 people. In total we evaluated 15 combinations of four accelerometers placed on the belt, the left ankle, the left wrist and the neck. The results showed that the neck and the ankle accelerometers proved sufficient to correctly recognize all the activities and falls with 94.2% accuracy. Each of the sensors used individually achieved 94.02% and 93.4% accuracy respectively.

KEYWORDS
activity recognition, fall detection, wearable sensors, machine learning

1 INTRODUCTION

According to United Nations World Population Prospects 2019, by 2050, one in six people in the world will be over the age of 65 [1]. As people are getting older, their risk for falls also increases. Falls are a major public health problem in elderly people often causing fatal injuries. It is important to assure that injured people receive assistance as quickly as possible. Because of this, building a good fall detection system is of a big importance to help medicine solve this problem.

The field of Human Activity Recognition (HAR) and fall detection has become one of the trendiest research topics due to availability of low cost, low power consuming sensors, i.e., accelerometers. The recognition of human activities has been approached in two different ways, namely using ambient and wearable sensors [2]. In the former, the sensors are fixed in predetermined points of interest on the body of the subject, so the inference of activities entirely depends on

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the voluntary interaction of the users with the sensors. In the latter, the sensors are attached to the user.

This paper presents a machine learning approach to activity recognition and fall detection using wearable accelerometers placed on different locations of the human body. The goal of the paper is to study how the location and the number of wearable accelerometers influence on the performance of the recognition of the activities and the falls. This study is of practical importance of such systems, i.e., to build a machine learning model that can correctly recognize the activities and the falls using as few accelerometers as possible.

2 RELATED WORK

A considerable amount of work has been done in human activity recognition for the last decade where a lot of studies aim to identify activities based on data obtained from accelerometers as sensors widely integrated into wearable systems [3][4].

Researchers have reported high accuracy scores in detecting activities when investigating the best placement of the accelerometer on the human body [5][6][7]. Increasing the number of sensors increases the complexity of the classification problem. For these reasons, a number of studies have investigated the use of a single accelerometer. However, doing so generally decreases the number of activities that can be recognized accurately [8]. Consequently, one of the major considerations in activity recognition is the location or combination of locations of the accelerometers that provide the most relevant information.

In [5] the authors study the best location to place accelerometers for fall detection, based on the classification of postures. Four accelerometers were placed at the chest, waist, ankle and thigh. Statistical features were calculated for each axis of the accelerometer in addition to the magnitude. Results indicated that one accelerometer (chest or waist) by itself was not enough to sufficiently classify the activities (75%). There was, however, a significant improvement in classification accuracy achieved by combining the accelerometer at the chest or waist with one placed on the ankle (91%). Following the work described in [5] we explore this approach using different dataset while investigating all possible sensor placement combinations.

3 ACTIVITY RECOGNITION

3.1 Dataset

In this research we used the UP-Fall Detection dataset, which is publicly available [9]. The dataset contains 17 Subjects that are performing 11 activities. Each activity is performed 3 times. The activities performed are related to six simple human daily activities and five human falls showed in Table 1. These types of activities and falls are chosen from the analysis of those reported in literature [10][11]. All daily activities are performed during 60 s, except jumping that is performed during 30 s and picking up an object which it is an action done once within a 10-s period. A single fall is performed in each of the three ten seconds period trials.

Table 1: Activities performed in the Dataset

Activity ID	Description	Duration (s)
1	Falling forward using hands	10
2	Falling forward using knees	10
3	Falling backwards	10
4	Falling sideward	10
5	Falling sitting in empty chair	10
6	Walking	60
7	Standing	60
8	Sitting	60
9	Picking up an object	10
10	Jumping	30
11	Laying	60

In order to collect data from young healthy subjects without any impairment, is considered a multimodal approach for sensing the activities in three different ways using wearables, context-aware sensors and cameras, all at the same time. However, of our particular interest is how acceleration data can be used for the recognition of activities. The analyzed data is obtained from accelerometers placed on ankle, neck, wrist and belt. This way we created 15 different
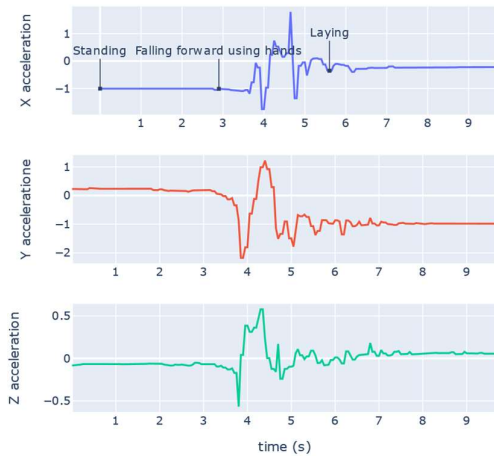
Figure 1 Raw Data from 3-Axis Accelerometer

datasets representing every combination of these sensors to show the importance of the placement of the accelerometer.

In our research the sampling rate of the sensor is 18 Hz, which means 18 samples are provided every second. In Figure 1**Error! Reference source not found.** the raw data from 3-axis accelerometer is shown from person who is performing three activities: standing, falling forward using hands and laying.

3.2 Feature Extraction

Feature extraction is really important step in the activity recognition process in order to filter relevant information and obtain quantitative measures that allow signals to be compared. In our research we used statistical features to create the feature vectors. All the attributes are computed by using the technique of overlapping sliding windows [5].

Because the final sampling frequency of our accelerometers was 18 Hz, we chose a window size of 18, which is one second time interval. We decided for one-second time interval because in our target activities there are transitional activities (standing up and going down) that usually last from one to four seconds. Statistical attributes are extracted for each axis of the accelerometer.

The feature extraction phase produces 36 features (summarized in Table 2) from the accelerations along the x, y, and z axes. The first three features (Mean X/Y/Z,) provide information about body posture, and the remaining features represent motion shape, motion variation, and motion similarity (correlation).

Once the features are extracted (and selected), a feature vector is formed. During training, feature vectors extracted from training data are used by a machine learning algorithm to build an activity recognition model. During classification, feature vectors extracted from test data are fed into the model, which recognizes the active.

Table 2: Overview of the extracted features. The number of features is represented with #

Feature name	#
Mean (X, Y, Z)	3
Standard deviation (X, Y, Z)	3
Root mean square (X, Y, Z)	3
Maximal amplitude (X, Y, Z)	3
Minimal amplitude (X, Y, Z)	3
Median (X, Y, Z)	3
Number of zero-crossing (X, Y, Z)	3
Skewness (X, Y, Z)	3
Kurtosis (X, Y, Z)	3
First Quartile (X, Y, Z)	3
Third Quartile (X, Y, Z)	3
Autocorrelation (X, Y, Z)	3

3.3 Methods

Machine learning approach was used for the activity recognition. In this study, the machine learning task is to learn a model that will be able to classify the target activities

(e.g. standing, sitting, falling, etc.) of the person wearing accelerometers. For this purpose, we used 4 different machine learning algorithms: Random Forest, Support Vector Machine, k-Nearest Neighbors and Multilayer Perceptron.

The Random Forest (RF) classifier, like its name implies, consists of a large number of individual decision trees that operate as an ensemble. The fundamental concept behind RF is the low correlation between any of the individual constituent models protecting each other from their individual error.

The Support Vector Machine (SVM) method has also been broadly used in HAR although they do not provide a set of rules understandable to humans. SVMs rely on kernel functions that project all instances to a higher dimensional space with the aim of finding a linear decision boundary (i.e., a hyperplane) to partition the data.

The k-Nearest Neighbors (k-NN) is a supervised classification technique that uses the Euclidean distance to classify a new observation based on the similarity (distance) between the training set and the new sample to be classified.

The Multilayer Perceptron (MLP) [12], is an artificial neural network with multilayer feed-forward architecture. The MLP minimizes the error function between the estimated and the desired network outputs, which represent the class labels in the classification context. Several studies show that MLP is efficient in non-linear classification problems, including human activity recognition. Brief study of MLP and other classification methods is shown in [13][14].

4 EXPERIMENTS

4.1 Evaluation Techniques

To properly evaluate the models, we divided the data into train and test using leave-one-person-out cross-validation. With the leave-one-person-out each fold is represented by the data of one person. This means the model was trained on the data recorded for 16 people and tested on the remaining person's data. This procedure was repeated for each person data (17 times) and the average performance was measured.

Four evaluation metrics are commonly used in activity recognition: the recall, precision, accuracy and F-measure. We have analyzed the accuracy score, which shows how many of the predicted activities are correctly classified.

4.2 Results

For the first experiment we compared 4 ML models using the ankle accelerometer - shown in Figure 2. We used the ankle accelerometer because our initial studies showed that it performs the best. Random Forest showed the best results with 92.92% of accuracy. Therefore, it was used for further experiments.

Table 3 shows the comparison of activity recognition accuracy using 4 accelerometers placed on ankle, belt, neck and wrist. It shows how the number and placements of accelerometer can affect the recognition of particular activities.
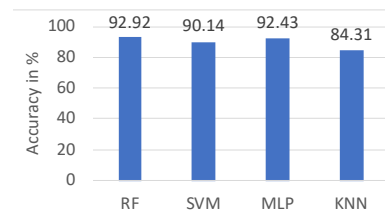
Figure 2: Comparison of different algorithms using Ankle Accelerometer

Placing the accelerometer on the belt can distinguish sitting, standing or jumping, but distinguishing different kind of falls that include some transitions, like standing, falling and then laying is a problem. Adding one accelerometer on the neck, can slightly improve the results, but still cannot recognize correctly the falls. Combination of neck and ankle accelerometer proved best results with 94.2% accuracy. On the other hand, an accelerometer on the ankle can distinguish walking, standing and laying, but has problems with picking up an object and also recognizing the falls. Most of the fall activities are recognized as standing or laying. By combining

Table 3: Comparison of activity recognition accuracy using different number of accelerometers (1, 2, 3 or 4) placed on ankle, belt, neck and wrist

Activities	Ankle	Belt	Neck	Wrist	Ankle+ Belt	Ankle+ Neck	Ankle+ Wrist	Belt+ Neck	Belt+ Wrist	Neck+ Wrist	Ankle+ Belt+ Neck	Ankle+ Belt+ Wrist	Ankle+ Neck+ Wrist	Belt+N eck+ Wrist	Ankle+ Belt+ Neck+ Wrist
Falling forward using hands	57.9	64.4	75.1	63.0	63.2	73.6	60.3	71.7	63.2	70.1	69.5	63.1	72.7	71.1	73.5
Falling forward using knees	72.6	81.4	76.2	55.7	76.4	77.7	61.2	77.6	68.6	64.5	77.9	75.8	75.0	72.4	78.7
Falling backwards	69.4	68.7	71.4	52.4	71.7	75.0	64.4	70.6	56.6	62.2	71.7	67.0	70.5	63.9	69.1
Falling sidewards	63.6	67.3	69.7	42.5	66.8	74.8	58.1	67.3	53.4	57.4	70.0	68.3	70.3	62.1	70.4
Falling sitting in empty chair	56.8	68.3	75.6	48.7	65.8	71.4	52.8	70.6	58.3	67.3	73.5	60.4	69.6	70.0	71.7
Walking	98.6	96.6	99.2	94.2	98.9	98.6	98.9	96.6	98.5	98.7	98.8	99.0	98.6	98.6	98.8
Standing	96.6	91.4	69.6	92.8	97.7	97.1	91.9	93.1	93.5	96.8	98.3	98.2	97.8	97.9	98.2
Sitting	90.2	66.4	95.0	85.2	75.9	84.5	80.6	83.9	68.4	87.6	71.4	72.3	79.9	85.5	76.8
Picking an object	67.7	73.0	86.8	43.3	76.0	88.0	63.0	82.1	71.3	82.9	87.7	74.1	87.0	82.1	86.8
Jumping	99.7	99.8	99.9	99.2	99.8	99.8	99.7	99.8	99.8	99.9	99.8	99.8	99.9	99.9	99.8
Laying	95.7	92.1	89.4	96.8	96.7	98.2	94.6	97.04	89.3	97.5	98.2	97.5	98.4	97.4	98.2

this sensor with neck accelerometer, the algorithm can distinguish each of the discussed activities.

Because of situation like this, we decided to compare the results using different number of accelerometers and different body placements. The idea is to use as few sensors as possible to maximize the user's comfort, but to use enough of them to achieve satisfactory performance.

Clasiffied as

Activity	1	2	3	4	5	6	7	8	9	10	11
1	73.6	0.0	1.3	0.7	0.9	0.4	12.2	0.0	0.0	0.0	11.0
2	0.0	77.7	0.0	1.6	0.4	0.4	4.3	0.0	0.0	0.0	15.6
3	0.3	0.0	75.0	3.5	1.2	0.0	7.8	0.0	0.0	0.0	12.2
4	0.0	0.0	3.3	74.8	1.5	0.5	9.7	0.0	0.0	0.0	10.3
5	0.4	1.5	2.1	5.4	71.4	0.0	9.3	0.0	0.0	0.0	10.0
6	0.0	0.0	0.0	0.0	0.1	98.6	1.3	0.0	0.0	0.0	0.0
7	0.1	0.1	0.0	0.0	0.0	0.4	97.1	1.9	0.3	0.0	0.2
8	0.0	0.0	0.0	0.0	0.0	0.0	11.0	84.5	0.1	0.0	4.5
9	0.0	0.0	0.0	0.0	0.0	0.5	10.6	1.0	88.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	99.8	0.0
11	0.1	0.1	0.2	0.1	0.2	0.0	0.7	0.3	0.0	0.0	98.2

Figure 3: Confusion matrix for Neck and Ankle Accelerometer

We must make a trade-off between correctly detecting simple activity and specific fall. The results showed that neck and ankle accelerometers are best suited for fall detection with overall accuracy of 94.19%. The confusion matrix for neck and ankle accelerometers is shown in Figure 3. The most false positive predictions for fall activities are predicted as laying. Also, very small percent of the non-fall activities are predicted as falls, which dismiss the false alarms for falls.

5 CONCLUSION

In this paper we presented an approach to human activity recognition and how location and number of sensors can impact on the process of HAR. Our aim was to build a model who can correctly recognize and classify the fall activities using small number of accelerometers, but still can obtain high accuracy scores. With one accelerometer placed on the ankle or the neck we got high accuracy scores, but by combining these two sensors the model can classify the falls more precisely.

The main input to our system is the data from the inertial sensors. Because the data is sensory, additional attributes are calculated. This process of feature extraction is general and can be used in similar problems. Next, the algorithms for the final tasks of activity recognition and fall detection are designed and implemented using the data from the ankle accelerometer. We used a machine learning approach for solving the problem of activity recognition. We evaluated the

models and Random Forest showed best results. Then, we compared the best model on different data, and we got the conclusion that the data from ankle and neck sensors was sufficient for human activity recognition and fall detection process with accuracy of 94.2%.

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Sistem za ocenjevanje esejev na podlagi koherence in semantične skladnosti

Automated Essay Evaluation System Based on Coherence and Semantic Consistency

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POVZETEK

V članku opisujemo implementacijo sistema za ocenjevanje esejev v angleškem jeziku. Zgledujemo se po metodologiji obstoječega sistema, ki poleg ocenjevanja sintakse uporablja tudi mere koherentnosti in semantične skladnosti. Metodologijo implementiramo v grafičnem okolju Orange, s prijaznim vmesnikom, opcijsko uporabo vektorskih vložitev za predstavitev besedila in možnostjo nadaljnjega razvoja sistema. Sistem evalviramo na podatkih dostopnih na spletnem mestu Kaggle in, kolikor je mogoče, rezultate primerjamo z rezultati dosedanje metodologije in jih podrobno analiziramo. Poglobimo se tudi v izbiranje atributov za izboljšanje rezultatov. Glavni prispevki dela obsegajo (1) implementacijo sistema, (2) enostavnost uporabe in (3) izboljšave dosedanjega dela, vključno z dodatnimi računskimi opcijami in podrobno analizo izbiranja atributov za izboljšanje rezultatov.

KLJUČNE BESEDE

ocenjevanje esejev, semantična skladnost, Orange

ABSTRACT

In this paper we describe an implementation of an essay grading system. We lean heavily on the methodology of an existing system, which, besides using syntactical measurements, also uses coherence and semantic cosistency measures. We implement the methodology in the Orange data mining tool, with a firendly user interface, optional use of word embeddings for word representation and the possibility for further developments of the system. The system is evaluated on public datasets from the Kaggle website. The results are to the most possible extent compared with the results of the existing methodology and analyzed in detail. We also compare several attribute selection methods, which improve our results. Main contributions of this work are comprised of (1) implementation of the system, (2) ease of use and (3) improvements upon previous work, including additional computing options and detailed attribute selection analysis.

KEYWORDS

automated essay evaluation, semantic consistency, Orange

1 UVOD

Učitelji v izobraževalnih ustanovah so odgovorni za predajanje znanj velikemu številu učencev. Del učnega procesa je tudi pisanje esejev, ki jih morajo učitelji prebrati in oceniti. Ocenjevanje esejev ni le časovno potratno, ampak potencialno tudi nekoliko pristransko. Naloga učitelja je tudi, da napake označi, popravi in komentira celotno delo.

S pomočjo računalnika lahko ocenjevanje esejev olajšamo. Dandanašnji sistemi za ocenjevanje esejev (tudi komercialni) se osredotočajo predvsem na sintaksno analizo, premalo pozornosti pa posvečajo semantiki [6]. To slabost obstoječih sistemov rešuje sistem SAGE, ki ga Zupanc opisuje v svoji disertaciji [5]. SAGE dosega zavidljivo napovedno točnost v primerjavi z ostalimi sodobnimi sistemi, vendar je trenutna implementacija sistema v prototipni fazi in ni zrela za produkcijo.

Glavni cilj dela je bila implementacija sistema na način, da bo uporabnikom čimbolj dostopen, enostaven in prijazen za uporabo. Da zadostimo tem ciljem, smo se odločili za implementacijo v programskem okolju Orange,[1] ki je namenjen hitremu prototipiranju modelov in raziskovanju podatkov, namenjen tako začetnikom kot zahtevnejšim uporabnikom. Sistem je v Orange-u implementiran v obliki gradnikov (angl. widgets). Med seboj jih lahko povezujemo in kombiniramo, tako da smo uvoz datotek, gradnjo in testiranje modelov prepustili gradnikom, ki so v Orange-u že implementirani. Skupno smo implementirali tri gradnike — prvi implementira vse atributske funkcije, vključno s koherenco, drugi implementira sistem za analizo semantične skladnosti, tretji pa je namenjen evalvaciji modela po kvadratno uteženi kapi.

Sistem Zupanc [6] temelji na ekstrakciji različnih atributov iz podanih besedil (esejev) in se loči na tri (pod)sisteme: *AGE*, *AGE+* in *SAGE*. Oznaka "sistem Zupanc" predstavlja njeno implementacijo vseh teh treh sistemov. Vsak sistem nadgradi prejšnjega z dodatnimi atributi. Sistem *AGE* predstavlja skupek atributov osnovne sintaktične statistike, berljivostnih, leksikalnih, slovničnih in vsebinskih mer. To obsega različne značilnosti besedila, vse od osnovnih, kot so število znakov, besed itd., pa do števila slovničnih napak in računanje podobnosti z ostalimi eseji. Skupno ta sistem zajema 72 različnih atributov, v prispevku tega članka pa smo temu sistemu dodali še pet novih atributov (št. znakov brez presledkov in štiri dodatne atribute, ki štejejo število posameznih oblikoskladenjskih oznak). Skupno torej 77 atributov.

Atributom sistema *AGE* dodamo atribute za merjenje koherence in s tem dobimo sistem *AGE+*. Koherenco merimo tako, da besedilo najprej razdelimo na prekrivajoče se odseke (drseče okno) in posamezne odseke pretvorimo v večdimenzionalni prostor. V tem prostor lahko posamezne odseke primerjamo in z različnimi merami ocenimo ocenimo konsistentnost besedila in tok misli. Število atributov za merjenje koherence je 29.

Če vsem zgornjim atributom dodamo še nabor treh atributov, ki jih pridobimo s preverjanjem semantične skladnosti, govorimo o sistemu *SAGE*. Sistem za zaznavanje semantičnih napak v ozadju uporablja ontologijo, kateri postopoma dodajamo dejstva, ki jih izluščimo iz besedila. Z logičnim sklepanjem nato ugotovimo, če so trditve iz besedila logično konsistentne ali ne. To nam prinese tri dodatne atribute in možnost povratne informacije, v katerih povedih je prišlo do semantičnega neskladja.

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[1] https://orange.biolab.si/

2 SORODNA DELA

V sklopu svojega dela se je Zupanc [5] osredotočila na (v času njenega raziskovanja že zaključeno) tekmovanje avtomatskega ocenjevanje esejev, ki ga je gostil Kaggle.[2] Na tem tekmovanju so pomerili različni sistemi, s katerimi je Zupanc primerjala svoj sistem. Najboljša mesta na končni lestvici so večinoma zasedali komercialni sistemi za ocenjevanje esejev, nekaj pa je bilo tudi po meri narejenih uporabniških modelov. Komercialni sistemi kot so PEG,[3] e-rater[4] in IntelliMetric[5] imajo že dolgo zgodovino in s tem velik tržni delež ter izpopolnjen finančni model. V času raziskovanja noben od naštetih ni ponujal brezplačne verzije sistema. Podrobno razčlenitev modelov in splošen opis njihovega delovanja najdemo v delih Zupanc [5] ter Zupanc in Bosnić [6].

V zadnjem času se na različnih področjih čedalje bolj uveljavljajo nevronski modeli, zato smo pogledali in testirali nekaj izvedb. Martinc in sod. [3] opisujejo uspešnost treh različnih nevronskih modelov pri ocenjevanju besedil, ki sicer niso eseji. Tudi Taghipour in Tou Ng [4] sta primerjala različne nevronske modele za ocenjevanje esejev (na istih podatkih kot mi). Najboljši model dosega skoraj tak rezultat, kot mi. Alikaniotis in sod. so objavili članek [1], kjer so tudi testirali uspešnost različnih nevronskih modelov na enaki podatkovni zbirki esejev, kot smo jo uporabljali mi.

3 OPIS IMPLEMENTACIJE IN METODE

3.1 Uporabljena orodja

Celoten sistem smo implementirali z uporabo orodja za podatkovno rudarjenje Orange v programskem jeziku Python. Glavne uporabljene knjižnice za razčlenitev besedila in izračun atributov so NLTK,[6] SpaCy,[7] scikit-learn[8] in language-check[9] za zaznavanje pravopisnih napak.

Za delo z ontologijami smo uporabili knjižnico rdflib[10] in zunanja sistema (v smislu samostojna lokalna programa) ClausIE (na voljo tudi OpenIE5.0) in HermiT.[11]

3.2 Implementacija gradnikov v Orange

Skupno smo razvili tri gradnike, ki zajemajo celoten opisan sistem. Slika 1 prikazuje vse tri gradnike, ki so opisani v nadaljevanju.

Prvi gradnik je namenjen izračunu vseh različnih mer. To so osnovne (plitke) statistične mere, mere berljivosti, leksikalne mere, slovnične mere, vsebinske mere in mere koherentnosti. Gradnik predstavlja sistema *AGE* in *AGE+*, odvisno od uporabnikove izbire atributov, ki naj se izračunajo. Če označimo izračun vseh atributov, razen atributov za koherenco, govorimo o sistemu *AGE*, z dodanimi atributi za koherenco pa govorimo o sistemu *AGE+*. Ker je računanje nekaterih naprednih mer bolj zahtevno, se lahko uporabnik odloči za izračun kakršnekoli kombinacije naštetih šestih skupin mer. Za vsebinske mere in mere koherentnosti je na voljo dodatna izbira metode pretvorbe besedila v večdimenzionalni vektorski prostor. Tu podpiramo dve metodi: statistično pretvorbo TF-IDF in vektorske vložitve GloVe (v dveh izvedbah: SpaCy in Flair).

[2]https://www.kaggle.com/
[3]https://www.measurementinc.com/products-services/automated-essay-scoring
[4]https://www.ets.org/
[5]http://www.intellimetric.com/direct/
[6]https://www.nltk.org/
[7]https://spacy.io/
[8]https://scikit-learn.org/stable/
[9]https://pypi.org/project/language-check/
[10]https://rdflib.readthedocs.io/en/stable/
[11]http://www.hermit-reasoner.com/
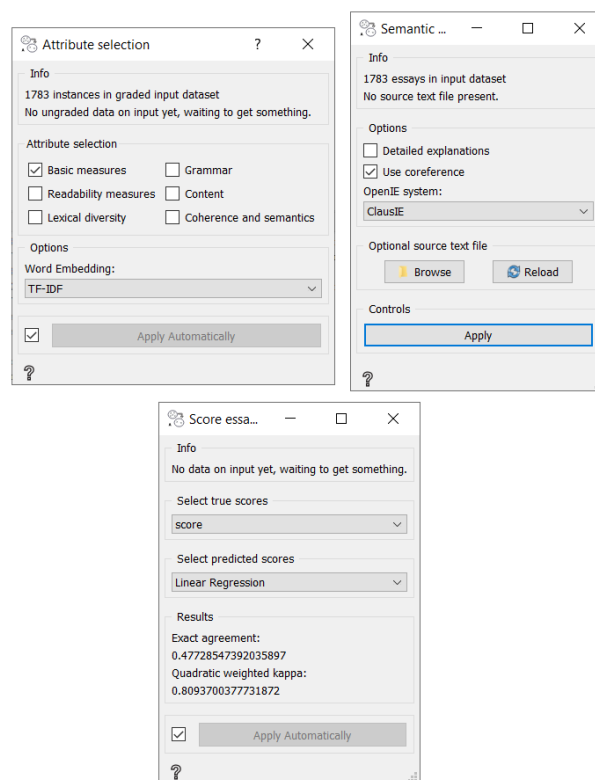
Slika 1: Prikaz vseh treh gradnikov

Gradnik ima tri vhode:

(1) vhod za ocenjene eseje,
(2) vhod za neocenjene eseje in
(3) vhod za izvorno besedilo.

Vhoda za ocenjene in neocenjene eseje sta namenjena učni množici ocenjenih esejev in množici neocenjenih esejev, ki jim hočemo napovedati ocene. Na obeh množicah se izračunajo enaki atributi. Atribute ocenjenih esejev uporabimo za gradnjo modela. Vhod za izvorno besedilo je neobvezen in predstavlja izhodiščno zgodbo, knjigo ali dejstva, ki naj bi jih pisec eseja poznal. Če so eseji osnovani na podlagi nekega izvornega besedila, ga povežemo na ustrezen vhod in s tem izračunamo dodaten atribut (podobnost eseja z izvornim besedilom). Gradnik ima dva izhoda, in sicer izhod za izračunane atribute ocenjenih esejev in izhod za izračunane atribute neocenjenih esejev. To nam omogoča, da podatke ustrezno nastavimo kot vhode v ostale Orange-ove gradnike.

Drugi gradnik obsega delo in iskanje semantičnih neskladnosti z ontologijo. Predstavlja izračun dodatnih atributov, ki jih prinaša sistem *SAGE*. Gradnik je samostojen zaradi velike računske in časovne zahtevnosti. Ima dve nastavitvi: ali želimo uporabiti razreševalnik koreferenc in ali želimo, da se nam za semantične napake vrne podrobna razlaga. Uporaba koreferenc je priporočljiva, saj je v primerih posrednega navezovanja na različne pojme v besedilu to edini način zajetja celotne semantične informacije. Izberemo lahko tudi izvorno besedilo ali zgodbo, s katerim se razširi ontologijo, tako da ta vključuje tudi vsebino osnovnega besedila. To besedilo se bo obdelalo pred vsem ostalim, izluščene trojice pa bodo dodane v ontologijo. Razširjena ontologija se bo uporabila za preverjanje skladnosti esejev. Če
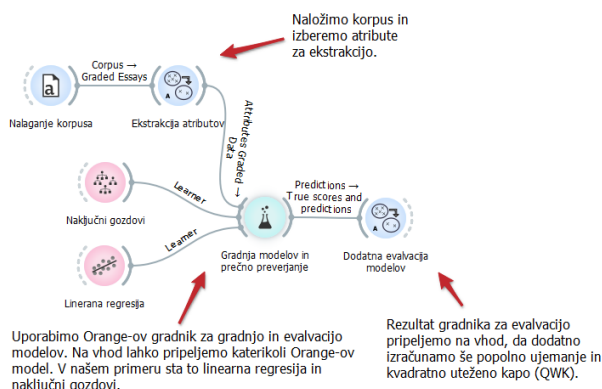
Slika 2: Primer uporabe sistema AGE/AGE+

izvornega besedila ne dodamo, se za preverjanje skladnosti normalno uporabi osnovna ontologija (ontologija COSMO). Gradnik ima samo en vhod — vhod za eseje ter en izhod — tabela treh atributov o številu posameznih napak in niz z osnovno razlago ter dodatni stolpec s podrobno razlago, če je ta izbrana.

Tretji gradnik je namenjen evalvaciji napovedanih ocen in pravih ocen esejev. Ker Orange ne podpira mer za izračun natančnega strinjanja (angl. *exact agreement*) in kvadratne utežene kape (angl. *quadratic weighted kappa - QWK*), smo naredili gradnik, ki prejme tabelo z napovedanimi ocenami in pravimi ocenami. Zgledovali smo se po izhodu gradnika *Test and Score* — za zagotavljanje interoperabilnosti lahko ta izhod vežemo neposredno na vhod našega gradnika, kjer se izračunata prej omenjeni meri.

Uporaba gradnika za izračun atributov in evalvacijo modela s kvadratno uteženo kapo je prikazana na Sliki 2.

3.3 Semantična analiza

Eden glavnih prispevkov dela Zupanc in Bosnić [6] je uporaba ontologij za ugotavljanje semantične skladnosti. Ta postopek je uporaben na dva načina: z njim pridobimo nekaj dodatnih atributov, ki jih lahko uporabimo pri napovedovanju ocen esejev, dodatno pa nam ta postopek tudi sporoči, kje se nahajajo semantične napake. Slednja funkcionalnost je zelo pomembna, saj tako učenec prejme neposredno informacijo o napakah v eseju.

Postopek temelji na uporabi ontologije, v katero postopoma dodajamo v relacije strukturirane stavke in sproti preverjamo skladnost ontologije. Osnovna struktura ontologije je predstavljena s "trojicami" v obliki *(osebek, relacija, predmet)*. Relacija lahko predstavlja omejitev, konceptualno povezavo (npr. *(Alice, isMotherOf, Bob)*) ali definira tip. V implementaciji smo za predstavitev trojic uporabili jezik RDF, ki je podoben jeziku OWL, vendar ni logični jezik. Uporabili smo ontologijo COSMO (angl. *Common Semantic Model*). Predstavljena je v semantičnem jeziku OWL[12] (*Web Ontology Language*), ki omogoča gradnjo kompleksnih shem različnih konceptov, dejstev in medsebojnih relacij. V primeru, da bi hoteli ontologiji dodati dodatna specifična znanja, to lahko storimo. V našem primeru je poleg nekaterih esejev tudi izvorno besedilo, na podlagi katerega so bili eseji spisani. Izvorno besedilo dodamo v ontologijo pred eseji in po enakem postopku kot eseji in je razložen spodaj.

Za posamezen esej poiščemo koreference v besedilu (angl. *coreference resolution*). Ugotavljanje referenc nam omogoča odkrivanje posrednih referenc na določene entitete in zamenjavo z neposredno entiteto. Primer: "*Bob likes pizza. He eats it all the time.*" nadomestimo z "*Bob likes pizza. Bob eats pizza all the time*".

Naslednji korak je razčlenitev besedila na posamezne povedi in ekstrakcija informacij s pomočjo sistema OpenIE (angl. *Open Information Extraction*). V tem koraku posamezne povedi pretvorimo v eno ali več trojic, ki opišejo relacije, izražene v povedi in so primerne za logično obdelavo. Za zgornji primer bi tako dobili dve trojici: *(Bob, like, pizza)* in *(Bob, eat, pizza)*. Uporabili smo sistem za ekstrakcijo ClausIE [2], podpiramo pa tudi možnost uporabe sistema OpenIE5.[13] Vse pridobljene trojice nato postopoma dodajamo v ontologijo, obenem pa preverjamo njeno skladnost. Za vsak element trojice poskušamo v ontologiji najti že obstoječ element. Pri tem preiščemo sopomenke, nadpomenke in protipomenke, v najslabšem primeru pa dodamo v ontologijo nov element. Po vsakem dodajanju elementov in trojic, preverimo skladnost ontologije. Skladnost preverjamo z logičnim sklepalnikom HermiT, ki vrača dva tipa napak. Prvi tip napak se zgodi, ko ima nek razred (*owl:class*) prirejene entitete, ki jih ne sme imeti (*unsatisfiable case*). Drugi tip napak pa se proži, ko se s sklepanjem ugotovi logična napaka — nekonsistentna ontologija (angl. *inconsistent ontology*). Do takšnih napak pride ponavadi zaradi neposrednih nasprotij (npr. *owl:disjointWith*) med dvema relacijama, ki pravi, da entiteta ne more imeti obeh relacij hkrati).

Na podlagi povzročenih tipov napak osnujemo tri dodatne atribute, ki jih lahko uporabimo pri napovedovanju ocen esejev: število neizpolnjenih primerov (pri dodajanju novih entitet v ontologijo), število napak nekonsistentne ontologije (pri dodajanju trojic) in vsota obeh prejšnjih.

3.4 Rezultati

Sistem smo testirali na podatkih že nekaj let starega tekmovanja ASAP na spletni strani Kaggle.[14] Podatki obsegajo osem različnih podatkovnih zbirk (oz. devet, ker se druga zbirka ocenjuje po dveh kriterijih). Tema esejev v vsaki podatkovni zbirki je različna. Zbirke so razdeljene na učno, validacijsko in testno množico, vendar ocene validacijske in testne množice niso na voljo, zato smo za evalvacijo našega sistema uporabili 10-kratno prečno preverjanje. Razpon ocen je v vsaki zbirki različen, gibljejo se od 0–4, pa vse do 0–60. Za oceno modelov smo uporabili mero kvadratno utežene kape (angl. *quadratic weighted kappa*), ki upošteva razpon ocen in vrne relativno ujemanje napovedane ocene z dejansko oceno. Sistem smo testirali na modelu linearne regresije in naključnih gozdov. Bolje se je odrezala linearna regresija, zato smo se nanjo osredotočili v nadaljnjih eksperimentih. Uporabili smo regularizacijo L2 s parametrom $\alpha = 0,02$.

Na začetku smo modele gradili na celotnem naboru izračunanih atributov. Ker sistem *AGE+*, domnevno zaradi prevelikega števila atributov (106), ni dosegal boljših rezultatov od sistema *AGE*, smo preizkusili nekaj metod za izbiranje atributov. Glavni metodi naše analize sta bili vnaprejšnje izbiranje atributov (angl. *forward attribute selection*) in izločanje atributov (angl. *backward feature elimination*). Obe metodi sta izboljšali rezultat. Uporabili smo jih skupaj z 10-prečnim preverjanjem. Na vsaki iteraciji prečnega preverjanja smo dodali/odstranili posamezne atribute in glede na povprečje preko vseh iteracij dodali/odstranili atribut z največjim/najmanjšim prispevkom. To smo ponavljali, dokler ni bilo

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[12]https://www.w3.org/OWL/

[13]https://github.com/dair-iitd/OpenIE-standalone
[14]https://www.kaggle.com/c/asap-aes

Tabela 1: Primerjava rezultatov brez izbiranja atributov naše implementacije sistemov AGE in AGE+ (TF-IDF), primerjava s sistemom Zupanc (AGE) in strnjeni rezultati izbiranja ter izločanja atributov na sistemu AGE+

	Brez izbiranja			Izbiranje	Izločanje
	AGE	AGE+	Zupanc (AGE)	AGE+	AGE+
DS1	0,8358	0,8343	0,8447	0,8369	0,8439
DS2a	0,7001	0,7073	0,7389	0,7158	0,7324
DS2b	0,6789	0,6676	0,5386	0,6941	0,7028
DS3	0,6578	0,6622	0,6591	0,6656	0,6958
DS4	0,7536	0,7547	0,7174	0,7619	0,7769
DS5	0,7964	0,7955	0,7949	0,8028	0,8122
DS6	0,7734	0,7675	0,7636	0,7771	0,7871
DS7	0,8071	0,8034	0,7888	0,8083	0,8183
DS8	0,7479	0,7428	0,7738	0,7681	0,7717
AVG	0,7501	0,7484	0,7356	0,759	**0,7712**

več izboljšanja. Pri analizi smo opazili, da je nabor atributov, ki pride v končni izbor, relativno majhen. Ugotovili smo, da je zaradi prečnega preverjanja velika možnost, da s trenutnim naborom atributov pridemo v lokalni optimum. Zaradi povprečenja čez vse iteracije lahko nek atribut v prvi iteraciji izboljša rezultat, v drugi pa poslabša, in je v povprečju označen kot neprimeren. Za izogibanje tem lokalnim optimumom smo implementirali mejo, kolikokrat se lahko v povprečju rezultat poslabša, preden nabor atributov označimo kot končen. S tem smo kratkoročno poslabšali rezultat, vendar dolgoročno ustvarili kombinacijo atributov, ki dajejo v povprečju boljši rezultat. S to metodo izogibanja optimumov smo še dodatno izboljšali končne rezultate, ki so strnjeno prikazani v Tabeli 1. Pri izbiranju in izločanju atributov je AGE izpuščen, saj AGE+ v obeh primerih dosega boljše rezultate. Ker testni podatki niso več na voljo, smo naše rezultate s sistemom Zupanc lahko primerjali le s primerjavo sistemov AGE z 10-kratnim prečnim preverjanjem. Vidimo, da dosegamo zelo podobne rezultate, kot sistem Zupanc oz. jih nekoliko presegamo. Z ustreznim izbiranjem atributov pa naš rezultat še dodatno izboljšamo.

Sistem *SAGE* smo iz tabele izpustili, saj so rezultati z izločanjem atributom le malenkost boljši od sistema *AGE+*, prav tako pa smo ga uporabili le na podatkovnih zbirkah, ki so vsebovale izvorno besedilo (samo štiri zbirke). Kljub temu pa sistem *SAGE* ob zaznanem semantičnem neskladju nudi izpis povratne informacije. Primer v nadaljevanju prikazuje delovanje razreševalnika koreferenc in odkrivanje semantičnih napak. Zaradi korenjenja so nekatere besede v razlagi lahko odsekane. Vhod "George likes basketball and doesn't like sports.", sproži napako z razlago: "Relation 'George likes basketball and George doesn't like sports.' is inconsistent with a relation in ontology: 'George likes basketball and George doesn't like sports.'" in podrobno razlago: "Relation not consistent: Georg likes Basketball. Relations doesNotLike and likes are opposite/disjoint. Relation not consistent: Georg doesNotLike Basketball.". Osnovna razlaga deluje na ravni povedi in nam v tem primeru pove, da je poved v nasprotju sama s sabo. Podrobna razlaga pravi, da George ima in nima rad košarke. Beseda "sports" se v podrobni razlagi ne pojavi, ker je košarka podrazred športa in tam najprej pride do nasprotja.

Omenili bi še primerjavo našega sistema z omenjenimi nevronski modeli. Model Taghipour in Tou Ng [4] dosega podobne rezultate, kot naš sistem (nekaj pod 0,77). Alikaniotis in sod. [1] opisujejo, da njihov model dosega rezultat 0,96, vendar sumimo na nekaj nepravilnosti, ki izvirajo iz napačne uporabe mere za

ocenjevanje modelov (kvadratno utežene kape). Sumimo, da so za učenje svojega modela uporabili vse podatkovne zbirke skupaj, saj je njihov rezultat v območju skoraj 100% natančnosti (0,96), z dvakrat večjo absolutno napako (RMSE), kot naš model, ki ima rezultat približno 0,77. Z uporabo vseh zbirk na našem sistemu tudi dobimo tako visok rezultat (0,97 in 0,94, odvisno od modela).

4 ZAKLJUČEK

V sklopu tega dela smo implementirali sistem za ocenjevanje esejev po zgledu dela Zupanc [5] v programskem okolju Orange. Implementacija v okolju Orange omogoča enostavno uporabo sistema in združljivost z že implementirami funkcionalnostmi Orange-a. Sistemu smo dodali nekaj novih atributov in možnost predstavitve besed z vektorskimi vložitvami GloVe. Naša implementacija sistema je na voljo na repozitoriju git.[15] Sistem temelji na ekstrakciji velikega števila atributov iz besedil in nato izboru najboljšega nabora za določeno podatkovno zbirko. Inovativni del preteklega dela, ki je vključen tudi v naši implementaciji, je dodaten sistem za preverjanje semantične skladnosti, s pomočjo katerega nabor atributov dodatno obogatimo, obenem pa imamo možnost, da nam sistem izpiše vse zaznane semantične napake oz. neskladja. Prispevek tega članka predstavlja tudi primerjava tehnik izbiranja atributov in primerjava rezultatov s preteklim delom. Sistem bi bilo smiselno preizkusiti tudi z drugimi napovednimi modeli, saj smo se v našem delu najbolj osredotočili le na linearno regresijo in naključne gozdove. Zanimiv izziv bi bil tudi prilagoditev sistema za slovenski jezik, ker je jezik sintaktično kompleksnejši, orodja za obdelavo besedil pa še niso tako zrela kot za angleški jezik.

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Mental State Estimation of People with PIMD using Physiological Signals

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ABSTRACT
People with profound intellectual and multiple disabilities are a very diverse and vulnerable group of people. Their disabilities are cognitive, motor and sensory, and they are also incapable of symbolic communication, making them heavily reliant on caregivers. We investigated the connection between physiological signals and inner states as well as communication attempts of people with PIMD, using signal processing and machine learning techniques. The inner states were annotated by expert caregivers, and several heart rate variability features were computed from photoplethysmogram. We then fed the features into hyper-parameter-tuned classification models. We achieved the highest accuracy of 62% and F1-score of 0.59 for inner state (pleasure, displeasure, neutral) classification using Extreme Gradient Boosting, which notably surpassed the baseline.

KEYWORDS
PIMD, mental state, physiological signals, classification

1 INTRODUCTION
People with profound intellectual and multiple disabilities (PIMD) often face extreme difficulties in their day-to-day life due to severe cognitive, motor and sensory disabilities. They require a nearly everpresent caregiver to help them with most tasks. Additionally, they are unable to communicate their feelings or express their current mental state in a traditional symbolic way. This causes a gap between a caregiver and the care recipient, as it can take an extended period of time for the caregiver to recognize any potential patterns and their relationship with the mental state of the care recipient.

The aforementioned reasons call for a technological solution that might help bridge the gap between the caregiver and the care recipient and help the former better understand the latter. The INSENSION project [8] aims to develop such assistive technology, which takes into account many aspects of the care recipient. The aim is to both bridge the previously mentioned gap as well as empower the people with PIMD to be able to interact with

their surroundings through technology. One part of the system considers the patterns in a person's gestures and facial expressions, which might have some significance and correlation to their behavioural and mental state, or their communication attempt. The initial solution dealing with this part was already described by Cigale et al. [1, 2]. In this paper, we instead focus on exploring the relationship between the physiological response of the body and the mental state of the people with PIMD by using features computed from photoplethysmogram (PPG). PPG is a periodic signal, where each cycle corresponds to a single heart beat. We obtained the PPG in two different ways: 1.) by using a high-quality wearable Empatica E4 with an optical sensor measuring the reflection of light from the skin and 2.) by using a contact-free RGB camera mounted on a wall, which records the color changes of the skin pixels. The features were then used to train classification models, which predicted the person's inner state or communication attempt.

The rest of this paper is structured as follows: we first investigate the related work in Section 2, then we describe the data collected and used in the experiments in Section 3. We continue with the methodology and experimental setup description in Section 4, and conclude with results and discussion in Section 5.

2 RELATED WORK
The connection between physiological parameters and mental states is a mature and highly-researched field when it comes to average healthy people.

Schachter et al. [6] investigated the emotional state of people as a function of cognitive, social and physiological state. Several propositions were made and experimentally confirmed, supporting the overall connection between emotional and physiological state.

Cigale et al. [1, 2] explored the communication signals of people with PIMD, which are atypical and idiosyncratic. They highlighted the challenging interpretation of these signals and their meaning and suggested how technology could help overcome the gap between caregivers and care recipients. Some models were proposed that take the person's non-verbal signals (NVS) as input and classify their inner state or communication attempt.

Kramer et al. [3] highlighted the challenges of analysing the NVS in people with PIMD, as they are difficult to discern, instead focusing on physiological body responses. They conducted a research in which the expressions of three emotional states of one person with PIMD were recorded during nine emotion-triggering

situations. They collected heart rate (HR) and skin conductance level (SCL), and investigated the connection between these two physiological signals and the emotional state. They found higher SCL activity during anger or happiness and lower SCL activity during relaxation or neutral state.

Vos et al. confirmed that HR and skin temperature allow the same conclusions in people with PIMD and people without disabilities, regarding positive and negative emotion. This finding gives additional motivation to our work, showing that the connection between physiological and mental state also holds for people with PIMD [9].

3 DATA

We created a recording setup in the INSENSION project, which uses two Logitech C920 cameras capable of recording full HD (1920x1080) resolution video at 30 frames per second (fps). The cameras were setup perpendicular to one another to record from two distinct angles, allowing for decent facial exposure even when the face changes direction. The caregivers were instructed to attempt to conduct their activity in front of one of the cameras whenever possible. Additionally, the subjects were given an Empatica E4 wristband, which served both as the ground truth for PPG, as well as a fall-back mechanism for obtaining physiological signals in cases when camera is unreliable or unavailable. The wristband records PPG at 64 Hz, allowing for capture of reasonable morphological details. The temporal synchronization between the video and ground truth was ensured to the best of our abilities using suitable protocols and checks.

With the described setup, we obtained 48 recording sessions, each lasting between 10 and 30 minutes. Five sessions were eliminated immediately, as there was a large mismatch between the duration of the video and the duration of the ground truth, which may happen due to several reasons, such as a caregiver forgetting to turn on the wristband during a session or the wristband losing connection.

It is important to note that the recordings were made in a natural way, as the caregivers were not given any additional restrictions other than to be in front of the camera when possible. In practice this means that large parts of some recordings might be useless due to the person with PIMD being turned away or the caregiver blocking them. Examples of good and bad sessions are shown in Figure 1.

3.1 Annotating the ground truth

In order to classify mental states of people with PIMD, we first required the ground truth annotations. As it is generally difficult to obtain such ground truth, we relied on the expert knowledge of partners in the project who specialize in education of people with special needs, alongside the caregivers, who know their care recipients the best. Together they devised an annotation schema, in which they annotated inner states and communication attempts of people with PIMD and can take the values given in Equations 1 and 2.

$$InnerState = \begin{cases} displeasure & \text{if 1, 2 or 3} \\ neutral & \text{if 4, 5 or 6} \\ pleasure & \text{if 7, 8 or 9} \end{cases} \quad (1)$$

The three numbers within each mental state indicate the intensity, where a lower number for displeasure means more intense displeasure, and a higher number for pleasure indicates more intense pleasure.
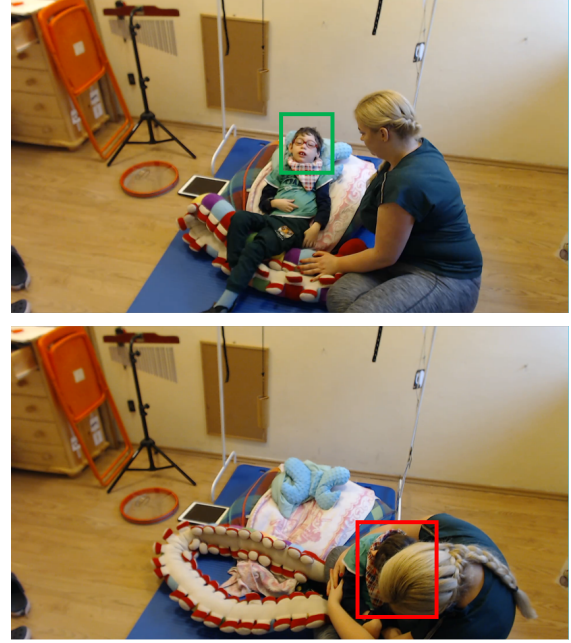
Figure 1: Example of good (green) and bad (red) video recordings.

$$CommAttempt = \begin{cases} protest \\ comment \\ demand \end{cases} \quad (2)$$

The caregivers were tasked with annotation of videos, looking at camera recordings and marking inner states and communication attempts in time, always marking the start and end of each recognized state, regardless of duration (can be a few seconds or a few minutes). Naturally, large periods remained where nothing was annotated, as the experts were either not sure or did not recognize any of the pre-defined states. This does not mean that nothing is happening in those periods, but simply that the inner experience of the person with PIMD is unknown. Thus, we added an additional class value for the areas where nothing was annotated – unknown.

4 METHODOLOGY OF MENTAL STATE ESTIMATION

Having both the ground truth annotations and physiological data and videos, we then investigated two approaches: 1.) we attempted to reconstruct PPG from the camera recordings in a contact-free manner and use the reconstructed rPPG (remote PPG) to calculate features and to classify inner state and communication attempt and 2.) we directly used the Empatica ground truth PPG to calculate features to be used in the same classification task.

4.1 Using rPPG Reconstruction

In order to obtain the remote PPG, we used a rather standard pipeline, which was updated with a convolutional neural network in order to further enhance the rPPG. At a high level, the pipeline consists of detection or region of interest (ROI), extraction of red, green and blue signal components (RGB), detrending and band-pass filtering of RGB, rPPG reconstruction using the Plane

Orthogonal to Skin (POS) algorithm, band-pass rPPG filtering (0.5 to 4.0 Hz), and rPPG enhancement via deep learning. Details were already described in our previous work [7] and are not subject of this paper.

We ran the pipeline described above on 30-second segments of video using a sliding window without overlap. We decided to use 30 seconds due to the nature of some frequency features that we chose, as frequency analysis makes sense once a reasonable number of periods are available - in our case this means that a sufficient number of heart cycles must be available. Additionally, this length makes sense as we are primarily attempting to predict inner states, which do not change extremely in such a short time span. An example output of the pipeline is shown in Figure 2.
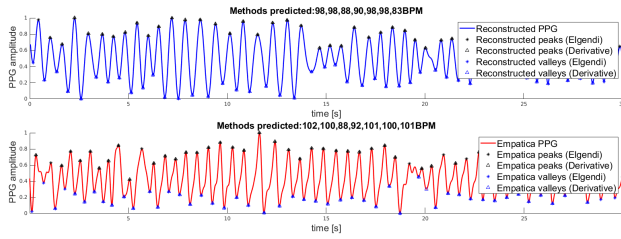
Figure 2: Example of a good rPPG segment obtained with our pipeline.

We then used the rPPG to compute several heart rate variability (HRV) features. These are known to be well-correlated with stress, cognitive load, conflict experience and other inner states [5, 4]. A detailed list of computed features is given in Table 1.

4.2 Using Empatica PPG

The Empatica records PPG directly on the skin, thus making the raw PPG readily available, without the need for additional reconstruction. Still, due to subject arm and wrist movements, we opted to use similar preprocessing steps used previously, namely detrending and band-pass filtering, as the signal can sometimes be quite noisy.

We computed the same set of features and window length as before (see Table 1), and used them in the same classification task, attempting to recognize inner states and communication attempts.

5 EXPERIMENTS AND RESULTS

Once both the input (HRV features) and output (annotations) were known, we investigated six classification algorithms (k Nearest Neighbours, Decision Trees, Random Forest, Support Vector Machines, AdaBoost and Extreme Gradient Boosting) for this task, always training separate models for inner state and communication attempt. We always compared each algorithm against a baseline majority vote classifier using two metrics, accuracy and F1-score.

5.1 Using Empatica PPG

We started our evaluation using the Empatica data, as it is more reliable, since the PPG reconstruction is not needed. At the time of evaluation, we had annotations for 15 recording sessions in which 2 different people with PIMD are present. Using the chosen 30-second window, we initially had 417 segments of Empatica PPG available. The unknown class label heavily skewed the data for both classes, and there is no way to know which (other) class

Table 1: List of computed HRV features.

Feature	Description
HRmean	$60/mean(NN)$
HRmedian	$60/median(NN)$
IBImedian	$median(NN)$
SDNN	$std(NN)$
SDSD	$std(abs(NN'))$
RMSSD	$sqrt(mean((NN')^2))$
NN20 and NN50	The number of pairs of successive NNs that differ by more than 20ms and 50ms
pNN20 and pNN50	The proportion of NN20 and NN50 divided by total number of NNs
SDbonus1	$sqrt(0.5) * SDNN$
SDbonus2	$sqrt(abs(2 * SDSD^2 - 0.5 * SDSD^2))$
VLF	Area under periodogram in the very low frequencies
LF	Area under periodogram in the low frequencies
HF	Area under periodogram in the high frequencies
LFnorm and HFnorm	Area under periodogram in the low and high frequencies, normalized by the whole area under periodogram
LFdHF	LF/HF
where std	is standard deviation,
abs	is absolute value,
X'	is the first order derivative,
$sqrt$	is the square root and
NN	are the beat-to-beat intervals.

label it actually belongs to, so we decided to exclude it from evaluation. This left us with 272 instances for class inner state and 80 instances for class communication attempt, which was annotated more sparsely. The final distributions for each class are shown in Figure 3.
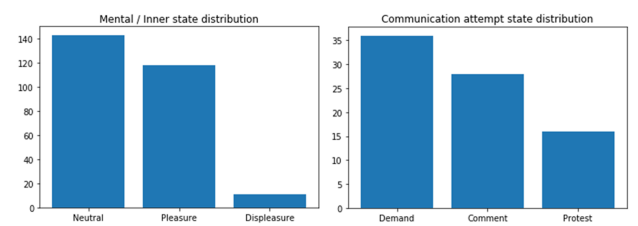
Figure 3: Distributions of both classes.

Initially we conducted a 5-fold cross validation (CV) to investigate the best hyper-parameters using a grid search. Once the hyper-parameters were determined, we ran a separate experiment, using the best overall hyper-parameters for each model. Again, we ran a 5-fold CV with the best hyper-parameter settings obtained on the full data to validate the performance. All the investigated algorithms (from the Scikit-learn and XGBoost packages) and their corresponding sets of optimized parameters with the best values are available from the authors, but are not listed here due to space restrictions. Results of our evaluation in terms of accuracy and F1-score for both classes are given in Table 2.

Table 2: Accuracy and F1 score for both classes.

Algorithm	$ACC_{mentalstate}$	$F1_{mentalstate}$
Baseline (majority)	0.52	0.36
kNN	0.55	0.55
Tree	0.54	0.56
RF	0.57	0.56
SVM	0.55	0.52
AdaBoost	0.59	0.56
XGB	**0.62**	**0.59**

Algorithm	$ACC_{commattempt}$	$F1_{commattempt}$
Baseline (majority)	0.45	0.27
kNN	0.42	0.42
Tree	0.41	0.39
RF	0.46	0.43
SVM	0.43	0.34
AdaBoost	0.43	0.41
XGB	**0.48**	**0.45**

5.2 Using rPPG reconstruction

Using the rPPG for evaluation proved to be more difficult, as we only had limited amount of good subsequent facial crops from the videos, while also having a limited amount of annotations. This meant that the overlap between the two was very small – we had only 12 such 30-second segments for inner state and only 6 for communication attempt. Such a low amount of data is infeasible to be used in a realistic evaluation scheme (not even all three different class labels were present), so we instead decided to use the models previously trained on the Empatica data, to classify these instances obtained via the rPPG. We achieved reasonably high accuracy of 75% and F1-score of 0.84 for inner state and low accuracy of 33% and F1-score of 0.33 for communication attempt. Confusion matrices are shown in Figure 4.
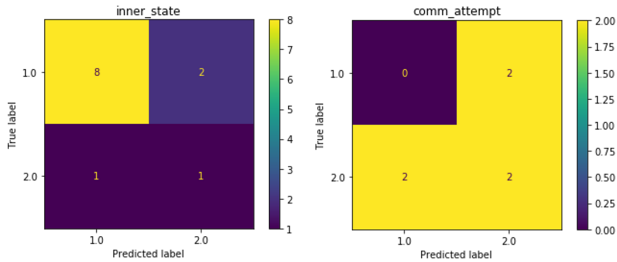
Figure 4: Confusion matrices for classifying rPPG instances using models trained on Empatica data. For inner state, the class values are 1.0="neutral" and 2.0="pleasure". For communication attempt 1.0="comment" and 2.0="demand".

6 CONCLUSION

We conducted an initial investigation of the connection between physiological signals and mental states of people with PIMD, attempting to classify their inner states and communication attempts. We used HRV features computed from the PPG obtained with an Empatica E4 wristband and investigated the performance of such models on instances obtained via rPPG. XGB has shown the best performance, achieving accuracy of 62% and F1 score of

0.59 for inner state, and accuracy of 48% and F1 score of 0.45 for communication attempt, notably surpassing the baseline majority classifier.

Limitations of our work lie in low number of instances for communication attempt and little variety in subjects, having just two for which annotations were available. Additionally, the evaluation using the rPPG is limited, as we had very few instances for which both high-quality segments of video and annotations were available. Thus, the focus of future work should be on gathering more data and conducting a more extensive evaluation of the methods, which is planned in the trial stage of the INSENSION project.

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Energy-Efficient Eating Detection Using a Wristband

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ABSTRACT

Understanding people's dietary habits plays a crucial role in interventions that promote a healthy lifestyle. For this purpose, a multitude of studies explored automatic eating detection with various sensors. Despite progress over the years, most proposed approaches are not suitable for implementation on embedded devices. The purpose of this paper is to describe a method that uses a wristband configuration of sensors to continuously track wrist motion throughout the day and detect periods of eating automatically. The proposed method uses an energy-efficient approach for activation of a machine learning model, based on a specific trigger. The method was evaluated on data recorded from 10 subjects during free-living. The results showed a precision of 0.84 and a recall of 0.75. Additionally, our analysis shows that by using the trigger, the usage of the machine learning model can be reduced by 80%.

KEYWORDS

Eating detection, wristband, energy efficient, activity recognition

1 INTRODUCTION

Understanding people's dietary habits plays a crucial role in interventions that promote a healthy lifestyle. Obesity, which is a consequence of bad nutritional habits and excessive energy intake, can be a major cause of cardiovascular diseases, diabetes or hypertension. Latest statistics indicate that obesity prevalence has increased substantially over the last three decades [1]. More than 600 million adults (13% of the total adult population) were classified as obese in 2014 [2]. In addition, the prevalence of obesity is estimated to be 23% in the European Region by 2025. Also, in 2017, it was reported that poor diet has contributed to 11 million deaths worldwide. Monitoring eating habits of overweight people is an essential step towards improving nutritional habits and weight management.

Another group of people that require monitoring of their eating behavior are people with mild cognitive impairment and dementia. They often forget whether they have already eaten and, as a result, eat lunch or dinner multiple times a day or not at all. It might cause additional health problems. Proper treatment of these issues requires an objective estimation of the time the meal takes place, the duration of the meal, and what the individual eats.

Wristband devices and smartwatches are increasingly popular, mainly because people are accustomed to wearing watches, which makes the wrist placement one of the least intrusive body placements to wear a device. Additionally, the cost of these devices is relatively low, which makes them easily accessible to everyone. However, these devices offer limited computing power and battery life, which makes the implementation of a smart feature as eating detection on such a device a challenging task.

This paper describes a method for real-time eating detection using a wristband. The proposed method detects periods and duration of eating. The output from the method can be used to track frequency of eating and could serve to start methods for counting food intakes.

The work done in this study is important for the following reasons. We developed a trigger that can reduce the usage of the machine learning procedure, meaning that our method will not greatly affect the battery life of the device. Additionally, we evaluated different machine learning algorithms in terms of accuracy and model size. The method was evaluated on data recorded in real-life from 10 subjects.

2 RELATED WORK

Recent advancements in wearable sensing technology (e.g., commercial inertial sensors, fitness bands, and smartwatches) have allowed researchers and practitioners to utilize different types of wearable sensors to assess dietary intake and eating behavior in both laboratory and free-living conditions. A multitude of studies for the detection of eating periods have been proposed in the past decade. Mirtchou et al. [3] explored eating detection using several sensors and combining real-life and laboratory data. Edison et al. [4] proposed a method that recognizes intake gestures separately, and later clusters the intake gestures within 60-minute intervals. The method was evaluated on real-life data. Dong et al. [5] proposed a method for eating detection in real-life situations based on a novel idea

that meals tend to be preceded and succeeded by periods of vigorous wrist motion. Amft et al. [6] presented an accurate method for eating and drinking detection using sensors attached to the wrist and upper arm on both hands. Navarathna et al. [7] combined sensor data from a smartwatch and a smartphone, which resulted in improved eating detection accuracy compared to only using smartwatch data. Kyritsis et al. [8] proposed a deep learning based method that recognizes bite segments, which are used for construction of eating periods.

The work presented in this paper is an extension of our previous work [9], and the main novelty is an energy efficient approach for real-time eating detection.

3   METHOD

The proposed eating detection method consists of two parts, namely: a threshold-based trigger, used for activation of an eating detection machine learning procedure, and a machine-learning method that predicts whether eating took place.

3.1   Energy-Efficient Trigger

The recent advancements in the technological development and accessibility of wearable devices bring new opportunities in the field of human activity recognition (HAR). However, the limited battery life and computational resources remain a challenge for real-life implementation of advanced HAR applications. Using a machine learning based model for eating detection that is working all the time results in a rapid battery drain. Therefore, we designed a threshold-based trigger that activates the machine learning model only when specific criteria are met. The main concept behind the trigger is to only select moments when the human is making a movement with his hand towards the head.

For this purpose, we used data from an accelerometer. This sensor provides information about the wristband's orientation from which we can see whether the hand is oriented towards the head. The recent accelerometers that are used in battery-limited devices can store acceleration values in their internal memory without interacting with the main chip of the microcontroller.

The first step of trigger implementation is to define the buffer size in the sensor's internal memory and the sensor's sampling frequency. Based on these two parameters, we enable the accelerometer to collect data for a specific time without interacting with the main chip of the microcontroller. This means that the main chip of the microcontroller could be in sleep mode for the predefined period. When the accelerometer's buffer is full, the accelerometer interrupts the main chip and transfers the stored acceleration data to it. We use the accelerometer's y-axis and z-axis to detect moments when the individual is moving the hand towards the face. Namely, we calculate the mean value for both axes, and if both of the values are above a predefined threshold value, the machine learning procedure for eating detection is activated. We used two axes for the trigger to reduce the possible situations in which our trigger is falsely activated. However, one can work only with one axis, which will result in more activated triggers. We could say that having more activated triggers is not desirable. However, if the eating detection method is not good enough to

detect eating after a trigger is activated during a meal, then the constraints of the trigger should be reduced.

The next step is the definition of stopping criteria for the machine learning model. The idea here is to stop the machine learning procedure after a specific number of windows if there is no eating detected. Each time our trigger is activated, the machine learning procedure is turned on for the next three buffers of data. The machine learning procedure is stopped if there is no positive prediction in any of the three windows. However, if there is at least one positive prediction, the machine learning procedure continues to work for another three new buffers. Also, the number of windows for which the machine learning procedure is active was experimentally obtained.

3.2   Machine-Learning Procedure

A detailed description of the used method can be seen in [9]. The method is based on machine learning and consists of the following steps: filtering the accelerometer and gyroscope data coming from the wristband, segmentation of the filtered data, feature extraction, feature selection, two stages of model training and predictions smoothing.

In the first step, the raw data were filtered with a 5th order median filter to reduce noise. Furthermore, the median filtered data was additionally filtered with low-pass and band-pass filters. Hence, we ended up with three different streams of data, median, low-pass and band-pass filtered data.

The accelerometer and gyroscope data were segmented using a sliding window of 15 seconds with a 3-second overlap between consecutive windows. This means that once we have 15 seconds of data, the buffer is adjusted to only store 3 seconds of new data. After that, each time the buffer is full, we add the new 3 seconds of data to the previous 15 seconds window and we drop the oldest 3 seconds from it. The reason for the length of the window is that it needs to contain an entire food intake gesture [10].

After the segmentation step, we extracted three different groups of features. Also, we included a feature selection step to improve the computational efficiency of the method, to remove the features that did not contribute to the accuracy and to reduce the odds of overfitting.

The training procedure for the method used in this study consists of three stages. The first two aim at training an eating-detection models on an appropriate amount of representative eating and non-eating data. The third step smooths the predictions of the model.

4   DATASET AND EXPERIMENTAL SETUP

For this study, we recorded data from 10 subjects (8 male and 2 female), ranging in age from 20 to 41 years. The data were recorded using a commercial smartwatch Mobvoi TicWatch S running WearOS, providing 3–axis accelerometer and 3–axis gyroscope data sampled at 100 Hz. The technical description of the sensors from the smartwatch shows that the recorded data is compatible with our target wristband for which we are developing our eating detection method. Additionally, the use of a commercially available smartwatch was an easier option for recording data. The collected dataset contains recordings

from usual daily activities performed by the subjects, including eating. The subjects were wearing the smartwatch on their dominant hand while recording. The smartwatch had an application installed on it, which enabled them to label the beginning and the end of each meal. There were no limitations about the type of meals the subjects could have while recording, which resulted in having 70 different meals included in the dataset. Furthermore, the subjects were also asked to act naturally while having their meals, meaning talking, gesticulating, using the smartphone, etc. The total data duration is 161 hours and 18 minutes, out of which 8 hours and 19 minutes correspond to eating activities.

For evaluation, the LOSO cross-validation technique was used. In other words, the models were trained on the whole dataset except for one subject on which we later tested the performance. The same procedure was repeated for each subject in the dataset. The results obtained using this evaluation technique are more reliable compared to approaches where the same subject's data is used for both training and testing, which show excessively optimistic results.

As mentioned before, smartwatches offer limited resources, one of which is the size of the RAM memory. Therefore, we analyzed models with different sizes to see whether the bigger and more complex models provide higher accuracy. We tested the performance of four different machine learning algorithms, Random Forest [11], Decision Tree [12], Logistic Regression [13] and LinearSVC [14].

We analyzed the following evaluation metrics: recall, precision and F1 score. These evaluation metrics are the most commonly used metrics for classification tasks like ours and give a realistic estimate of the efficacy of the algorithm. Also, the final results were obtained from the whole recordings by each subject. The reason for this is mainly to give a real picture of how good the developed method is in real-life settings.

5   RESULTS

The primary use of the trigger is to reduce the activity of the machine learning procedure. However, for the efficiency of the trigger, a very important requirement is when and how often the trigger is activated during a meal. In order to achieve accurate predictions, we want the trigger to be activated as soon as the meal is started. Additionally, the percentage of activated triggers during a meal should be bigger compared to noneating segments. For this purpose, we explored which window size works best with our trigger. Table 1 shows the results achieved in the conducted experiments. We tested two different window sizes with two slide values for each window, resulting in a total of four combinations.

Table 1: Different window size for the trigger procedure.

Window and slide size	Trigger activation time	% of activated triggers	Meals detected
3 - 1	36 s	34.2	68/70
3 - 3	41 s	32.6	68/70
15 - 3	48 s	42.0	55/70
15 - 5	41 s	42.0	54/70

Table 2: Results of eating detection procedure achieved with different algorithms and their model size.

Algorithm	Precision	Recall	F1 score	Model size
Random Forest	0.84	0.75	0.79	36339 KB
Logistic Regression	0.70	0.71	0.70	1.25 KB
LinearSVC	0.69	0.71	0.70	1.8 KB
Decision Tree	0.59	0.65	0.62	175 KB

The used combinations for the window and slide size are shown in the first column of the table. The second column shows the average time needed for the trigger to be activated for the first time after a meal is started. The third column shows the average percentage of triggered windows during a meal. These two columns were used as a metric for selecting the optimal size of a window and slide between the windows. The last column shows the number of meals when the trigger was activated. The values for the second and third columns were obtained only from the meals for which the trigger was activated. Row-wise comparison between these two columns shows the results obtained with each different combination of a window and slide. We can see that the most optimal combination regarding the average time needed for a trigger to be activated after a meal is started is a window size of 3 seconds with a slide of 1 second between two windows. Therefore, in our further analysis, we used this combination. The optimal window size of 3 seconds is expected if we have in mind that the usual intake gesture lasts around 2 seconds. Longer windows fail to detect the gesture while having a meal because usually we have two or three intakes in 15 seconds and the mean value over the whole window is low.

Table 2 shows the final results obtained using the whole method described in Section 2. Row-wise comparison between the used evaluation metrics shows the results obtained using the different algorithms shown in the first column. Additionally, the last column of the table represents the final model size. We can clearly see that the results achieved with Random Forest are better than the remaining algorithms. However, if we compare the model size of the best performing algorithm with the remaining algorithms we can say that the results achieved using Logistic Regression and LinearSVC are acceptable. Additionally, the precision value of 0.84 shows that the combination of trigger and machine learning procedure can differentiate between eating and noneating segments. However, the recall value of 0.75 suggests that a more accurate method regarding the eating periods is needed.

We also analyzed how much time each of the previously described algorithms was active during the noneating period. The results from this experiment are shown in Table 3. Additionally, in this table we can see the false positive rate during the noneating period. The best results are achieved using a Random Forest classifier, which is active only 20% of the whole noneating period. This means that our trigger-based procedure reduces the usage of the machine-learning procedure for 80%. However, this number also depends on the detection method because once it is activated, the eating predictions extend the active time of the method.

Table 3: Comparison of active time and false positive rate of the machine learning algorithms during noneating period.

Algorithm	Active time during noneating period	False positive rate
Random Forest	20%	1.36%
Logistic Regression	22%	2.18%
LinearSVC	22%	2.34%
Decision Tree	23%	3.93%

6   CONCLUSION AND FUTURE WORK

In this paper, we presented a method that can accurately detect eating moments using a 3-axis accelerometer and gyroscope sensor data. Our method consists of an energy-efficient trigger and a machine-learning procedure, which is started only after the trigger is activated. We evaluated this method using a dataset of 70 meals from 10 subjects. The results from the LOSO evaluation showed that we are able to recognize eating with a precision of 0.84 and recall of 0.75.

The presented results are important because both the training and the evaluation data were recorded in uncontrolled real-life conditions. We want to emphasize the real-life evaluation since it shows the robustness of the method while dealing with plenty of different activities that might be mistaken for eating as well as recognizing meals that were recorded in many different environments while using many different utensils. The proposed method can also deal with interruptions while having a meal, such as having a conversation, using the smartphone, etc. Additionally, we believe that the energy efficiency of the proposed method is very important. The proposed technique uses a trigger to activate the machine learning procedure and it is able to reduce the active time of the machine learning procedure for almost 80%. If we have in mind that the wristbands are devices with limited resources, we could say that even small reductions in resource usage can be significant for longer battery life.

The initial results achieved in this study are encouraging for further work in which we expect to improve the eating detection method. In the near future, we plan to optimize our machine learning procedure to detect eating periods more accurately once the trigger is activated. Furthermore, we want to overcome the problem with false positives predictions. For this problem, we believe that a more sophisticated method for selecting representative noneating data will help to recognize the problematic activities and directly include them in the training data. Also, we plan to investigate personalized threshold values. We believe that personalized values for the threshold will help to activate the trigger during eating periods more easily. Additionally, this could reduce the activation of the machine-learning procedure during non-eating periods. Also, we plan to explore memory efficient methods for storing the models in memory.

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Comparison of Methods for Topical Clustering of Online Multi-speaker Discourses

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ABSTRACT

Discussions held on online forums differ from traditional text documents in several ways. In addition to individual text-bodies (submission comments, forum posts etc.) being very short, they also have multiple messengers, each of whom may exhibit unique patterns of speech. Consequently, state of the art methods for text summarization are often rendered inapplicable for these sorts of corpora. This paper evaluates the topic-clustering algorithm used in the state-of-the-art online comment clustering techniques, as parts of commonly used summarizer models. It proposes two alternative, vector-based approaches and presents results of a comparative external analysis, concluding in the three methods being comparable.

KEYWORDS

latent Dirichlet allocation, word embeddings, GloVe, hyperdimensional computing, self-organized maps, topical clustering, clustering evaluation, discussion summarization

1 INTRODUCTION

User generated comments carry a great amount of useful information. Big data researchers have successfully used them to predict stock market volatility [1] and predict the characteristics of such comments that perform the best on a given online platform [2]. User comments can also offer vast amounts of complementary information, as well as being forms of information surveillance, entertainment or social utility [3]. Existing mechanisms for displaying comments on websites do not scale well and often lead to *cyberpolarization* [4]. Furthermore, they are platform-specific and often fail to offer an overall image of the topics discussed in a given comments section.

A comprehensive, easily understandable automatic summary of the online discourse at hand can be instinctively understood as a solution to this problem. This, however, is no easy task, seeing as these corpora are often very short and come from multiple

speakers. Consequently, traditional summarization methods do not translate well to these sorts of text bodies.

In Section 2 of this paper, the related work establishes the general framework that other authors generally use for the task at hand. It establishes the Latent Dirichlet Allocation (LDA) topic modeling algorithm as the current leading method for topical grouping of individual comments. These topical groups play a pivotal role in later summarization steps, also presented in Section 2.

In this paper, we externally evaluate and compare LDA versus two frameworks, using word representations in semantic vector space. We describe the analyzed methods in Sections 3 and 4. In Section 5, we describe the comparative evaluation methodology used to determine the applicability of each modeling technique and present our results. We follow it up by discussing further work in the conclusion of this paper.

2 RELATED WORK

Online discussion summarization is a field that has not been addressed directly by many authors. One group of works [5-7] have roughly described a three-step process, commonly presented as the state of the art. The approaches includes a topical clustering of all the observed comments, establishing a ranking method for determining the most salient ones in each cluster, and later summarizing this selection. Between them, the authors confidently establish Latent Dirichlet Allocation (LDA) topic modeling as the most human like grouping algorithm. Further work also proposes a novel graph-based linear regression model based on the Markov Cluster Algorithm (MCL), [8] which outperforms LDA, but uses the knowledge of multidomain knowledge bases for implementation. While we argue that extractive summarization is not an ideal method for the analysis of multi-speaker corpora, the first step of identifying and topically clustering individual comments in each comment section is assumed as a required step towards successful summarization of the topics discussed therein.

To the best of our knowledge, popular NLP word embedding algorithms (i.e. *word2vec, GloVe*) have not been used directly for comment summarization applications up until now. Similarly. neither have hyperdimensional representations, another topic of interest.

3 NLP METHODS

In this work, we examine three distinct topical clustering models, the output of which is always a set of comment clusters, given a multi-comment input.

The first is an LDA model, using a Term frequency – inverse document frequency (TFIDF) word representation as an input. In this representation, the comments were hard-clustered into the groups, determined by the degree of membership of which had been the highest in a soft-clustering approach, provided by the LDA model.

The second examined model uses *GloVe* word embeddings clustered with the k-means clustering algorithm, thus portraying words in semantic vector space using information of contexts in which words often appear.

The third model creates Hyperdimensional representations of words, mapped them into a two-dimensional topology using the self-organized maps algorithm and then clustered it like the preceding model. This approach is the least explored for this use-case and is inspired by the observed differences between the functionality of the human brain and the traditional von Neumann architecture for modern computing.

We performed the comparative evaluation of the models on the *Reddit Corpus (by subreddit)* dataset, provided by the Cornell Conversational Analysis Toolkit (Convokit)[1]. Five *Conversations,* corresponding to as many treads on the website Reddit were extracted from the corpus. We selected threads, discussing topics from different subject domains, where each contained at least 50 non-removed comment text bodies. Two human annotators were then asked to manually identify topical clusters in the selected *Conversations*. The comment texts were provided to them in the form of a set of numbered text files, containing only the text data in chronological order of submission. Reddit post titles or other metadata were not available to the annotators and no guidance was given as to the number of topics required. The clusterings were examined as-is, with no singleton removal performed.

We describe the NLP techniques used to create the three clustering models in the following subsections, with external evaluation results being presented in Section 5.

3.1 Latent Dirichlet Allocation

Latent Dirichlet Allocation (LDA) is a topic modeling technique initially proposed in the context of population genetics, but later applied in machine learning in the early 21st century. It assumes a generative process of documents as random mixtures over a collection of latent topics. Each of these topics, in turn, is characterized by a certain distribution over words. A topic model can be created by estimating the per document distribution of topics θ and the per topic distribution over words φ. [9] Many methods, such as variational inference, Bayesian parameter estimation [9] and Collapsed Gibbs sampling [10], have been used to approximate these values. In the end, they all boil down to maximizing the model's probability of creating the exact documents, provided to it in the input, assuming the knowledge of the number of topic distributions.

3.2 Word Embeddings

Word Embeddings is a collective name for a set of language modeling and feature learning techniques, yielding word representations using vectors, the relative similarities of which correlate with the semantic similarity of the represented words. These meanings are extracted from the contexts – fixed-size windows of preceding and succeeding words, in which individual words appear in in the training corpus. The generation of these vectors is achieved by Context counting [11] or Context prediction [12]. While there have been several claims of one of the methods for synthetizing word embeddings being superior over another, recent work implies the correspondence between these model-types [13]. Whichever way these word-vectors are created, they represent semantic meaning in vector space. Using algebraic similarity measures (in our case, cosine distance) on comment-word averages, the relative likeness of the examined comments' meanings is calculated. Comment clusters can then be created by clustering the semantic-space points into groups with high intra-cluster and low inter-cluster similarity. These groups represent topical clusters, used in our examination.

3.3 Hyperdimensional Computing

Hyperdimensional computing is a family of biologically inspired methods for representing and manipulating concepts and their meanings in high-dimensional space. Random Bipolar vectors of high, but fixed dimensionality (≥ 1000) are initialized as individual word representations and are then transformed in ways that represent semantically similar comments closer in the high-dimensional vector space, while the similarity of dissimilar comments is likely close to zero due to their inherent orthogonality. The methods used to transform these vectors are binding, bundling and permuting [14]. By using these methods, individual hyperdimensional vectors are created for each comment, encoding the used words and their position in the comment in the vector.

Similar to the clustering of word embeddings, semantically similar comment groups can be found by clustering, thus determining the outputs of the third model. However, the performance of this method did not yield comparative results at first. We hypothesised that this might be due to the high component count of the used vectors (more than double the dimensions of the Word Embedding approach), so a method of dimensionality reduction was examined, aiming to improve its results. It is described in the next sub-section.

3.4 Self-Organized Maps

Self-organizing maps (SOM), also known as Kohonen networks are computational methods for the visualization and analysis of high-dimensional data. The output of the algorithm is a set of nodes, arranged in a certain topology that represents the nodes' mutual relation, with each node being represented with a weight vector of t dimensional components, with t corresponding to the uniform dimensionality of data being reduced [15]. As data representations in high-dimensional vector spaces are inherently vulnerable to sparseness, clustering outputs can differ in cases where the clustered data is first dimensionally reduced. Thus, we used the SOM algorithm to examine if the results (of the

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[1] https://convokit.cornell.edu/documentation/index.html/

examination in Section 5) of any of the proposed frameworks can be improved by dimensionally reducing the vector representations prior to clustering.

SOM proved to drastically improve the performance of the Hyperdimensional computing model, while making the Word Embeddings-based model perform worse. Consequently, we only use SOM prior to clustering the HD-based approach in the evaluation, presented in Section 5.

4 IMPLEMENTATION

All implementational work was done with the *Python* programming language. All text corpora were pre-processed using the WordNetLemmatizer and PorterStemmer from NLTK.[2] Stop word removal was done in the pre-processing step using the topic modeling package Gensim[3], which also provided the submodules for TFIDF and LdaModel, used for the implementation of Latent Dirichlet Allocation. GloVe word embeddings were provided as part of the NLP open-source library SpaCy[4] as part of the *"en_core_web_md"* pretrained statistical model for the English Language. The SOM algorithm was implemented using the SimpSOM package[5], with k-means clustering being provided by Scikit-Learn.[6]

5 EVALUATION

To analyze the applicability of LDA, Word Embeddings and dimensionally reduced Hyperdimensional computing for the discussed use-case, topical clustering outputs were created for 5 Reddit *Conversations*. Two human annotators also manually created topical groups for these conversations. The goal of our evaluation was to see which model created the most *human-like* clusters; consequently having the highest average agreement measure with the clustering samples, provided by the two annotators.

Topical clusters, created by the three models, were externally evaluated using four symmetric agreement measures: The V-Measure [16], The Fowlkes-Mallows Index [17], the Rand Index [18] and the Mutual information score [19]. The latter two were also adjusted for variance. For each examined model, the best performing number of topic clusters was selected. The agreement of the clustering output of each model was measured against both of the manual clusterings, with the *per annotator* average of each metric being the final output.

Figure 1 shows the result scores of all four metrics for each analyzed method. In the top row, the average agreement between the two annotators is also shown. This is, expectedly, higher than the average agreement between any examined model and the human outputs. A few takeaways can be addressed, examining the figure. Firstly, the different methods were successful to a varying degree, depending on the used metric, with each performing the best according to at least one. Secondly, when comparing their average relative success in relation to the agreement scores between Annotator A and Annotator B, we can see that their performances are very similar. This can be seen

even clearer in Figure 2, which shows each model's performance with respect to the agreement score between the two human annotators. The percentage is calculated as an averaged sum of all four metric scores, weighted by the sum of these scores, achieved by the human versus human evaluation. In the figure, Word Embeddings can be seen as the best-performing approach, reaching 54.18 % of the Human agreement. The performance of LDA presented in Figure 2 is also comparable to that found in [5].

However, the difference in results between the best and the
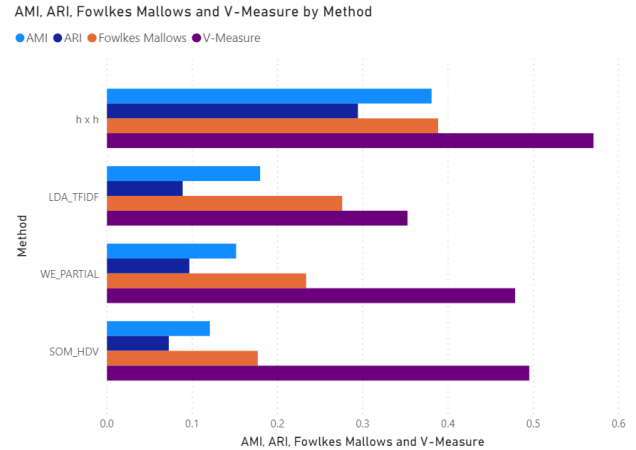
Figure 1: Visualization of agreement metric results between the human annotators (top) and the average annotator vs. model agreement (bottom three)

worst performing models being less than 7% of the total human agreement score, this metric is not enough to establish Word Embeddings as superior to LDA or indeed, dimensionally reduced High-dimensional computing. We can conclude that both Hyperdimensional computing and Word Embeddings can produce topical clusters, comparable to the current state of the art LDA method.

Semantic document representations performing as well as the state-of-the-art topic modeling framework using LDA opens up plentiful possibilities in the field of multi-speaker conversation analysis. Whereas topic modeling's more direct approach of inferring latent conversation topics might be useful in their discovery, the possibility of applying algebraic functions to individual comment vectors might enable further topic mining and experimentation. While the k-means clustering algorithm requires a desired number of clusters at input, similar to LDA, its job is not to encode semantics in the Word Embedding or SOM-HDC framework. This means that an alternative clustering algorithm – one without the need for an input number of medoids - could be used for the task of grouping comments. This, in turn, would result in a truly unsupervised topical clustering framework. A comparative evaluation of these approaches is a field of interest in the future, as our non-conclusive experiments have

[2] https://www.nltk.org/
[3] https://radimrehurek.com/gensim/
[4] https://spacy.io/

[5] https://github.com/fcomitani/SimpSOM/
[6] https://scikit-learn.org/

already shown a vast variance in results when using different clustering approaches.

■ LDA_TFIDF   ■ GloVe   ■ SOM_HDV
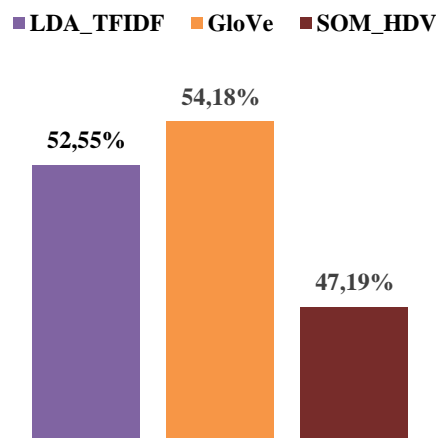
Figure 2: Percentage of the Human versus human agreement score achieved by each model (averaged between 4 agreement metrics)

6   CONCLUSION

In this article, we work from our hypothesis that popular semantics-laden vector representations of text data can be applicable in the established framework for extractive online discussion summarization. We present two models using different vector-based representation techniques and conclude that they are both comparable to the Latent Dirichlet Allocation topic modelling technique, used in most literature, with the Word Embeddings-based framework outperforming it in our external evaluations.

As mentioned in Section 2, the authors of this article argue that extractive summarizations are intrinsically less suitable when working with multi-speaker corpora. Our future work in this field includes the modeling of an abstractive summarizer framework, using the findings presented in this paper. Our intent is to use them in conjunction with graph-based approaches that take advantage of multidomain knowledge bases like DBPedia for both clustering and topic-labelling [8, 20].

Whether used in extractive or abstractive applications, we presume that the field will greatly benefit from our findings, seeing that the two vector-based representation frameworks open a plethora of new possibilities for other researchers. These include the detailed data manipulation using algebraic operations on individual comment vectors, as well as said vectors being suitable inputs for deep learning models using neural networks.

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Machine Learning of Surrogate Models with an Application to Sentinel 5P

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ABSTRACT

Surrogate models are efficient approximations of computationally expensive simulations or models. In this paper, we report improvements of a framework for learning surrogates on input and output spaces with reduced dimensionality. We present non-linear embeddings and feature importance as additional methods for dimensional analysis and reduction. The choice of models for prediction is extended with two types of ensembles of decision trees. The performance of the additions is evaluated and compared with the original approaches on a dataset, generated by RemoTeC, a complex radiative transfer model.

KEYWORDS

spectral data, neural network, ensemble, surrogate model, dimensionality reduction

1 INTRODUCTION

The **TROPO**spheric **M**onitoring **I**nstrument (TROPOMI) is an on board satellite instrument on the Copernicus Sentinel-5 Precursor satellite [9]. Its main objective is to provide accurate observations of atmospheric parameters, as the concentrations of atmospheric constituents. Those can be used to obtain better air quality forecasts and to monitor global trends. However, the retrieval of interesting attributes involves running a retrieval algorithm, such as RemoTeC [2, 8], based on "optimal estimation methods" that tend to be computationally very expensive [7].

Machine learning techniques can be used to learn surrogate models that approximate the outputs of intensive simulations and are much faster at making predictions [13]. A framework for learning surrogates of radiative transfer models has been developed [1]. Due to the high dimensionality of both input and output spaces, the framework employs dimensionality reduction - methods that find low-dimenensional projections (embeddings) of data that preserve as much information as possible [4]. Predictive models are learned on input and output spaces with reduced dimensionality.

Despite promising results, the existing framework for learning surrogates is limited to simple feed-forward neural networks for

the task of prediction, while offering a choice between PCA and autoencoders to reduce dimensionality [4, 6, 3]. In this paper we present an extension of the framework with two types of ensembles of decision trees for prediction [4], as well as an evaluation of the performance and utility of three additional algorithms for dimensionality analysis and dimensionality reduction: t-SNE [11], UMAP [12] and feature importance based on random forests [10].

2 DATASET

The training dataset was generated using the RemoTeC tool and in total consists of 50000 samples. Each input state vector contains a set of atmospheric parameters: **s**olar **z**enith **a**ngle (SZA), albedo, temperature, pressure, aerosols and profiles of the CH4, CO and H20 gases (in total 125 dimensions). The sampling of the data ensures that the data covers the entire range of conditions that S5P/TROPOMI is expected to encounter. Exploratory data analysis reveals three dimensions with zero variance. Removing them results in a dataset with a 122-dimensional input space.

The output training data was created using the RemoTeC RTM in the S5P/TROPOMI Shortwave InfraRed (SWIR3) band. Each target vector consists of an infrared spectrum with 834 dimensions.

3 SURROGATE MODELS

The framework for learning surrogates is capable of learning both forward and backwards models. The former predict spectra, given atmospheric parameters. The latter reverse this process and learn to approximate atmospheric parameters that produce a given spectrum, which is useful for optimizing parameters of the RemoTeC simulation. Surrogates are generally predictive models that map directly between input and output data of a simulation or computationally expensive model. They offer much faster predictions at the cost incurring a prediction error. However, when the data is high dimensional and contains many samples, the computational cost of training and prediction can still be non-trivial. In such cases, methods of dimensionality reduction can offer not only time savings, but also improvements in predictive performance. In our framework, we employ dimensionality reduction to atmospheric parameters, as well as to the spectral space. Predictive models learn to map between reduced spaces. An inverse transformation is performed on predictions in the reduced space to obtain predictions in the original output space. For that reason, dimensionality reduction algorithms must provide

an inverse transformation in order to be useful as a component of a surrogate model in our framework.

3.1 Dimensionality Reduction

A high number of dimensions makes a problem much harder for many machine learning algorithms due to the curse of dimensionality. For this reason, we have tried a range of dimensionality reduction (DR) methods on our data before performing training on them. DR methods are (potentially unsupervised) algorithms that try to find a projection of the data to a lower dimension of space that preserve as much information as possible.

A lower number of dimensions helps reduce computation time and often even improves the predictive performance of models. Furthermore, DR methods can also be used to visualize high dimensional data by finding an informative projection into two dimensions that is understandable to humans. Some algorithms, such as t-SNE or UMAP, serve especially this purpose.

Principal **C**omponent **A**nalysis (PCA) is one of the most popular dimensionality reduction methods [4]. PCA finds linear projections to a lower-dimensional subspace so that variance in the data is maximized. Visualizing the ratio of variance, covered by individual principal components is a way of assessing the intrinsic dimensionality of the data, as shown in Figure 1. We see that, for the 122-dimensional atmospheric parameter space, we need:

- 23 dimensions to explain 95% of the variance,
- 45 dimensions to explain 99% of the variance,
- 73 dimensions to explain 99.9% of the variance,

and for the output 834-dimensional spectral space:

- 1 dimension to explain 95% of the variance,
- 2 dimensions to explain 99% of the variance,
- 9 dimensions to explain 99.9% of the variance.
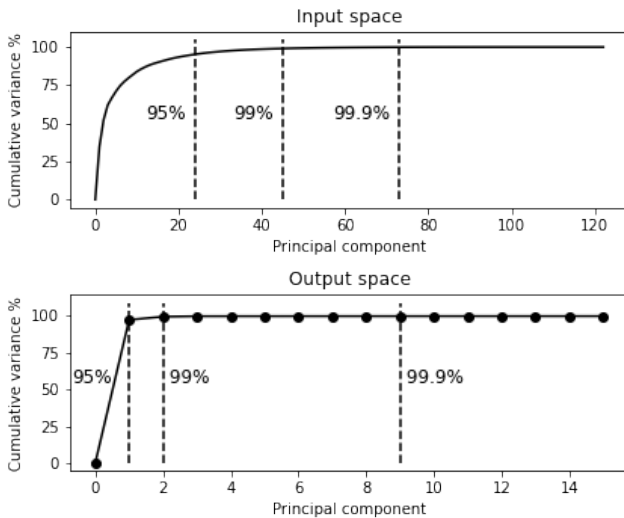
Figure 1: Dependence of the cumulative relative variance on the number of principal components for both the input and the output space.

Auto**e**ncoders (AE) [3] are a type of artificial neural network used to learn low dimensional representations. AE are trained to reproduce input data on the output of the network after passing through a bottleneck in the network architecture. To prevent autoencoders from memorizing the training dataset, a variety of regularization techniques can be employed. One of options is adding artificial noise to the input data, which forces the network to generalize.

In our framework, we employ this kind of autoencoder, often referred to as a denoising autoencoder, by adding Gaussian noise with mean 0 and standard deviation 0.1 to input data during the training process. A more thorough investigation of the effect of this technique on the predictive power can be found in [1]. For both atmospheric parameters and the spectral space, we used the same 7 layers architecture with an appropriate size of input and output layers. The architecture can be summarized as:

- input layer of size N_0 + Gaussian noise
- dense layer of size $N_1 < N_0$ and ReLu activation
- dense layer of size $N_2 = \frac{1}{2}N_1$ and ReLu activation
- dense embedding layer of size N_3 and linear activation
- dense layer of size N_2 and ReLu activation
- dense layer of size N_1 and ReLu activation
- output layer of size N_0 and linear activation

The **t**-Distributed **S**tochastic **N**eighbor **E**mbedding (t-SNE) [11] is a non-linear unsupervised technique for high dimension data visualization that can model complex, non-linear dependencies. t-SNE places points that are similar in the original space close together in the embedding layer with a high probability, while placing dissimilar points close together with only a low probability. Since t-SNE is a stochastic and non-parametric method there is no way to perform a reverse transformation from the embedding space to the original space. This excludes the method from use as part of the surrogate modelling process. It can, however, be useful for visualizing the dataset. Another disadvantage of t-SNE is its high computational complexity.

Uniform **M**anifold **A**pproximation and **P**rojection (UMAP) [12] is another dimension reduction technique used for dataset visualizations, constructed from a theoretical framework based in Riemannian geometry and algebraic topology. UMAP preforms similarly to t-SNE, but preserves more of the global data structure with superior run time performance. As is the case with t-SNE, UMAP does not allow for reverse transformations, which means we can not use it to learn surrogates. However, visualizations using UMAP allowed us to gain useful insights into the structure of our dataset.

3.2 Prediction Models

One of the predictors we used in our experiment was a feed-forward **n**eural **n**etwork (NN). We have chosen an architecture, consisting of 2 hidden full connected layers with ReLu activation functions and linear activation on the output layer [6].

Random **F**orest (RF) is an ensemble learning technique suited for both regression and classification problems. It uses sample bagging and feature sampling methods to train a set of decision trees. Prediction is performed by averaging over predictions from the individual regression trees. The main advantage of RF over a simple decision tree is the much better generalization. We decided to use this kind of predictor, because it is capable of performing multi target regression [10].

Extra **R**andom **T**rees (ET) is a technique very similar to random forests, with two main differences. First, it uses the whole dataset for training individual trees instead of using bags of samples. Second, it uses random cuts for each split, instead of using the optimal one (in case of Gini or Entropy reduction). It has been shown to perform better than random forests for some problems [5].

4 EXPERIMENT

Our experiment is composed of three parts. In the first two, we employ methods of dimensionality reduction as a way to gain insight and understanding about our dataset and problem. The third part is an empirical evaluation of different combinations of methods for dimensionality reduction and prediction, aiming to identify the one that offers the best predictive performance on unseen data.

4.1 Visualization

We applied the UMAP and t-SNE visualization techniques to both atmospheric parameters and spectrum data. As expected, both methods showed clusters in the atmospheric parameters data. In the spectrum data space, UMAP identified a structure in the data, depicted in figure: 2. A comparison of the data points sampled from different clusters shows a large difference in the scale of individual data points. This is likely one of the reasons why such a high variance is concentrated in the first principal component (as seen in Figure 1).

(a) UMAP visualization

(b) Comparison of data points
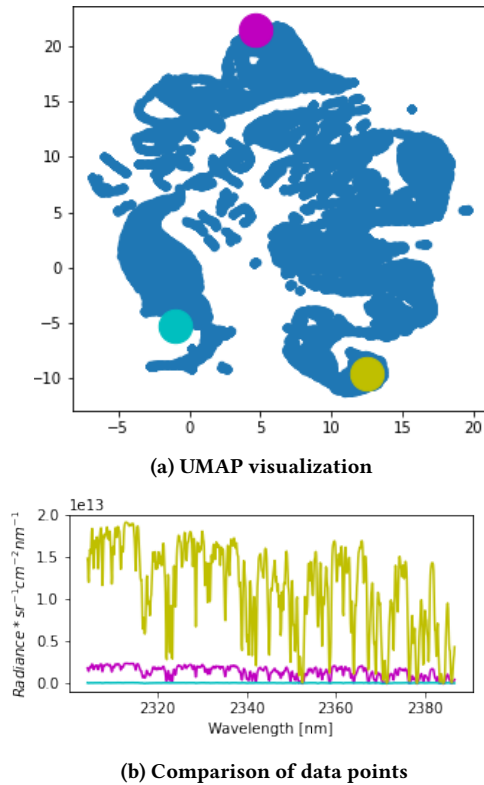
Figure 2: UMAP visualization of the spectrum data.

4.2 Feature Importance

The main advantage of using tree-based models over neural networks is their interpretability. While the ability to be understood by a human is lost when moving to an ensemble from a single tree, random forests can be very useful for estimating the importance of individual features for prediction. We trained a random forest predictor on the full dataset and visualized feature importance values in Figure 3. We see that 70% of feature importance is accumulated in just two dimensions. This corresponds well to the PCA estimate of most variance being encompassed by

two principal components. Only about half of the features are assigned non-negligible importance. The features identified by this approach warrant further investigation by domain experts.
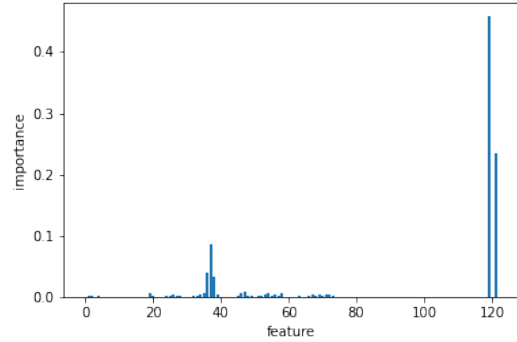
Figure 3: Random forest predictor importance of atmospheric data features.

4.3 Regression

To compare different regressors and methods of dimensionality reduction, we performed forward and backward predictions using neural network, random forest and extra random trees for both autoencoder and PCA embeddings. We reduced the dimensionality of the input space from 123 to 73 and the dimensionality of the output space from 834 to 9. These values correspond to 99.9% explained variance when using PCA. The noise level of the autoencoder was set to $\sigma = 0.1$. A more thorough study of the effects of these parameters can be found in [1]. We compare the predictive power of various combinations of either AE or PCA for dimension reduction, and either neural network, random forest or extra trees as a predictive model, using 10-fold cross validation. In Table 1 we compare the results, using the coefficient of determination as the evaluation metric [4]:

$$R^2 = 1 - \frac{MSE(\text{model})}{variance(\text{training set})}.$$

Table 1: Coefficient of determination for various combinations of dimensionality reduction methods (DR) and predictive models (PM), estimated by 10-fold cross validation.

	forward		backward	
PM / DR	AE	PCA	AE	PCA
NN	0.9995	**0.9998**	0.8454	0.9206
RF	0.8931	0.9937	0.9267	0.9311
ET	0.9228	0.9958	0.9370	**0.9510**

For the forward model, the best performance of $R^2 = 0.9998$ is achieved by a neural network, mapping between spaces reduced by PCA. For the backward model, the best performing model are extra trees, paired with PCA, achieving $R^2 = 0.9510$. Both represent very satisfactory and promising models to employ as surrogates for radiative transfer modeling. From Table 1, we can also see that PCA outperformed autoencoders in all cases, while also being much faster to compute. The comparison of predictive models is not as simple. For the forward model, the neural

network is the best, but only by a small margin. For the backward model, the differences are larger, with the neural network performing the worst. The performance of random forests was between the performances of the other two predictive models for both the forward and the backward problem.

Since one of the main uses for surrogate models is speeding up computation, time complexity is an important consideration. The main disadvantage of neural networks is the computational complexity required for both training and prediction. An autoencoder takes about ten times as long to transform a data point to the embedding space than PCA. For predictive models, the neural network used in this study needed approximately three times as long to make a prediction than random forests and extra trees, which had a similar time complexity. Nonetheless, making predictions for a test set of 5000 points using any of the described surrogates takes up to one second, while running the full RemoTeC simulation requires several hours of computation.

When comparing with the evaluation results reported for the original framework in [1], the performances in this paper are slightly worse. The reason is the fact that the original study reduced the dimensions of the input space to 102 and the output space to 50 dimensions. In this study we focused on further reducing the dimensions and reduced the dimension of the input space to 73 dimensions and the output space to 9 dimensions. It is an interesting observation that for different dimensionalities, the best performance is achieved by different algorithms.

5 DISCUSSION AND FURTHER WORK

The original framework for learning surrogates on input and output spaces with reduced dimensionality showed high predictive and computational performance on the RemoTeC dataset. The results were very promising for applications in data analysis for Earth Observation missions as a way to dramatically speed up computation without sacrificing much accuracy. However, no single model and approach is the best for every dataset and application, which made the limited scope of options in the original framework a potential downside. With the work presented in this paper, the range of methods available has been extended. Since the choice of algorithms for dimensionality reduction on the input and output spaces, as well as the choice of prediction model for both the forward and the backward model are all independent from each other, the number of combinations of algorithms available is considerable. Furthermore, the dimension analysis enabled by UMAP, t-SNE and feature importance represents a new way of assessing intrinsic dimensionality and making a more informed choice of the number of target dimensions.

The paper presents an evaluation of the performance of various included methods on the RemoTeC dataset. However, each of the analyzed algorithms is defined by a number of hyperparameters, which is especially true for neural networks and autoencoders. Furthermore, the dimensions of the reduced input and output spaces can also be consider hyperparameters of the framework. For the presented evaluation we chose the hyperparameters based on values reported in previous work and to some degree optimized them manually. A more rigorous study is required that employs automated hyperparameter optimization in order to compare the available algorithms fairly and arrive at a reliable conclusion of what is the best approach to modeling the RemoTeC simulation.

Finally, in this study we touched upon the subject of estimating feature importance using random forests in order to gain insight about the data. However, feature importance can also be used to compute feature rankings and perform feature selection, which can be considered as another method of dimensionality reduction. In further work, it might be worthwile to investigate this approach further and include it as an option in the framework for learning surrogates.

6 ACKNOWLEDGEMENTS

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Deep Multi-label Classification of Chest X-ray Images

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ABSTRACT

In this paper we address the problem of Chest X-ray (CXR) classification in a multi-label classification (MLC) setting, in which each sample can be associated with one or several labels. The availability of large-scale CXR datasets has provided the ability to develop highly accurate deep-learning based supervised models, that closely resembles the performance of human radiologists. We compare an end-to-end deep-learning based approach with different ensembles of predictive clustering trees (PCTs) and show that similar predictive performance can be achieved, when using the features extracted from the pre-trained deep-learning model.

KEYWORDS

Chest X-ray, deep-learning, predictive clustering trees, random forest, extra tree

1 INTRODUCTION

Chest X-ray (CHR) is one of the most common medical imaging modalities, with millions of scans performed globally every year [6]. A computer-aided diagnosis (CAD) system can significantly reduce the burden of radiologists and thus reduce prevalence and early detection of many deadly diseases. There has been a lot of effort recently, to harness the power of machine learning based methods, especially deep-learning, for disease classification and localization from CXR images [17]. Interpreting CXR images is very difficult even for the trained pathologists, with different visual ambiguities representing a significant challenge to distinguish between different diseases, resulting in misdiagnoses [5].

Recently, deep-learning based approaches have been presented, that together with the availability of large-scale datasets significantly improve the performance of CAD methods and in some cases reach the radiologist-level performance [8]. In comparison with other approaches and datasets [9, 13, 1], newly presented datasets [8, 10] enable the development of CAD methods for detection of presence of multiple diseases present in CXR images at the same time.

We evaluate an end-to-end deep-learning based approach for multi-label classification (MLC) of CXR images, based on DenseNet architecture [7] and compare it with the traditional approach based on predictive clustering trees (PCT) [2], in an ensemble setting, using the features extracted from the pre-trained deep-learning network. We demonstrate a similar predictive performance on a large-scale CheXpert dataset [8], thus opening the potential to use PCTs also in a hierarchical setting [20], which

taking into account underlying dependency structure and powerful deep features, could advance current state-of-the-art of the supervised MLC deep-learning based approaches.
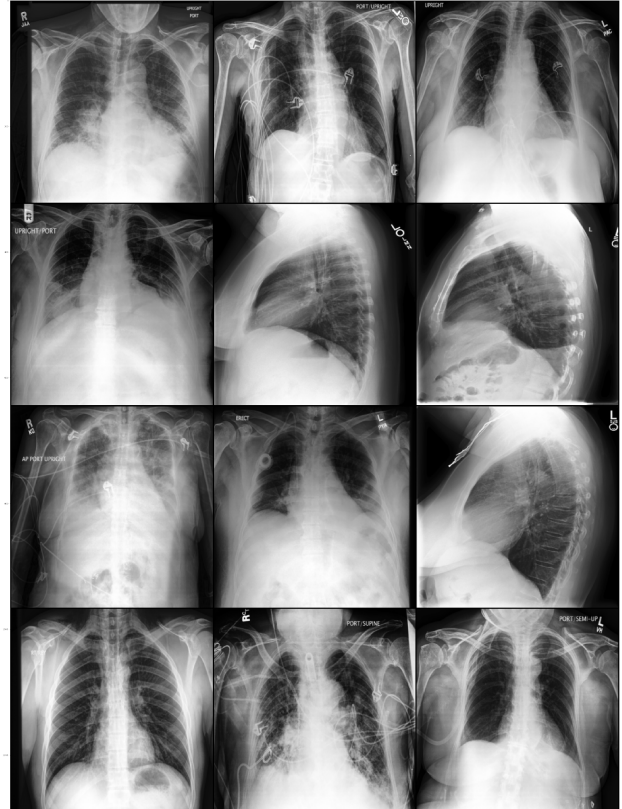
Figure 1: Few examples of Chest X-ray images from the CheXpert dataset [8].

2 RELATED WORK

Recent prevalence of deep-learning methods and increased availability of large-scale datasets with labeled data has provided medical community with significant advances, in comparison with the methods that require sub-optimal manual feature engineering [14]. State-of-the-art CNN models are becoming a de-facto standard for a wide range of application in medical imaging, such as detection, classification and segmentation. Similar advances in terms of the methods and available data have been observed in the domain of Chest X-ray (CXR) images.

Multi-label classification (MLC) setting is a very common setting in interpreting CXR images, due to presence of multiple diseases in one particular CXR sample. Deep-learning architecture CheXNet [19] was proposed, based on DenseNet-121 [7], trained on ChestX-ray14 dataset [21], which achieved state-of-the-art results over 14 labeled pathologies and even exceeded

(a)

(b)
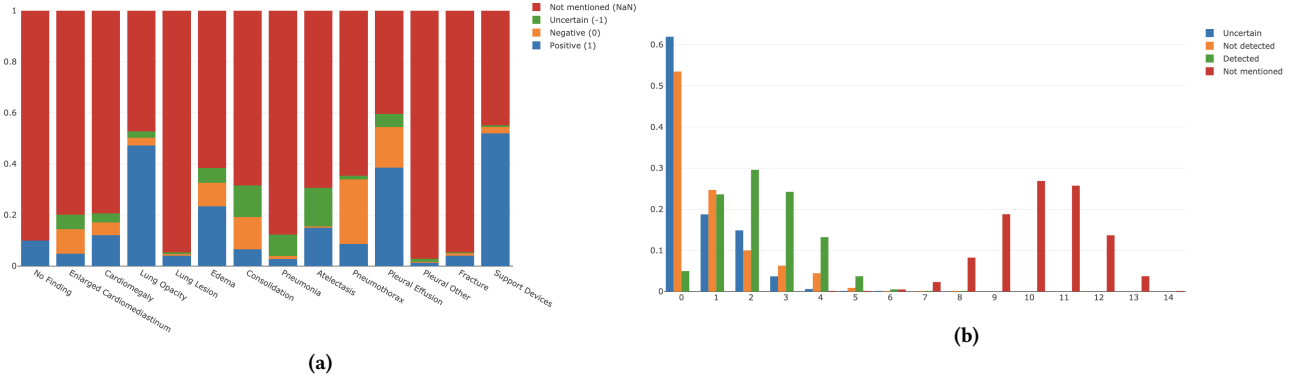
Figure 2: (a) Label uncertainty distribution over 14 pathologies in the CheXpert dataset [8] over all the samples in the training data and (b) distribution and probability of occurrence of multiple pathologies in a particular sample (multi-label classification).

radiologist performance on pneumonia. Recently, very large-scale CXR datasets were presented, such as CheXpert [8] and MIMIC-CXR [10], which enabled the development of much more robust supervised models. Additionally, the new datasets also capture the notion of uncertainty through labels and different approaches have been proposed for handling such labels. A similar architecture to CheXNet was proposed and performance surpassed 3 certified radiologists in 3 different pathologies [8].

The above MLC approaches do not take into the account the dependencies between disease labels, which, when exploited, significantly improves the performance of the predictive models [16]. We evaluate an end-to-end deep-learning based approach for MLC of CXR images, based on DenseNet architecture [7] and compare it with the traditional approach based ob predictive clustering trees (PCTs) [2], in an ensemble setting, using the features extracted from the pre-trained deep-learning network. We demonstrate a similar predictive performance on a large-scale CheXpert dataset [8], thus opening the potential to use PCTs also in a hierarchical setting [20], which taking into account underlying dependency structure and powerful deep features, could advance current state-of-the-art of the supervised MLC deep-learning based approaches and also compete against hierarchical deep-learning based approaches [4, 16], which take the hierarchy into account implicitly, using the conditional probability.

3 CHEXPERT: A LARGE CHEST RADIOGRAPH DATASET

CheXpert [8] is a large publicly available dataset for chest radiograph interpretation, consisting of 224,316 CXR images of 65,240 patients, where the presence of 14 different observations is labeled as positive, negative, uncertain or not mentioned. CXR images are collected retrospectively from Stanford Hospital, together with associated radiology reports. Labels (and their uncertainty) were automatically extracted from the section of the radiology report, which summarizes the key findings. A large list of phrases was manually curated by multiple board-certified radiologists to match various ways of observations, mentioned differently in the reports. Extracted phrases are then classified into positive, negative, uncertain or not-mentioned classes and aggregated into a final set of predefined observations (i.e. pathologies) with prevailed occurrence. The publicly available test data consists of 234 samples from 234 patients, where ground truth is set by a consensus of 3 radiologists, who annotated the set

using radiographs, thus labels only represent positive or negative class, with no uncertainties. Evaluation is performed only on 5 observations, selected based on their clinical significance and prevalence in the dataset (i.e. Atelectasis, Cardiomegaly, Consolidation, Edema and Pleural Effusion).

The distribution of all the observed pathologies in the training data and their uncertainty is presented in Figure 2a and the distribution of observations over a single example in Figure 2b, which shows that there is around 30% chance of having at least 2 pathologies present at the same time, labeled as definite positive. In CheXpert [8], different strategies of using uncertainty labels were evaluated. The two most simple approaches are to ignore uncertain samples during the training or to map them to either negative of positive class. They also evaluate a semi-supervised approach, where the ignore approach is used to label uncertain examples, in order to re-label them. 3-class classification approach is also evaluated where uncertain label is used as a separate class during the training and during testing, only the probabilities for positive and negative class are reported. In our work, we use the simple mapping approach, by mapping uncertain labels to a positive class and not-mentioned samples to a negative class.

3.1 Methods

We evaluate an end-to-end deep-learning based approach for multi-label classification (MLC) of CXR images, based on DenseNet-121 architecture [7] and compare it with the traditional approach based ob predictive clustering trees (PCT) [2], in an ensemble setting, using the features extracted from the pre-trained deep-learning network.

3.2 End-To-End Deep Learning

Several convolutional neural networks (CNNs) were evaluated in CheXpert [8] and DenseNet-121 [7] architecture produced the best results. Because of that, we used DenseNet-121 for all of our experiments. Original DenseNet is designed for multi-class classification, where the neural network has the same number of output nodes as the number of classes. Each output node belongs to some class and outputs a score for that class. In a multi-class setting, the scores are passed through softmax layer, which converts scores into probabilities (class probabilities sums to 1) and the input sample is classified into a corresponding class, that has the highest probability.

In a multi-label classification (MLC) setting, the difference is, that an input sample can belong to multiple classes at the same time, thus the final score needs to be independent for each of the classes, because of that, sigmoid function is used instead of softmax. Additionally, categorical cross-entropy loss function needs to be replaced with binary cross-entropy. We implemented modified DenseNet-121 in PyTorch[1] using Adam optimizer with the same learning rates and parameters as used in CheXpert [8]. The images were resized to 320 x 320, same as in [8] and we trained the network for 10 epochs using a fixed batch size of 32 images and evaluated the performance on a left-out validation set of 500 images using the receiver operating characteristic curve (ROC) and its area under the curve (AUC), averaged across all observations. The best performing model in terms of global AUC score was selected for evaluation on a test set, presented in Section 4.

3.3 Predictive Clustering Trees

Predictive clustering trees (PCTs) [2] are decision trees viewed as a hierarchy of clusters, where the top node corresponds to one cluster containing all the data, which is recursively partitioned into smaller clusters while moving down the tree. PCTs are constructed with a standard "top-down induction of decision trees" (TDIDT) algorithm, the major difference in comparison with CART [3] or C4.5 [18] induction is that the PCTs treat variance and prototype functions as parameters, selected based on the learning task at hand. To construct a regression tree, for example, the variance function returns the variance of the given instances' target values, and the prototype is their average value. For the task of predicting tuples of discrete variables, used in the multi-label classification (MLC) [15], the variance functions is computed as the sum of the Gini indices[28] of the variables from the target tuple and the prototype function returns a vector of probabilities, that an example belongs to a particular class in the target tuple.

In our work we utilized PCTs in an ensemble setting, where a set of predictive models (i.e. PCTs) predictions are combined to obtain a final prediction, this is especially useful for unstable base predictors (e.g. trees), where small changes in the dataset, yield substantially different models and usually achieves a much better predictive performance [12]. In our work we consider a Random forest of PCTs (RF-PCT) [12] and ensembles of extremely randomized PCTs (EXTRA-PCT) [11] for MLC. In RF-PCT, several bootstrap replicates are first constructed and a randomized PCT is then applied, by selecting a subset of attributes in each node, on which all possible tests are considered and the best one is selected. The number of attributes selected is a given parameter, typically a function of the total number of attributes (e.g. log(N) - where N represents the number of attributes). In EXTRA-PCT, no bootstrap replicates are constructed and in each internal node, for the each attribute, a test is selected randomly.

We used CLUS[2] framework for the PCT construction. We used 50 baseline PCTs for RF-PCT, as well as EXTRA-PCT. The input presented the 1024D features extracted from the pre-trained DenseNet-121 network, extracted before the last fully-connected classification layer in DensetNet-121. Similarly to the DenseNet-121 end-to-end approach, the RF-PCT and EXTRA-PCT were evaluated on a test set in terms of AUC score.

4 RESULTS

We evaluated different approaches on the publicly available test data, consisting out of 234 samples from 234 patients, where ground truth is set by a consensus of 3 radiologists. We report the results in terms of the Receiver Operating Characteristic Curves (ROC) in Figure 3 and its area under the curve (AUC) in Table 1. In terms of the approaches presented in our work (i.e. DenseNet-121, RF-PCT and EXTRA-PCT), DenseNet-121 performs the best, with EXTRA-PCT approach following it closely. The biggest differences are observed on the Cardiomegaly class, which coincides with the results reported in CheXpert [8], as most of the uncertain cases are borderline, which reduces the performance of the simple mapping to positive or negative label.

Table 1 also compares presented approaches against the DenseNet-121 baseline presented in CheXpert [8], where 10 checkpoints per run were chosen and each model was run three times, thus generating and ensemble of 30 models, which improved the results by a small margin over our baseline DenseNet-121 approach. Nevertheless, we achieved or surpassed CheXpert results on Cardiomegaly and Pleural Effusion classes and also achieved similar performance on other classes.

5 CONCLUSION

In this paper we addressed the problem of Chest X-ray (CXR) classification in a multi-label classification (MLC) setting and compared an end-to-end deep-learning based approach with different ensembles of predictive clustering trees (PCTs) and showed that similar predictive performance can be achieved, when using the features extracted from the pre-trained deep-learning model. This results show the potential to use PCTs also in a hierarchical setting, which taking into account underlying dependency structure and powerful deep features, could advance current state-of-the-art.

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[1]https://pytorch.org/hub/pytorch_vision_densenet
[2]http://clus.sourceforge.net/

(a) DenseNet-121   (b) RF-PCT   (c) EXTRA-PCT
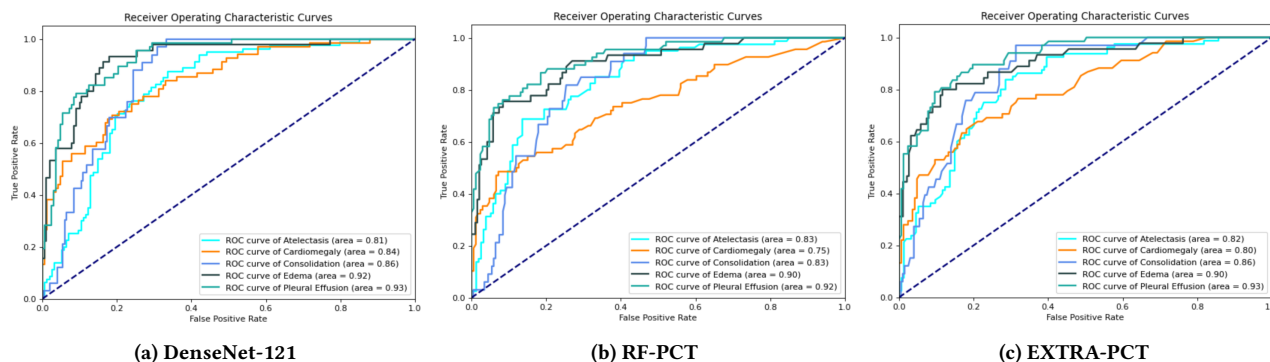
Figure 3: Receiver Operating Characteristic Curves (ROC) for an end-to-end deep-learning approach based on DenseNet-121 (a) and ensemble of Predictive Clustering Trees (PCTs) based on random forest (b) and extremely randomized trees (c).

Table 1: Comparison of different methods against the baseline CheXpert results [8] in terms of AUC scores.

Method	Atelectasis	Cardiomegaly	Consolidation	Edema	Pleural Effusion
CheXpert (U-Ones) [8]	**0.86**	0.83	**0.90**	**0.94**	**0.93**
DenseNet-121	0.81	**0.84**	0.86	0.92	**0.93**
RF-PCT	0.83	0.75	0.83	0.90	0.92
EXTRA-PCT	0.82	0.80	0.86	0.90	**0.93**

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Smart Issue Retrieval Application

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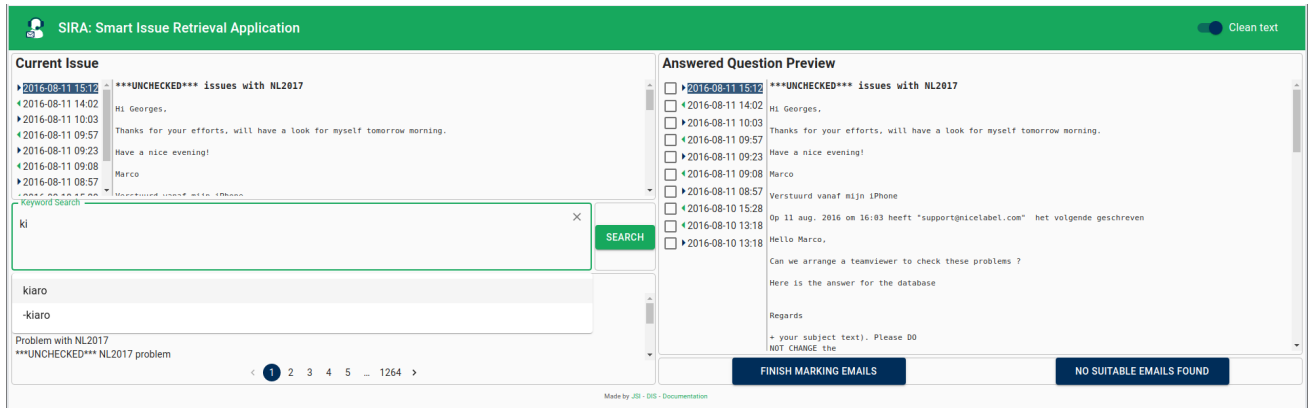
Figure 1: SIRA screenshot

ABSTRACT

We present Smart Issue Retrieval Application (SIRA), a customer support tool for searching of relevant email threads or issues when an email thread and keywords are given. Presented are the overall application architecture, the processing pipeline, which transforms the data into a search friendly form, and the search algorithm itself.

KEYWORDS

customer support, language models, information retrieval

1 INTRODUCTION

Customer support is an important part of many large businesses and high quality customer support can improve the user experience and help businesses retain their customer for longer periods. For larger companies, it can also be a strain on their human resources as many customer support issues need to be resolved in short time. While the customer support team may resolve most issues on their own sometimes they need the help of the development department. Often similar issues are presented to the developers multiple times.

In order to minimize the number of issues that need attention from other departments, we have developed an application to help the customer support technicians resolve issues without help from developers. While some issues will still need the attention of

developers, SIRA can help find existing answers to questions that have already been resolved by developers and therefore reduce the amount of distractions for the development team.

We use language models in order to retrieve information about the question from the issue at hand. Using multiple different approaches, application searches the database of resolved issues in order to find a developers' answers to same or similar questions.

2 SIRA ARCHITECTURE

SIRA comprises five main application components (Fig. 2):

(1) *Database*. PostgreSQL [6] is used as the application database, since it includes decent built-in text search capabilities and change data capture options.
(2) *Processing daemon*. Python [7] process responsible for data processing for search in the event of change data capture.
(3) *Back-end application*. Python Flask-based back-end application exposing the application programming interface for SIRA.
(4) *Front-end application*. React-based [8] single-page application for interacting with SIRA.
(5) *Documentation*. MKdocs-based user documentation for final users, admins, and developers.

Each SIRA component is packaged within a Docker [4] image and can be managed using "docker-compose" [2] tool. This enables deterministic packaging of application code for development, testing and production.

3 SIRA FUNCTIONALITY

The main goal of SIRA is to enable customer support staff to quickly find answers to similar questions that have already been resolved in the past. Search is therefore the primary functionality of the application and can be split into three parts:
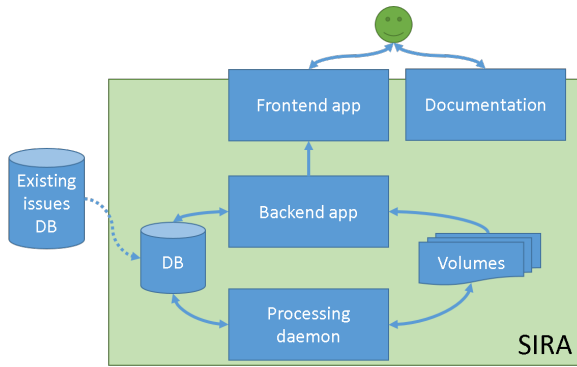
Figure 2: SIRA architecture overview

(1) *Processing.* Upon new data arrival, pre-processes the text to obtain representation suitable for search.
(2) *Search.* Computing relevancy scores upon search request by taking into account as much information about issue or email thread as possible.
(3) *Logging.* To improve the search in the future the search results and structured user feedback is gathered and stored.

In the rest of this section we will describe each part in more details.

3.1 Processing

For the search to be efficient it is beneficial to pre-process the raw emails. The processing daemon runs as a separate python process and utilizes PostgreSQL's logical replication functionality in order to transform new content as soon as it is written to the database. The following steps are executed when processing the issues:

(1) *HTML clean.* Beautiful Soup [1] library is used to extract only relevant text from email XML markup.
(2) *Empty line removal.* Python script is used to detect and remove empty lines.
(3) *Repeated emails removal.* Parts of emails are deleted if they already appear within some previous mails of the same issue.
(4) *Semi-structured emails handling.* Some emails are actually a filled out form in an email format. A python script is used to extract only the relevant information.
(5) *Non-author lines removal.* A machine learning model was developed and is deployed for tackling this task.
(6) *Non-alphanumeric-only characters lines removal.* Python script is used to detect and remove those lines.
(7) *Word vector representation computation and update.* Fast-Text [3] word vectors are used to compute word vector representation of text.
(8) *Storing of processed text.* The processed text is stored into database, where built-in database indexing is utilized to further prepare the text for efficient text searching.

In the rest of this section we focus on the non-trivial processing steps.

3.1.1 Repeated emails removal. There were two reasons for removing repeated emails from an email thread. First, when displaying an email, usually also all the previous emails are included, which results in poor readability. Second, some methods for comparing the text take into account the number of occurrences of a

particular word. This is sensible for cases when the word actually repeats in the content. However, if it repeats due to the text duplication it could negatively impact the search results.

We define a repeated email as an email body that appears within another email body. This is usually a result of using a "Reply" functionality when responding to an email within an email client.

To delete email A from email B, the following method is used:

(1) Extract only alphanumeric characters from the two email bodies A and B to get alphanumeric(A) and alphanumeric(B).
(2) If alphanumeric(A) appears within alphanumeric(B), mark it for removal from alphanumeric(B).
(3) If alphanumeric(A) does not appear within alphanumeric(B), iterate over substrings of alphanumeric(B) and compute the matching percentage of consecutive alphanumeric blocks from alphanumeric(A). The substring with the maximum match is a candidate for removal. If it exceeds a predefined threshold it is indeed marked for removal from alphanumeric(B).
(4) Reconstruct B by dropping the substring marked for removal and all non-alphanumeric characters positioned within the marked substring when expanded with all the characters.

3.1.2 Non-author lines removal. An email body usually comprises:

(1) Relevant content
(2) Signature
(3) Confidentiality notice
(4) Previous email headers
(5) Previous email content

The only text that should be used for text comparison is the relevant content part. While previous email content was mostly removed in the repeated emails removal step (3.1.1), other email body parts can still impact text comparison results. Machine learning was utilized to develop a model for determining whether a particular line in the email body belongs to the relevant content part of an email or not.

Dataset preparation. First, we implemented an application with a basic graphical user interface that enabled us to label each line with one of the following categories:

(1) AUTHOR. The relevant content falls into this category.
(2) QUOTED. This is the previous email content.
(3) AUTO-PERSONALIZED. This is the text, that was set by a user in the email client, which is automatically inserted by the email client. Signature is an example of this.
(4) AUTO-NON-PERSONALIZED. This is the text inserted by the email client automatically. An example of this is previous email headers.
(5) NEEDS-PRETTIFY. Sometimes the whole email body is present in one line only. To properly label the body it should be further split into multiple lines.
(6) OTHER. Everything else.

Second, we labeled each line belonging to 100 random issues. This way we generated a dataset of 37,421 labeled lines in 586 emails. Since the assumption was that the "QUOTED" lines are already filtered out using remove repeated emails method, we omit those lines from the dataset. This left us with 9,848 labeled lines.

Features. The computed features were of two types: local features that took into account just the current line, and global

features that took into account the relative position and content of a line within the whole email.

Local features:

(1) Number and proportion of capitalized words
(2) Number and proportion of non-alphanumeric characters
(3) Number and proportion of numeric characters
(4) "CountVectorizer" from the scikit-learn ([5]) package
(5) "TfidfVectorizer" from the scikit-learn package
(6) Word vector line representation

Global features:

(1) Line position from the start
(2) Line position until the end
(3) Does "regard" appear before this line, within this line, after this line
(4) Do four or more consecutive non-alphanumeric characters appear before this line, within this line, after line
(5) Does a date-like string appear before this line, within this line, after this line
(6) Does a time-like string appear before this line, within this line, after this line

In order to smooth the predictions we also tested hierarchical modeling by first building a model for "AUTHOR" detection and then using the predictions on the lower level as additional features for the higher level. One approach for using the predictions from the lower level was to just use the "AUTHOR" predictions of lines just before and just after the current line. The predictions were padded with 1 at the beginning of an email and with 0 at the end. The second approach was based on the sum of three consecutive "AUTHOR" class probabilities for: lines, just before the current line, lines where the current line is in the middle, and lines just after the current line. We padded the predictions with 1s at the beginning of an email and with 0s at the end.

Further, the features were scaled using the StandardScaler and the feature space dimensionality was reduced using the principal component analysis - PCA, both from the scikit-learn package.

Models. For modeling we utilized scikit-learn package and tested the following algorithms: (1) Logistic regression, (2) Multinomial Naive Bayes, (3) Support vector machine, (4) Random forest classifier.

Rudimentary hyper-parameter tuning was done to pick the best ones.

Evaluation. Each pipeline was evaluated using 10-fold cross validation with the splits over issues. This means that all the lines belonging to one issue were either in the training or the testing set to prevent data leaking.

Model selection. The performance of all models was tracked through various metrics:

(1) Confusion matrix
(2) Precision and recall at different minimum recall thresholds
(3) Precision-recall curve
(4) "AUTHOR" probabilities for each line in the test set

The main concern regarding the model performance was that it should prioritize keeping the "AUTHOR" lines ("AUTHOR" recall) over average model accuracy. This is a direct result of the application architecture – if the line would be removed by the chosen model, it wouldn't be possible to search over it. This would directly impact the performance in the real-world. Additionally, few additional lines shouldn't hinder the readability too much.

The gathered metrics enabled us to closely inspect each model and overview the performance regarding real-world application.

A basic GUI was built to inspect the models and overview the miss-classified examples. In the end, the hierarchical model was chosen with most of the presented features, with the exception of "CountVectorizer" and "TfidfVectorizer" features. The additional chosen higher-level feature was the sum of three consecutive "AUTHOR" probabilities. Random forest was chosen as the classification algorithm, without feature standardization or dimensionality reduction step. The threshold probability was lowered to 0.12 so recall could be kept high.

The final model miss-classified 59 out of 2,394 rows marked as "AUTHOR" (recall = 0.975) and 629 out of 7,454 rows marked as "OTHER" (recall = 0.806).

3.1.3 Word vector representation computation and update. Word vector representation of content is used to compare email bodies and email subjects between different issues.

To compute the word vector representation of text, either issue body or issue subject, the following steps are executed: (1) Tokenize text, (2) Remove stop-words, (3) Query word vector representation for each word using fastText common crawl word vectors with dimension 300, (4) Compute mean of all word vectors belonging to the words in the text, (5) Normalize the mean vector by dividing the mean vector by the mean vector length.

Instead of generating the representation vectors on-the-fly, they are pre-computed and only read when needed, which greatly reduces the inference time. To update word vector representation of a particular text, the corresponding row in the word vector matrix is updated with the new values and stored on disk as a Numpy array.

3.2 Search

Each issue consists of: subject, document (the email body of text), and keywords the user marked the issues with. The keywords can be positive, meaning that a keyword is related with the contents of the issue, or negative when keyword is *not* related with the contents of the particular issue. Additionally, a keyword can be explicit, where a user uses the keyword for searching when considering a particular issue. On the other hand, a keyword can be implicit – soft keywords, where the user searched for relevant issues using a keyword, but the search results were not marked as relevant.

When computing the relevancy of issues, given a starting issue and some keywords, several relevancy sub-scores are first computed and then aggregated to form a single relevancy score. In Table 1 all combinations for relevance sub-scores are listed.

The final score is computed as a weighted average, as in equation 1. The weights w_i were determined based on the final user feedback.

$$
\begin{aligned}
\text{finalScore} = \; & w_1 \cdot \text{KeywordToKeywordScore} \\
& + w_2 \cdot \text{KeywordToSoftKeywordScore} \\
& + w_3 \cdot \text{KeywordToDocumentScore} \\
& + w_4 \cdot \text{KeywordToSubjectdScore} \\
& + w_5 \cdot \text{DocumentToKeywordScore} \\
& + w_6 \cdot \text{DocumentToSoftKeywordScore} \\
& + w_7 \cdot \text{DocumentToDocumentScore} \\
& + w_8 \cdot \text{SubjectToKeywordScore} \\
& + w_9 \cdot \text{SubjectToSoftKeywordScore} \\
& + w_{10} \cdot \text{SubjectToSubjectScore}
\end{aligned}
\tag{1}
$$

Table 1: Relevance sub-scores matrix

		Other issues		
		(Not) Keyword	Soft (Not-) keyword	Document	Subject
Current issue	(Not-) Keyword	Exact match	Exact match	Full-text search	Full-text search
	Soft (Not) Keyword	/	/	/	/
	Document	Reverse full-text search	Reverse full-text search	Word vector cosine similarity	/
	Subject	Reverse full-text search	Reverse full-text search	/	Word vector cosine similarity

3.2.1 Exact match. This relevance score compares (soft) keywords related to issues and those inserted in the keyword input box. Given a (soft) keyword, search for all the documents that are in relation to this exact (soft) keyword. Each relation can either be positive or negative. Therefore, the returned score is positive in case of positive relation and negative otherwise.

3.2.2 Full-text search. This relevance score compares keywords entered in the keyword input box and issue documents or issue subjects. Full-text search capability of PostgreSQL is leveraged for this score. However, the results are modified to return negative scores in case of not-keyword match.

3.2.3 Reverse full-text search. This relevance score compares the selected issue document or subject and all existing (soft) keywords. First, for each keyword a full-text search relevance score is computed. Second, for each issue in the database do a sum of its related keyword relevance scores.

3.2.4 Word vector cosine similarity. This relevance score compares the selected issue document and subject to all existing issue documents and subjects, respectively. Pre-computed word vectors as described in Section 3.1.3 are used. The relevance score is computed as:

$$wordVectorSimilarity(T_1, T_2) = 1 - T_1 \cdot T_2. \quad (2)$$

Since the word vectors used are normalized, this is actually $1-$ cosine distance between T_1 and T_2.

Two other methods for comparing the text were also tested: PostgreSQL built-in trigram text similarity, which was too slow for production use, and tf-idf representation of text and cosine distance-based relevance score, which did not perform as well as the word vectors method.

3.3 Logging

To improve the search performance in the future, several interactions with the application are logged:

(1) Search results with relevance scores
(2) Viewed search results
(3) Relevant issue/belonging email found
(4) No relevant issue/belonging email found

Only after sufficient real-world usage of the application we can quantitatively evaluate the performance of the whole search pipeline and act upon the results.

4 DISCUSSION AND CONCLUSION

The SIRA system was developed and deployed, including five docker-image packaged modules. The main functionalities of the first major release include preprocessing of the text of the issue, search integrating four different search algorithms and a logging system that stores interactions with the system into the database, including user defined keywords and appropriate results marking.

Preprocessing is done without any user interaction and involves multiple algorithms and AI methods to extract the text of the issue from original encoded emails. Testing of the algorithms shows good results both in terms of precision and recall. Word vector representations are pre-computed in order to improve performance of search algorithms.

Based on the extracted plain text of the issue the application searches for similar issues that have already been resolved. The users can therefore quickly find the information related to the issue. The system is currently in use and only after some time of real-world usage we will be able to evaluate the whole system.

Due to logging the interactions in the database we expect to be able to analyze the usage and quality of the results. This will allow us to improve the system and add other functionality that will improve user experience and further improve the customer support technicians' workflow.

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Adaptation of Text to Publication Type

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ABSTRACT

In this paper, we propose a methodology that can adapt texts to target publication types using summarization, natural language generation and paraphrasing. The solution is based on key text evaluation characteristics that describe different publication types. To examine types, such as social media posts, newspaper articles, research articles and official statements, we use three distinct text evaluation metrics: length, text polarity and readability. Our methodology iteratively adapts each of the text evaluation metrics. To alter length, we focus on abstractive summarization using text-to-text transformers and distinct natural language generation models that are fine-tuned for each target publication type. Next, we adapt polarity and readability using synonym replacement and additionally, manipulate the latter by replacing sentences with paraphrases, which are automatically generated using a fine-tuned text-to-text transformer. The results show that the proposed methodology successfully adapts text evaluation metrics to target publication types. We find that in some cases adapting the chosen text evaluation metrics is not enough and we can corrupt the content using our methodology. However, generally, our methodology generates suitable texts that we could present to a target audience.

KEYWORDS

text adaptation, context-aware, artificial intelligence, text summarization, natural language processing

1 INTRODUCTION

With more and more internet usage, the textual data on the internet is highly increasing. However, different media target different audiences and thus an arbitrary article may not be appropriate for everyone. Consequently, already published content is being rewritten and adapted for other target audiences.

Why is targeting audiences so important? When speaking with someone in person, we adjust body language, tone and the words we use, so that the audience understands the message we are trying to send. In a similar manner, we also have to be aware of the target audience when writing. Even though the task of adapting texts to different audiences may look easy to experienced writers, rookies and amateurs may struggle in selecting the information that might be relevant to a particular target audience. Nevertheless, a way to deal with words and some common sense should be enough to complete the task, but due to the latter requirement automating this task becomes a much harder problem.

In this paper, we adapt texts to context by manipulating three text evaluation metrics: length, polarity and readability. Our method will be able to transition between social media posts, research articles, newspaper articles and official statements, where each publication type targets a different audience. While governmental institutions and academics both publish neutrally-oriented texts, research articles tend to be much longer than official statements. Social media and news usually target wider audiences, which is why texts should be more readable. However, the two can be separated by the amount of opinion we can include. Newspaper articles should be less biased and thus include less positively or negatively-oriented words.

Our methodology iteratively adapts key text evaluation metrics towards the mean values of the target publication type that will be calculated from a sample set of articles. In each iteration our method first manipulates length using abstractive summarization techniques and natural language generation models. Next, it replaces words with more appropriate synonyms and adjusts polarity and readability scores. Finally, it uses a fine-tuned text-to-text transformer to generate more appropriate paraphrases that replace whole sentences in our text and alter readability.

2 RELATED WORK

While we are trying to automatically adapt texts to a particular genre, researchers have already made progress in automatic text simplification, where we try to adapt text to be more readable and easier to understand. Carroll and Tait [2] developed a methodology to simplify texts for people that suffer from aphasia, which is a disability of language processing. The developed system consists of an analyser component, which provides syntactic analysis and a simplifier component, which adapts texts using lexical and syntactic simplification. Lexical simplifier replaces the words in text with synonyms by considering Kucera-Francis frequency of each available synonym that is held in WordNet. Syntactic constructions that are not constructed in Subject-Verb-Object order can also be tough to process for aphasic people. Therefore, the authors proposed several syntactic simplifications, such as replacement of passive constructions with active constructions.

A lot of research has already been done on how to evaluate and alter text and we will use many existing methods to help us develop our methodology. We picked three text evaluation metrics that can be reasonably altered using existing methods. Flesch [5] developed an equation that determines the readability of the text using the number of words per sentence and the number of syllables per word ratios. Even though structure-based metrics are important, we also have to consider the message of the text. Using sentiment analysis, we can determine whether the writer has positive or negative affections towards the topic of the text. Feldman [4] in his article discusses several approaches of sentiment analysis based on the unit that we will be classifying (i.e. documents, sentences, aspects).

As length is one of the chosen text evaluation metrics that we wish to adapt, we have to be able to both summarize and

extend the text. According to Allahyari et al. [1], we differentiate between extractive and abstractive summarization approaches. Extractive approaches shorten the original text by excluding less relevant sentences. Significance of the sentence can be evaluated by determining whether the sentence is related with the main topic or whether its content is distinctive in comparison to other sentences. On the other hand, abstractive approaches tend to summarize texts in a new (more human-like) manner by structuring the text into some logical form such as graphs, trees and ontologies [6].

When adapting shorter texts to longer, natural language generation has proven to be a very strong tool. Radford et al. [7] developed a natural language generation technique to generate additional text and produced state of the art results using unsupervised multitask learners for model learning. Their model was trained to predict the next word in text based on 40GB of Internet content. They concluded that large training datasets and models trained to maximize the likelihood of a sufficiently varied corpus can learn a surprising amount of tasks, while no supervision is needed in training.

Another method that is commonly used when adapting texts to context is paraphrasing, i.e. rewording of something written by changing its structure or replacing the words with their synonyms. Goutham in his article [9] used a pre-trained text-to-text transfer transformer to generate paraphrases of questions. The model was fine-tuned, where the input texts were questions from Quora and the expected output were the questions that were labeled as their duplicates.

In our paper, we plan to exploit the aforementioned abstractive summarization technique to shorten our texts and fine-tune the pre-trained natural language generation model that Radford et al. [7] developed. Similarly as Goutham [9], we intend to fine-tune a pre-trained text-to-text transformer that would be able to generate paraphrases of a sentence. To calculate readability score of the input text, we plan to use the formula proposed by Flesch [5].

3 ADAPTATION OF TEXT

As mentioned before, the proposed method iteratively manipulates the chosen text evaluation metrics to adapt text to different target audiences. In Figure 1, which gives an overview of the method, we can see that before we start running the process, we calculate the initial values of text evaluation metrics for each publication type as the average values of a set of documents. Our main dataset consists of 150 documents for each publication type, where all the documents hold text that contain COVID-19 related content, with which we minimize the effect of variables that we will not take into account in text adaptation. We also define the number of iterations (in our case: 5) and the acceptable error ϵ (in our case: $\epsilon = 0.1$) that determines whether it is still worth altering a particular text evaluation metric.

In each iteration, relative differences between current and initial values of text evaluation metrics are calculated. If the absolute relative difference to some metric is bigger than ϵ, we try to adjust it to the targeted value. We adjust key text evaluation metrics in the main loop of the process in Figure 1 using the following procedures:

- In case the target length is smaller than its current value, we use a pre-trained **T5 text-to-text transformer [8]** to **summarize** the input text. The model is an encoder-decoder model that uses transfer learning on a model that is

firstly pre-trained on a data-rich task using texts from the Colossal Clean Crawled Corpus and then fine-tuned on a downstream task using a dataset of texts and their summaries as the expected outputs from the aforementioned corpus.

- To generate additional text, if the input text is shorter than the average text of the target publication type, we use **fine-tuned natural language generation models**. We generate four pre-trained GPT2 natural language generation models [7] that are based on the aforementioned unsupervised multitask learners. Each model is then fine-tuned on a dataset of 100 texts of a certain considered publication type and should be able to generate texts similar to the ones that it was fine-tuned on. Consequently, we would assume that the generated text needs less further adaptation.

- While adapting length might be the procedure with the most visible results, we also have to adapt the other text evaluation metrics. We develop a **synonym replacement** procedure to adjust polarity and readability scores to the target values. The procedure is executed in iterations and in each iteration we replace the word with the highest sum of absolute relative differences of polarity and readability scores to the initial values of the target publication type with its optimal synonym, i.e. the synonym which causes the sum of absolute relative differences to minimize. We used the lexical database WordNet to acquire synonyms of the considered word.

- Finally, we alter readability by **generating paraphrases with a T5 text-to-text transformer [9]** that was fine-tuned to generate paraphrases by learning on Microsoft Research Paraphrase Corpus dataset [3]. We then pick the optimal paraphrase, which minimizes the relative difference to the target readability score.

Replacing sentences with their paraphrases could potentially also alter length and polarity. We test the assumption by generating five paraphrases for each sentence in 100 documents for each considered publication type and find that the relative difference of length and polarity between the initial sentence and its paraphrases is not significant. The obtained mean relative difference of polarity scores in this preliminary analysis was $0.91 \cdot 10^{-3}$ and the mean relative difference of lengths was $0.11 \cdot 10^{-3}$.

4 EVALUATION AND RESULTS

In our experiments, we evaluate the quality of text transformation between all possible pairs of four different publication media types: social media, news, research articles and official statements. We tested our methodology by generating adapted texts of a subset of the main dataset that was introduced in Section 3. The subset consists of 100 documents for each publication type (i.e., 400 altogether) that were randomly chosen from the main dataset. We adapted each document to the other three publication types and thus test all of the 12 possible transitions. We observed how the key text evaluation metrics behaved and whether the generated text was meaningful or not. The results text evaluation metrics before and after adaptation to context are shown in Table 1. In Table 2, we present the results of content quality evaluation of the generated texts.

From Table 1 we can observe that the text evaluation metrics successfully changed in the right direction. In most cases we

Input publication type		Official statements		Research articles		News		Social media	
		Target publication type							
		Initial	Adapted	Initial	Adapted	Initial	Adapted	Initial	Adapted
Official statements	Length			0.79	0.04	0.04	0.03	36.39	0.35
	Polarity			2.88	0.15	2.05	0.04	2.78	0.4
	Readability			0.36	0.75	0.23	0.35	0.4	0.24
Research articles	Length	3.06	0.05			2.99	0.04	136.23	0.33
	Polarity	0.81	0.27			0.33	0.07	0.18	0.46
	Readability	0.17	0.08			0.34	0.22	0.45	0.12
News	Length	0.97	0.03	0.99	0.03			63.79	0.4
	Polarity	0.88	0.14	0.43	0.1			0.33	0.37
	Readability	1.21	0.05	1.2	0.84			0.24	0.11
Social media	Length	0.69	0.02	0.64	0.03	0.97	0.04		
	Polarity	0.85	0.28	0.28	0.02	0.55	0.06		
	Readability	0.71	0.27	0.69	0.8	0.24	0.28		

Table 1: Absolute relative differences to initial values of target publication type before and after transition
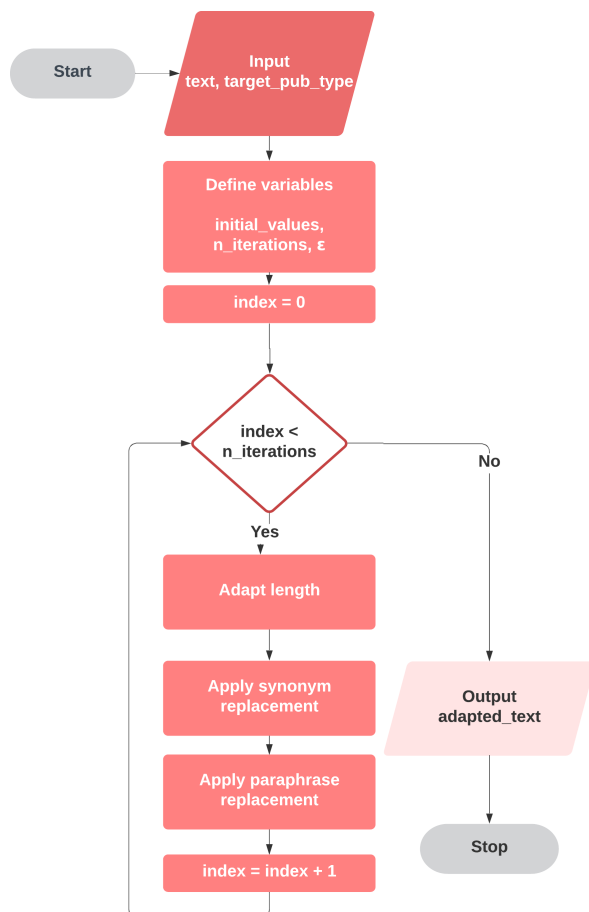
Figure 1: Flowchart of the text adaptation methodology

significantly improved the values of metrics. The length manipulation managed to consistently decrease the relative difference towards targeted length and in many occasions even converge under ϵ value. Polarity and readability scores seem harder to adapt. However, in each case we successfully adapted the sum of relative differences of those metrics, with which we can conclude

that synonym replacement method performs suitably, too. Its inefficiency may be caused by the lack of choice in synonym and paraphrase replacement and the limited amount of words and sentences that can be replaced.

As an example, we tried to adapt this research article to a social media post. By including statements that are colored in yellow in Figure 2, such as "The authors have proposed" and "The researchers used", we imply that the social media post talks about a research article, which it does. Furthermore, the replacement of the word "texts" with "written matters" and the word "audiences" with "audience groups" indicates that the initial readability of this research article is higher than the expected value of social media posts, because we lower the Flesch Reading Ease score with the mentioned transformations. The content is appropriate as it extracts some of the most crucial concepts of this article.

Figure 2: Example of text adaptation from this research article to a social media post

Additionally, we evaluated the content quality by checking semantic similarity between the input and the generated text. Using GloVe word embeddings, we transformed the text into vectors and calculated the angle between the vectors. With cosine measure we evaluated whether the vectors point in a similar direction, i.e. the contents of texts, are similar. In Table 2, we present the mean cosine similarities between GloVe embeddings of the input and the adapted texts. The results show that the generated texts preserve the original content. Cosine similarity scores are high in all transitions, however, the scores are a bit lower when we adapt to or from a social media post. This could be a consequence of the inability to thoroughly define the content in short texts that are expected in social media.

While our method successfully adapts key text evaluation metrics, our results are not perfect when it comes to the content. Our method has its drawbacks such as generating lots of additional content, which often results in an unconnected text. Additionally, synonym replacement and paraphrase generation

Original publication type / Target publication type	Research article	Official statement	Social media	News
Research article		0.94	0.82	0.97
Official statement	0.95		0.82	0.97
Social media	0.83	0.93		0.90
News	0.95	0.96	0.82	

Table 2: Cosine similarities between GloVe embeddings

can incorrectly replace original sentence or word, where the paraphrase or synonym changes the meaning but proves to be effcient when adapting text evaluation metrics, if there exist such synonyms that are more appropriate to use for a particular target audience. Nevertheless, our methodology generated a few sequences that could be published for target audiences without any changes and lots of texts would only require minor corrections.

To conclude this section, we are satisfied with the benchmarking results that our method produced in adapting key text evaluation metrics. The methodology produces some interesting content and can thus be used as a baseline for further text adaptation to target audiences.

5 CONCLUSION

In this article we developed a methodology that adapts texts to context. The methodology focuses on three text evaluation metrics: length, readability and polarity of the text. Our method iteratively adapts text to the calculated initial values based on the targeted publication type by adjusting the key text evaluation metrics. We successfully managed to adjust text evaluation metrics in nearly all transitions.

While we found text evaluation metrics that define different publication types, in some cases adjusting these measures is not enough. Generating longer sequences of additional text, we find that the generated content is not connected and while we can find a chain of related topics of subsections, in some cases it is hard to define the common thread that is held throughout the whole text. Additionally, if such synonyms and paraphrases exist that corrupt the content but improve the relative differences to the targeted values of key text evaluation metrics, the methodology will replace existing words and sentences with senseless content. Despite these drawbacks, we generated lots of results that reflect the targeted publication types and even more results that would require only minor changes to be completely acceptable. We conclude this article with satisfactory results of both content of generated texts and their values of key text evaluation metrics.

Our ideas for further work include improvement of natural language generation model, where the pre-trained model that we used should be trained on longer texts so that we could generate text based on longer prompts and thus make sure that we hold the common thread throughout the whole text. Determining whether synonyms or paraphrases corrupt the message of the text is also very important. Word embeddings can be used to represent the context of the text and we could use it to determine whether the synonym fits the current context or not. Another way to adapt text to context would be to create a dataset of texts, where each row hold different versions of the same text and each version represents the text written for different target audience. This way we would be able to teach text-to-text models to adapt text to

context and the methodology could also consider patterns that might not be obvious to human's eye.

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PREDGOVOR

Na letošnji konferenci Kognitivna znanost sodelujejo avtorice in avtorji z različnih disciplinarnih področij in predstavljajo tako empirične rezultate svojih raziskav kot tudi teoretska raziskovanja z najrazličnejših področji – od kognitivne nevroznanosti in psihologije do empirične fenomenologije, filozofije in umetne inteligence.

Upamo, da bo letošnja disciplinarno in metodološko bogata konferenca odprla prostor za izmenjavo zanimivih raziskovalnih idej ter povezala znanstvenice in znanstvenike z različnih disciplinarnih področij, ki se ukvarjajo z vprašanji kognicije.

Toma Strle
Jaša Černe
Olga Markič

FOREWORD

At this year's Cognitive Science conference, the authors present their empirical studies as well as theoretical research from a diverse range of disciplinary backgrounds – from cognitive neuroscience and psychology to empirical phenomenology, phiosophy and artificial intelligence.

We hope that this year's cognitive science conference – rich in disciplinary approaches and methodologies – will open space for exchanging intriguing research ideas and will bring together scientists from a diverse range of areas related to the exploration of the human mind.

Toma Strle
Jaša Černe
Olga Markič

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Phenomenology of Dissolution Experiences:
An Exploratory Study

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ABSTRACT

We report on an exploratory empirical phenomenological study investigating the so-called *dissolution experiences* (DEs), characterized by the subject experiencing a) a dissolution of her psychological or sensory boundaries and/or a fading of the sense of the self as a separate entity, and/or b) a feeling of unity or identification with (elements of) the surrounding environment. We conducted nine phenomenological interviews investigating seven DEs. The qualitative analysis of collected descriptions of experience elucidated the temporal unfolding of each DE episode, identified typical experiential elements characterizing (specific phases of) DEs, and inquired into the differences and similarities of DEs across different contexts. This study is considered a pilot for a more extensive investigation of DEs. Our findings provide grounds for making the first step towards the phenomenological and conceptual clarification of DEs, which have recently become an object of growing interest in the scientific community, consequently enabling further research.

KEYWORDS

Empirical phenomenology, Dissolution of the sense of boundaries, Sense of self, Altered states of consciousness

1 INTRODUCTION

Various strands of scientific [e.g., 1–11] and non-scientific [e.g., 12–19] literature report on experiential episodes during which "the subjective sense of one's self as an isolated entity can temporarily fade into an experience of unity with other people or one's surroundings, involving the dissolution of boundaries between the sense of self and 'other'" [1:1]. In autobiographical accounts, experiences of this kind are typically (albeit not always; see for instance [20]) described as "positively transformative moments that rank among the most meaningful of one's life" [1:6]. Most frequently, they are reported in association with religious and mystical traditions (e.g., *Atman Brahman* union in the traditional Indian philosophy of *Advaita Vedanta* [13], the meditative state of *Samadhi* in Classical Yoga and Buddhist meditation systems [14], the phenomenon of *unio mystica* in the Christian Tradition [15]; for an overview, see [1, 2]).

The sciences of the mind have lately shown an increased interest in this kind of experiences. The loss or decrease of the sense of boundaries between the 'self' and 'world' (also described as 'other' or 'nonself', cf. [1, 4]), brought about in the context of meditative practice, has been recently explored in studies using both third-person [3] and first-person [4] approaches. Apart from meditation, similar experiential phenomena have long been associated with the use of psychedelic substances such as LSD and psilocybin [5], and have been, in this context, observed and investigated in several recent studies [e.g., 6–8]. Changes in the habitual sense of being a separated entity have also been reported in contexts related to the engagement with art [9] or nature (cf. [10]). Finally, one can find a myriad of descriptions of similar experiences in prose and poetry, for instance in the literary and philosophical movement of transcendentalism [16], in Walt Whitman's poetry [17], in the cultural and literary movement of the Beats [18], and in the poetic tradition of *haiku* [19]; these sources frequently describe such experiences as arising from contact with nature.

Despite their apparent abundance, experiences of this kind seem to lack a common phenomenological and conceptual description, with reports frequently expressed in language specific to the particular context in which they occurred, or in which they are described. This makes it difficult to compare instances of potentially similar experiences reported in different traditions and situations, or by different subjects. Depending on the particular text, these might be described under a variety of names, including *dissolution of the sense of boundaries* (see for example [3–4]), *self-transcendent experiences* (e.g., [1]), *ego death* (e.g., [2]), *ego dissolution* [6–8], and *oceanic feelings* [11]. In one of the few available overviews of such phenomena, the article titled *The varieties of self-transcendent experiences* [1], such experiences are characterized by "transient mental states marked by decreased self-salience and increased feelings of connectedness" [1:1] (cf. also [19]).

We refer to these and similar phenomena as *dissolution experiences* (DEs). In line with the above-mentioned characterizations [1, 11], we define DEs as experiential episodes marked by (a) a feeling of a dissolution of one's psychological and/or sensory boundaries or a fading of one's sense of self as an isolated entity, separated from 'world', 'other' or 'nonself', and/or (b) a feeling of one's unity and/or identification with the surrounding environment, with other people or objects, or with something perceived as larger than oneself.

In this contribution, we present the method and results of an exploratory empirical phenomenological study in which we investigated seven experiential episodes that, according to the above-specified criteria, qualify as DEs. The findings of this study will serve as guidelines for specifying the focus and methodology to be adopted in a more extensive study, currently in its early stages of development, whose final aim will be to provide a detailed phenomenological description of DEs.

The research questions we attempted to answer were: (1) What is it like to experience DEs; what are the typical experiential elements that can be found in DEs? (2) What are the potential similarities and differences between DEs occurring in different contexts?

2 METHOD

Between October 2019 and January 2020, six co-researchers (three females) participated in the study. Their average age was 31,2 (SD = 12,6) and they had, on average, 17,7 years of education (SD = 3,0). Five of our co-researchers were current postgraduate students of cognitive science; three among them had basic experience in phenomenological reporting and one of them was trained in the micro-phenomenological method. One co-researcher was not familiar with either cognitive science or phenomenological inquiry prior to the interview.

We conducted nine interviews about seven experiential episodes (two episodes being an object of an interview twice) satisfying the above-specified criteria of DEs. We selected co-researchers who reported having experienced a (candidate) DE at any point in their life, and expressed interest in its phenomenological exploration. The to-be-explored DEs were identified by the co-researchers themselves in a conversation with the principal investigator prior to the interview.

In line with the breadth of our definition of DEs, the investigated episodes varied with regard to their approximate duration (ranging from a few moments to several minutes), the time since their occurrence (ranging from five days to 25 years prior to the interview), as well as the context and activity within which they arose. All investigated DEs occurred in an ecological setting: three in the course of meditative practice, three during the use of psychedelic substances, and one in the course of engaging with art.

To assist co-researchers in producing phenomenologically rich descriptions of their experience, rather than (as appears to often be the case in describing DEs) relying on experientially ungrounded conceptualizations, we chose to base our interviewing approach on the guidelines of the micro-phenomenological interview method [21]. When the generated description was phenomenologically too coarse, or when co-researchers resorted to explaining, judging, or conceptualizing their experience, the interviewer re-directed their focus back to describing experience as it was concretely and actually lived.

For illustration, consider the following excerpt from the interview about DE6 (i.e., the sixth investigated experience), showing a back-and-forth exchange between the interviewer and the co-researcher Marco, aiming to describe his experience without falling back on phenomenologically imprecise notions and metaphors:

> Marco: It's kind of impersonal and like not being in a body [...] Like part of something that's a lot bigger than yourself. [...] Like I'm not aware of a body anymore. The sense of my body, like being here at a certain point in the world, is gone.
>
> Interviewer: Okay. And *how do you know* that the sense of being in your body is gone?
>
> Marco: Hm. It feels like I'm the universe. [Laughs.] I feel like I'm the universe. I feel like I'm the void. [...] It's a void feeling.
>
> Interviewer: Okay, and *how does it feel* like to be the void?
>
> Marco: At first, it's cool! I think there is a first aspect of awe, like a positive aspect of awe...
>
> Interviewer: Okay, but how do you feel, how do you know that you are the void?

The interviews were conducted in English and Italian; they lasted from 56 to 78 minutes. Each interview focused on detailing the diachronic and synchronic dimension of the selected DE. We started each interview by first asking the co-researcher to describe the selected experience in its full temporal unfolding; we then inquired in more detail into the structure – rather than the content – of the experience within specific temporal phases (of variable duration) that were characterized by the same experiential elements; we also focused on the transitions between different phases. The *peak phase*, i.e., the phase during which the elements characterizing DEs – a dissolved sense boundaries and/or a feeling of unity or identification with (elements of) the surrounding environment – were present to the largest extent, was identified already during the interview; the synchronic structure of this phase was investigated in more detail.

All interviews were recorded on audio or video and transcribed verbatim. Our analysis process was informed by general guidelines of qualitative analysis [22]. Transcripts were chronologically ordered, eliminating or marking the so-called "satellite dimensions" [23], so that further analysis focused on the parts containing phenomenological descriptions. Descriptions of experience were divided into temporally distinct phases (extraction of the diachronic structure), with this process being guided by the prior identification of the peak phase. For each phase, we identified and described different experiential elements present (extraction of the synchronic structure). Interview excerpts used in the present contribution have been edited for clarity by removing the interviewer's interventions and less relevant parts of the transcripts.

3 RESULTS

In accordance with the exploratory character of the study, its findings are not conclusive, but present preliminary insights

that will guide our further research into DEs. Due to the nature of our results and the space limitations of the present contribution, we decided to refrain from laying out an exhaustive list of constructed experiential categories. Instead, this section presents a limited selection of identified experiential elements and characteristics that we find particularly interesting and/or illustrative of the investigated DEs.

Specific aspects of DEs are presented in subsections 3.1–3.3. We would, however, like to start this section by first giving the reader a general impression of the studied experiences by presenting a typical description of a peak phase, taken from the interview about DE7. Co-researcher Lev experienced DE7 while attending a concert, standing in a crowd of people in front of the stage, with the band playing a specific song. The initial phases of the experience, in line with the unfolding of the song, were characterized by a crescendo of feelings of connectedness, while Lev's sense of self, sense of time, and sense of space were gradually diminishing. At a certain point, however, there was a sudden "break in the song" in which only the singer was performing, with the rest of the band remaining silent; during this phase, Lev reported having briefly regained the type of awareness (of himself, his body, and the surrounding space) that he described as similar to that which he habitually experiences in the context of his everyday life. When the band suddenly started playing again, Lev rapidly entered the peak phase of the experience:

> This contrast [between the "break" and the band playing again] really made me lose all my sense of self [...] it's like the feeling where it feels like it is exploding and it's just big, all the borders are gone [...] it's like a huge euphoria. But it feels like it's everywhere. It doesn't feel that it's in my body or... It just feels that *everything* is very euphoric.

This feeling was accompanied by a decrease of the sense of being a separate self:

> It feels like everything is one, so like I'm aware that [the other people] are there but it feels like they are the same as me and we are the same as the music, and [...] just everything appears to be one, everything. So before, it seems like we're connected, we're two different things that are connected, but in the end [i.e., when the peak phase begins] it doesn't seem like [we] are two different things anymore. [...] This sense of connection changes into a sense of unity. [This sense of unity] cannot really tie to my experience, it just seems like a big experience, *one big experience*. Not like me feeling these things, just like [...] this kind of feelings [that] float in the room, it's not like me feeling it in my chest or in my whatever, but it just seems to be there, everywhere. [...] It's not something that I do or that I perceive [...] it's just... *I'm part of everything else* [...] If it's my behavior or someone else's, it doesn't really make a difference [...] I'm out there somewhere. I don't really know [where], but I also don't really care.

Before presenting specific experiential aspects of DEs, it is important to stress that the investigated DEs presented high variability with regard to their diachronic as well as synchronic structure.

Variability in the diachronic structure. While the above excerpt from DE7 serves as a good illustration of the peak phase, its diachronic unfolding differed from that of the majority of investigated experiences. Namely, DE7 started with a gradual diminishment of Lev's sense of boundaries, which was then regained during the "break" in the song, only to be abruptly lost again with the beginning of the peak phase. By contrast, all other experiences (6/7) were characterized by a continuous, uninterrupted climax of defining elements of DEs towards the peak phase; in the phases following the peak phase, these elements would then gradually or abruptly disappear.

In line with this more typical temporal unfolding is, for example, DE2, during which co-researcher Claire perceived a progressive lessening of – as she called them during the interview – the "lines of her body". In the initial phase of the experience, Claire was feeling the freshness of the air touching her skin, and a straight "line" between the skin and the space around it; then, starting from the lower left part of her face and gradually encompassing all of her body, all the "lines" of her face and body began feeling "wobbly" at first and then altogether absent from experience. In the last phase of the experience, the "lines" separating her body from the outside world "entered into focus" again.

Variability in the synchronic structure. The seven investigated DEs highly varied with respect to the particular experiential elements present in (specific phases of) the described experience. The most notable difference refers to which of two above-specified criteria for DEs – (a) and/or (b) – were satisfied during their peak phase, and in what way.

Co-researcher Nadja, for example, described an experience (DE1) she had while meditating with her eyes closed, sitting with her legs crossed on the floor of her room. As she was focusing on her breathing (visualizing wood while exhaling, and imagining being part of this wood while inhaling), she started experiencing a gradual dissolution of the boundaries separating her body from her surroundings. Just before the peak phase, Nadja reported feeling a "hole" in the middle of her chest; in the peak phase, she described a sense of not having a frontal part of her torso at all. Here, a dissolution of bodily boundaries (criterion a) was reported without any sense of identification or unity with (elements of) the surrounding environment (criterion b).

In DE3, on the contrary, co-researcher Andrea was experiencing strong identification with objects present in her physical surroundings (criterion b); however, she did not report on any sense of boundary dissolution (criterion a). The experience arose after Andrea consumed LSD and inhaled laughing gas, starting then to recognize the reflection of her own face in various objects in her surroundings that she would look at. She reported feeling that the reflections she was seeing were "also part of who [she was]", and while she described "extend[ing] a little bit outwards, into what [she was seeing] and touching", she stressed she never stopped feeling "in [her] body".

When involving a sense of boundary dissolution, the investigated DEs also varied with regard to the described mode of experiencing this dissolution: while in some cases, the dissolution was described as an emphatically bodily experience or even had a very specific bodily location (as in

the above-described DE1), in other cases (for example in DE7), the co-researcher described the dissolution largely without referring to the bodily feelings.

In what follows, we list a subset of some interesting or illustrative experiential elements and characteristics that featured in particular temporal stages of the investigated DEs: (1) the peak phase, (2) the phases preceding the peak phase, and (3) the phases following the peak phase.

3.1 Elements present during the peak phase

Identification of the action of feeling and the object felt. Peak phases of four investigated DEs (in particular, three from the context of using psychedelic substances, and one from engaging with art) were characterized by instances where the co-researcher could not distinguish between the *action* of feeling and the *object* of feeling, or was experiencing the two as identical. For example, co-researcher Andrea, who experienced DE3 while she was sitting on a couch, reported:

> There was a certain awe. With the insight of everything being me [...] It was not like there was a world out there... There's just my perceptions of the world, which are part of *me* because they are *my perceptions*, and this extended to tactile feelings [as well as visual]. So, when I was feeling the couch, the feeling of the couch was part of me. [...] It's difficult to distinguish my perceptions of things from the actual things. [...] I could feel the softness of the couch, that softness was part of me, or just the pressure against me was part of me.

Lev, in describing DE7, similarly remarked:

> I cannot really tell what's the difference between me feeling something and me seeing something, or like... what the rest of the world does, it's like it's the same for me [...] what is going on on the stage and what is going on in my head, I cannot really tell the difference.

Transmodality. Two DE descriptions (one from the context of using psychedelics, and one from engaging with art) reported on the unification of different sensory modalities. Marco, who experienced DE6 while being in the forest under the influence of mescaline, thus described the merging of senses accompanying the onset of his sense of boundary dissolution:

> ... it might be hard to separate different aspects of the visual and the feeling and the thinking because it might have all been into one. Like the visual part was also the feeling, like my sense of self was encompassed by this visual aspect, like this broad universal view, and then the feeling, like it might have all been wrapped into one.

Similarly, in describing the beginning of the peak phase in DE7, Lev reported:

> Then, when everything else comes in again, it just loses the separation between the sound and colors and different sensory perceptions.

3.2 Elements present before the peak phase

"Feeling" that passes through the bodily boundaries. In four investigated DEs (two from the meditation context, one from the psychedelics context, and one from engaging with art), co-researchers reported a *feeling* (a term all four spontaneously used in all four occasions to refer to different sensations, e.g., a pulsating or a movement) that they

perceived as "passing through their bodily boundaries", usually without encountering obstacles in doing so (or encountering them less and less). This feeling was felt as moving either from the outside inwards or from the inside outwards, and was sometimes experientially related to the loosening of the sense of boundaries. For example, Claire described an experience (DE2) that she had while lying on her bed and following a guided meditation. Throughout the experience, she felt a pulsating sensation spreading from her chest that was loosening the "lines of her body":

> [A]s this pulsates, I don't feel any... block in a way. [...] Nothing slows the feeling down in this area. [...] It goes everywhere, sort of just spreads over the body and then goes out into space. [...] Makes my, like this separation of my body, it makes it sort of thinner and lessens it.

Another example can be found in DE1, in which the peak phase (already mentioned above) was preceded by Nadja experiencing the movement of air freely passing between the space in front of her chest and the inside of her chest:

> I inhaled, and I was surprised by this stream of air entering clearly and directly into my chest. As if the air passes directly from here [pointing to space in front of her chest] towards the inside, and there is nothing that it has to go through. [...] I just observe this sensation, I continue inhaling and exhaling, until I really [...] notice that this air is not stopped by anything. [...] At a certain point I really feel like there is a hole in my body that makes the air going through it. At the beginning, just a hole. Then, after a while, I just feel there's no frontal area [...] So the frontal part is really just this exchange of air, there's nothing else [...] and in this way there's no separation between what is actually the area inside my body and what is outside, because the exchange of air is happening in the same space. I'm just a shape in which this exchange of air can take place, but nothing else.

3.3 Elements present after the peak phase

Need to go back to the habitual way of experiencing. In two of the investigated DEs (one from the meditation context and the other from the psychedelics context), the end of the peak phase was accompanied by a need to go back to the "habitual" way of experiencing. In describing DE2, Claire described it as

> a wish, like this nag or a need to come back, to not stay in this because it's really pleasant [...], something that urges to come back and then colors the entire space.

Marco reported on the need to "pull away" from what he was experiencing in DE6 (i.e., losing of sense of time and space, accompanied by visual hallucinations of "weird creatures"):

> And then there's a sense that I don't want to, I don't want that, it's too scary. (...) Well, I don't know if I can control it or not, but when I get scared [...] then I pull out of it.

Returning to the body/moment/location. In several analyzed DEs, we noted changes, throughout the experience, of the sense of body (5/7), time (4/7), space/location (4/7), or of what the co-researcher was doing (2/7). Usually, the awareness of these aspects was at its lowest during the peak phase, and returned towards the end of the DE. For example, Claire reported that at the end of her DE,

> [t]here is a sense of coming back to the body. [...] The body comes into focus again and the room [...] the sense of the

room, where I am positioned, that there is a bed underneath my legs and my body and then there is a drawer next to me and stuff like that, all that sort of comes back, […] it brings to focus the body and where I am and what I'm doing. […] So it's like *making* the room and the world in a way.

4 FUTURE DIRECTIONS

Despite most co-researchers being familiar with the basic guidelines for phenomenological reporting, the generated descriptions of experience have often failed to reach the desired phenomenological depth and precision, instead frequently staying at the level of general remarks and conceptualizations. It might well be that at least some aspects of DEs are particularly difficult – or perhaps impossible – to be put into words. Marco, for instance, emphasizes that a part of his experience of boundary dissolution (DE6) is better describable as an "*absence* … of what you thought was always there, rather than a *presence*". Our co-researchers often mentioned that their experience was difficult to describe, and further sometimes expressed concern that any words they could find were too metaphoric or esoteric to do justice to the DE as it was actually lived. For example, Jan, describing DE5 experienced while meditating on a hill with other meditators, commented:

> But what can I say, "ah what a good vibration" – I don't mean to say this as those "ah I've been to India"! I mean, you were really feeling it, you were feeling that there was… That something was vibrating, no?

In describing the peak phase of DE7, Lev similarly remarked:

> Everything is just really like on the same, I don't know – that sounds esoteric – but like everything is on the same frequency, everything is like coherent, everything shakes together.

Setting aside the question of whether the defiance to verbal description might present an inherent feature of DEs, we believe that the quality of phenomenological reports could be nevertheless substantially improved by (a) increasing the number of interviews dedicated to the exploration of a particular DE; (b) training co-researchers in phenomenological reporting in the context of everyday lives.

The results found in this study will enable us to refine the research design to be implemented in our further inquiry into DEs. In the course of the larger study based on this pilot, we are planning to collect a sample of approximately thirty DEs, experienced in different context; however, each co-researcher will, prior to exploring their DE, undergo a period of training in a technique similar to *descriptive experience sampling* [24]. This will enable co-researchers to learn to better observe and describe their experience, as well as provide descriptions of aspects of co-researchers' everyday experience that can be later on compared to characteristic experiential aspects of their DEs.

ACKNOWLEDGMENTS

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Primerjava rezultatov analize funkcijske magnetne resonance z različnimi programskimi orodji

Results of Functional Magnetic Resonance Imaging Analysis with Different Software Tools: A Comparison

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POVZETEK

Funkcijska magnetna resonanca (fMR) je metoda slikanja aktivnosti možganov, ki temelji na kompleksni analizi podatkov, ki jo omogočajo različna programska orodja. Med temi so najbolj pogosto uporabljeni AFNI, FSL in SPM. Želeli smo preveriti, če dobimo enake rezultate, ko podatke analiziramo z različnimi orodji. Naloga, ki so jo udeleženci opravljali, je bila osnovana na blok eksperimentalnem načrtu; opazovali smo čustven odziv na slike nezdrave hrane v primerjavi v nevtralnimi slikami, ki niso povezane s hrano. Pokazala se je velika variabilnost rezultatov med programskimi orodji, tako v viških aktivacij, kot v samih področjih teh razlik. Obstaja veliko možnih razlag za te rezultate; največji pomen pripisujemo različnim pristopom registracije in normalizacije, ki so onemogočili direktno primerjavo. Ta študija je šele začetek eksploracije tega področja in nakazuje potrebo po večji refleksiji fMR znotraj nevroznanosti.*

KLJUČNE BESEDE

funkcijska magnetna resonanca, statistična analiza, metodologija, programska orodja, nevrofilozofija

ABSTRACT

Functional magnetic resonance imaging (fMRI) is a method of capturing brain activity, which is based on a complex analysis of data. This is done in one of the available software packages, out of which AFNI, FSL and SPM are most commonly used. We wished to check if we got the same results, if they were analyzed with different packages. The task that the participants were given was based on a block experimental design; we observed the emotional response to images of unhealthy food compared to neutral images not related to food. The results showed a large variability of the peaks of activation, as well as areas associated with them between the packages. There are many explanations for these results; we would put the main emphasis on the different approaches to registration and normalization, which meant that a direct comparison was not possible. This study is only the beginning of the exploration of this area and shows a need for more reflection on fMRI in neuroscience.

KEYWORDS

functional magnetic resonance, statistical analysis, methodology, software packages, neurophilosophy

*Tekst je v celoti osnovan na magistrskem delu z istim naslovom.

1 UVOD

Funkcijska magnetna resonanca (fMR) je raziskovalno najpogosteje uporabljena metoda slikanja možganske aktivnosti [1]. Končni prikaz aktivnosti določenih predelov možganov nastane s kompleksno analizo podatkov. Za analizo teh podatkov obstaja več programskih orodij, med katerimi so najpogosteje uporabljeni Analysis of Functional Images (AFNI), FMRIB Software Library (FSL) in Statistical Parametric Mapping (SPM). Celoten postopek analize vključuje dolg niz odločitev glede zaporedja izvedbe posamičnih korakov ter specifičnih vrednosti parametrov [2]. Ker vsako orodje uporablja nekoliko drugačne nastavitve in drugačno programsko kodo za procesiranje signala, obstaja možnost, da pri uporabi različnih orodij ne dobimo enakih rezultatov. Primerjava rezultatov teh orodij je pomembna, da ugotovimo, ali so rezultati fMR analize skladni pri uporabi različnih orodij ali so odvisni od specifične izbire programskega orodja za analizo. V slednjem primeru je to potrebno ustrezno upoštevati pri vrednotenju in interpretaciji rezultatov.

Za končno oceno aktivnosti možganov morajo biti zbrani podatki obdelani v kompleksnem procesu analize, ki vključuje kontrolo kakovosti, popravo prostorskega popačenja, popravo premikov glave, popravo časa zajema posamičnih rezin možganov, prostorsko normalizacijo, prostorsko glajenje, časovno filtriranje, statistično modeliranje, statistično analizo in vizualizacijo [2].

Carp [3] poudarja, da je v fMR eksperimentih prisotna velika variabilnost v metodoloških odločitvah. Po pregledu 241 fMR študij je Carp [3] poročal o uporabi 32 različnih programskih orodij in 207 kombinacij korakov analize. Zaradi velikega števila kombinacij korakov pride do analitične fleksibilnosti, t.j. večji spekter zaključkov analiz z uporabo sprejemljivih metod. Iz analitične fleksibilnosti sledita dve negativni posledici: povečano število lažnih pozitivnih rezultatov in selektivno poročanje.

Le nekaj raziskav je do sedaj primerjalo rezultate analiz z različnimi programskimi orodji. Bowring idr. [4] so opazili veliko variabilnost v vrednosti t-statistik in lokacijah statistično značilnih aktivacij, vendar to ni bilo konsistentno pri vseh eksperimentih. Glede na splošni vzorec aktivacij ni bilo opaznih večjih razlik. Medtem ko so pri tej študiji analizo prilagajali eksperimentom, so Pauli idr. [5] primerjali analize s programskimi orodji AFNI, FSL in SPM, pri katerih so uporabili najpogosteje uporabljene nastavitve za vsako programsko orodje. Rezultati so pokazali podoben splošen vzorec aktivacije,

kjer je bilo pri AFNI-ju nekaj manj aktiviranih vokslov. Študija lažnih pozitivnih rezultatov [6], ki je spet primerjala AFNI, FSL in SPM, je pokazala, da vsa orodja kljub nadzoru večkratnega testiranja kažejo inflacijo statistične značilnosti. Podobno je pokazala študija, ki je primerjala rezultate analiz na ravni posameznikov (in ne na ravni skupin), kjer so razlog za povišano število lažnih pozitivnih rezultatov pri SPM-ju pripisali preveč enostavnemu modelu za šum, pri FSL-ju pa podcenjevanju prostorskega glajenja [7].

Temelj vsakega znanstvenega pristopa je zanesljivost. Ta je bistvenega pomena, če je naš cilj odkrivanje resnice in če želimo metodo aplicirati v praksi in če želimo sodelovati z raziskovalci z istega in drugih področij. Bennett in Miller [8] sta poudarila, da se raziskovalci, ki uporabljajo fMR metodo, premalo zavedajo (ne)zanesljivosti svojih raziskav. Zaradi številnih korakov v predprocesiranju pri izločanju šuma, in metodoloških odločitev, ki sledijo iz tega, je zanesljivost težko doseči. Iz tega sledi indirektnost opazovanja [9] in vprašljivost spadanja v paradigmo realizma [10].

Zanimalo nas je, ali s programskimi orodji AFNI, FSL in SPM dobimo enake rezultate pri analizi fMR podatkov in posledično, ali današnje stanje fMR raziskav odraža resničnost ali metodološko pristranskost. Cilj raziskave je bil, da s primerjavo rezultatov, pridobljenih s programskimi orodji AFNI, SPM in FSL, dobimo pregled nad razlikami in podobnostmi med rezultati. Zanimala nas je razlika v moči aktivnosti, vzorcu aktivnih predelov in deležu vokslov nad določeno mejo.

2 METODE

Raziskava je zajela kontrolno skupino 16 zdravih otrok in mladostnikov (10 ženskega spola) iz študije debelih mladostnikov. Povprečna starost udeležencev je bila 14,1 let (*SD* = 2,7 let, min = 10 let, max = 19 let).

Študija je bila sestavljena iz dveh nalog čustvene nasičenosti dražljajev, povezanih s hrano. Dražljaji pri blok načrtu so bile slike, ki smo jih razdelili v dve kategoriji: kategorija nezdrave hrane in kategorija nevtralnih slik, ki niso prikazovale hrane.

Podatki so bili analizirani ločeno za blok in z dogodkom povezan načrt v vsakem od treh programskih orodij AFNI, FSL in SPM. Najprej je bila narejena povprečna strukturna slika vseh udeležencev, ki smo jo uporabili za predlogo. Vsaka analiza je bila izvedena po postopku in s parametri, ki so privzeti ali priporočeni za vsakega izmed programskih orodij; pri FSL-ju in SPM-ju smo uporabili privzete nastavitve, pri AFNI-ju pa te možnosti ni, tako da smo uporabili priporočene. Zaradi tega je prišlo do razlike v analizi: pri AFNI-ju smo vključili korak poprave časa zajema posamičnih rezin možganov, pri drugih dveh orodjih pa ne. Po predprocesiranju, prvostopenjski in drugostopenjski analizi smo dobljene rezultate primerjali na več načinov. Variabilnost moči razlik med aktivacijami pod različnimi pogoji med programskimi orodji smo pokazali z razlikami med Z-vrednostmi. Položaj aktivnosti smo primerjali s splošnim vzorcem aktivnosti ter določanjem aktivnega predela s pomočjo različnih atlasov. Razlike med statistično značilnostjo rezultatov smo pokazali z deležem vokslov, ki presegajo izbrano mejno vrednost.

3 REZULTATI

3.1 Variabilnost moči aktivnosti

Variabilnost moči aktivnosti pri programskih orodjih smo prikazali s primerjavo razlik med Z-vrednostmi v vsakem vokslu končnih slik. Zaradi nekaterih razlik v končnih funkcijskih slikah med orodji, ki se pojavijo zaradi različnih pristopov registracije in normalizacije, smo za to primerjavo naredili masko in upoštevali le voksle, ki so prisotni pri vseh orodjih.

Kot je razvidno s histograma na sliki 1, je največ vokslov z minimalnim razponom Z-vrednosti pri primerjavi AFNI-ja in FSL-ja. Drugi dve primerjavi imata bolj podobno porazdelitev, pri vseh pa je razpon manjši od 1 pri vsaj polovici vokslov.
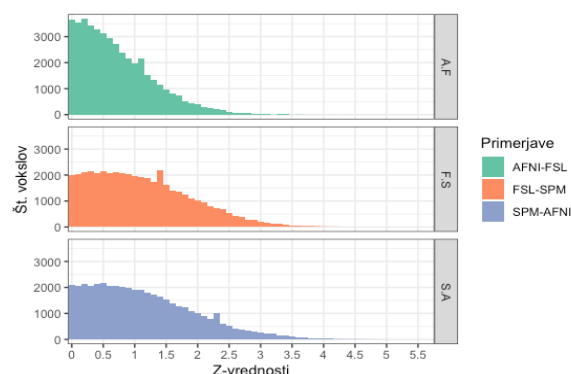
Slika 1: Porazdelitev razponov Z-vrednosti pri vseh primerjavah. med programskimi orodji

3.2 Variabilnost položaja in vzorca aktivnosti

Položaj aktivnosti smo primerjali z lociranjem področij aktivnosti in opisom splošnega vzorca. Rezultati aktivnih področij so se izkazali za zelo različne.

Največji delež vokslov s prepoznanimi razlikami med aktivacijama pod pogojema nezdrava hrana - nevtralni dražljaj je bilo pri analizi v FSL-ju, kjer je 1,14 % vseh možganskih vokslov prišlo nad mejno vrednost. Sledil je AFNI, kjer je bilo 0,48 % vseh možganskih vokslov nad mejno vrednostjo, pri SPM-ju pa je 0 % vokslov preseglo mejo.

Analiza v FSL-ju je pokazala pet skupkov, kjer se največji nahaja v levem fusiformnem korteksu. Sledita pozitivna razlika med aktivacijama pod pogojema nezdrava hrana - nevtralni dražljaj v desnem superiornem parietalnem režnju in desnem inferiornem okcipitalnem režnju. Dve negativni razliki med aktivacijama sta se pokazali v bilateralnem parahipokampalnem girusu in lingualnem girusu, kot je razvidno na sliki 2.

Slika 2: Rezultat analize v FSL-ju (koordinate: 24L 40P 10I)

Analiza naloge z blok načrtom je v AFNI-ju pokazala šest skupkov: dve negativni razliki med aktivacijami pod pogojema F - C v bilateralnem lingualnem in fusiformnem girusu, ena pozitivna razlika v levi insuli, dve pozitivni razliki v bilateralnem lateralnem okcipitalnem korteksu in ena v srednjem frontalnem girusu (slika 3).
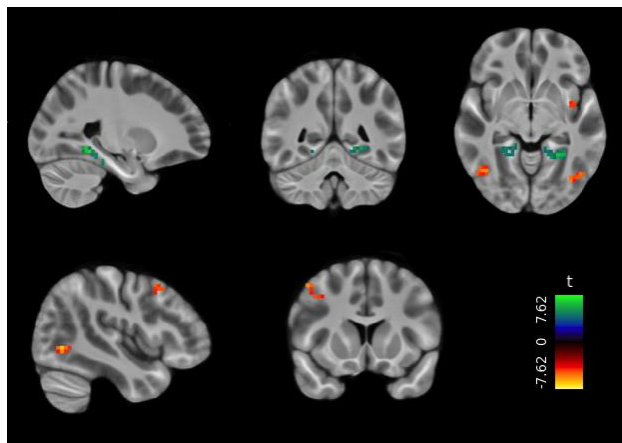
Slika 3: Rezultat analize v AFNI-ju (koordinate zgornjih treh rezin: 23L 49P 5I, koordinate spodnjih dveh rezin: 43R 12A 44S)

Pri primerjavi vzorca aktivnosti najbolj izstopa analiza v SPM-ju, ki ni pokazala nobenega aktivnega področja. AFNI in FSL sta delno pokazala različna aktivna področja, razen negativne razlike med aktivacijami pod pogojema F - C v lingualnem girusu in pozitivne razlike med aktivacijami v desnem lateralnem okcipitalnem korteksu, kjer je prišlo do bistvenega pokrivanja. To vidimo na sliki 4, kjer + nakazuje aktivacije in - nakazuje deaktivacije.
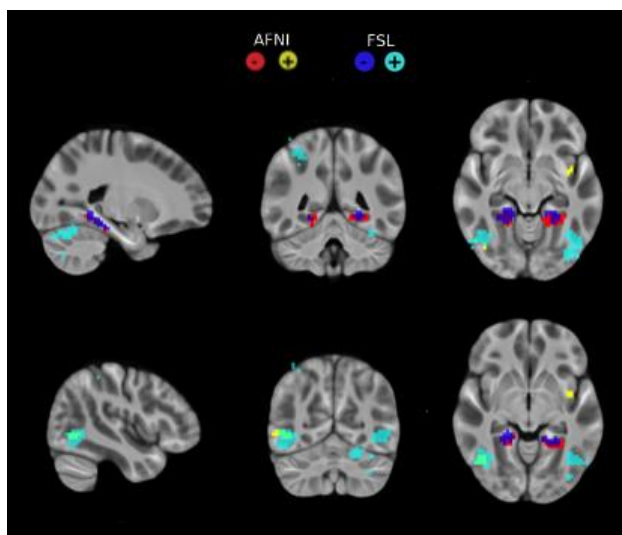
Slika 4: Področja aktivnih predelov glede na različna programska orodja (koordinate zgornjih rezin: 21L 47P 10I, koordinate spodnjih rezin: 43R 61P 61)

4 DISKUSIJA IN SKLEPI

V pridobljenih rezultatih se je pokazala velika variabilnost področja in moči aktivacije med programskimi orodji. Ena izmed možnih razlag, zakaj je prišlo do te variabilnosti, je razlika v metodah analize pri različnih programskih orodjih. Vsako orodje ima drugačno ozadje, različne pristope ter drugačno zaporedje postopkov.

4.1 Primerjava postopkov

Privzete ali priporočene nastavitve za vsako orodje so se razlikovale na vsakem koraku, sami koraki pa so se razlikovali v vrstnem redu. Pri vsakem orodju smo za popravo premikov glave uporabili drugačno referenčno sliko (sredinski volumen, povprečje vseh volumnov ali volumen z najmanj odstopanji v signalu) pri registraciji na strukturno in standardno sliko pa smo uporabili drugačne transformacije. Glede na bistvene razlike v maskah rezultatov vsakega orodja lahko sklepamo, da je ta korak bistven za razlike v naših rezultatih. Z AFNI-jem smo opravili najbolj konservativno glajenje, z SPM-jem pa najbolj liberalno. Razlika se je pokazala že pri rezultatih, ki niso statistično značilni, a je še bolj očitna po popravkih za multiple primerjave. Ker obstaja veliko pristopov k temu problemu – kot poudarijo Poldrack idr. [2], je meja arbitrarno določena – ima vsako orodje drugačen priporočen način popravkov na ravni skupkov. Veliko korakov (predvsem pri predprocesiranju in pri postavljanju končne meje) pri metodah je torej lahko pripomoglo k variabilnosti rezultatov, veliko sprejemljivih možnosti v metodoloških odločitvah pa pomeni tudi veliko analitično fleksibilnost [3].

4.2 Primerjava rezultatov

Glede na velike razlike v rezultatih je potrebno izpostaviti, da primerjava vrednosti vokslov temelji na predpostavki, da so slike prostorsko poravnane. V našem primeru niso bile, kar vidimo v različnih oblikah končih slik možganov. To je zato, ker smo želeli uporabiti privzete nastavitve, te pa so se pri registraciji in normalizaciji tako razlikovale, da so ustvarile končne slike različnih oblik. V manjši meri razlike opazimo pri Z-vrednostih pred postavitvijo meje. Kljub visokem maksimalnem razponu se pri vseh primerjavah vsaj polovica vokslov razlikuje za eno standardno deviacijo ali manj.

Variabilnost viškov se je pokazala že v drugih študijah [11] [12], medtem ko je aktivnost na različnih področjih bolj nepričakovana (napram [4] [5] [11][12]). Pri raziskavi, ki so jo opravili Pauli idr. [5], se je AFNI izkazal za programsko orodje z najbolj konservativno analizo, medtem ko je v našem primeru glede na delež aktivnih vokslov to bil SPM. Medtem ko pri SPM-ju ni bilo aktivnega področja, smo z AFNI-jem našli šest skupkov velikosti med 16 in 64 vokslov, s FSL-jem pa kar pet skupkov velikosti med 56 in 406 vokslov.

Glede na to, da eno orodje (SPM) ni pokazalo nobene aktivnosti, se postavi vprašanje lažnih pozitivnih rezultatov. Prejšnje raziskave so pokazale, da vsa orodja lahko povzročijo inflacijo statistične značilnosti [6], pri čemer je je pri SPM-ju vzrok enostaven model za šum, pri FSL-ju pa podcenjevanje prostorskega glajenja [7]. Ker smo dobili tri različne slike, bi glede na našo študijo morali potrditi izjavo Ionnadisa [13], da je več raziskovalnih zaključkov napačnih kot pravilnih. Pomembno

pa je poudariti, da naši zaključki veljajo le za privzete oz. priporočene nastavitve vsakega programskega orodja.

4.3 Pomanjkljivosti študije

Za bolj trdne zaključke bi lahko študijo izvedli z določenimi popravki. Obstaja vprašanje, ali s takim eksperimentom sploh opazimo čustveni odziv na nezdravo hrano. Ker smo za to raziskavo uporabili le osebe iz kontrolne skupine, je še posebej vprašljivo, če nam rezultati kaj povejo. Izstopa tudi majhno število udeležencev. Dodatno je treba izpostaviti, da so bili udeleženci otroci različnih starosti, kjer prihaja do velikih razlik v razvoju možganov, zato težje dobimo dokončne zaključke. Na tej točki razvoja takšnih raziskav bi bilo bolj primerno primerjati slike odraslih možganov, saj je pri pediatričnih slikah več komplikacij [14].

Ker smo za analizo uporabili privzete nastavitve programskih orodij, se je pokazala velika razlika med analizami. Zato je to ena izmed odločitev, ki bi jo lahko premislili. Ena izmed rešitev bi bila poskus izvedbe analiz z različnimi programskimi orodji, ki so si čim bolj podobne. To pa je težko izvedljivo zaradi različnih filozofij orodij, ki so sicer odprta, ko se uporabi ukazna vrstica, vendar je za približevanje drugim orodjem potrebno vzpostaviti veliko sprememb. Predvsem bi bilo potrebno večjo pozornost posvetiti registraciji in normalizaciji, da bi bile slike dejansko poravnane in bi jih lahko primerjali.

Za bolj jasno primerjavo bi morali uporabiti večji vzorec, naloga za analizo pa bi morala biti bolj enostavna ter – na tej točki našega poznavanja nevroslikovnih metod – zelo skladna s prejšnjimi študijami (na primer premikanje prsta). Glede na to, da so se razlike pri nalogi z blok eksperimentalnim načrtom kazale v aktivnih področjih, ne pa toliko v vrednostih vokslov, bi bilo verjetno relevantno pri vseh analizah postaviti isto mejo in primerjati te rezultate

4.4 Implikacije za nevroznanost

Variabilnost korakov analize postavi pod vprašaj direktnost opazovanja možganske aktivnosti. Poleg indirektnega merjenja živčne aktivnosti, ki je v sami osnovi metode fMR, različni koraki analize vzpostavijo še večjo distanco s predmetom opazovanja. Če uporabimo metaforo fotografije, ki je pogosta pri opisu fMR [15], dobimo tri različne fotografije istega učinka; torej ena analiza ne daje popolnega razumevanja možganske aktivnosti. To še posebej postavi pod vprašaj paradigmo realizma, ki velja v slikanju s fMR.

Ti podatki kažejo na problem fMR, ki sta ga poudarila Bennett in Miller [8]: nezanesljivost metode. Eden izmed temeljev znanstvene metode je zanesljivost in če dobimo različne rezultate pri isti nalogi, to močno izpodkoplje glavno nevroslikovno metodo. Pomembnost zanesljivosti in veljavnosti metode je jasna tako za raziskovalno delo kot za aplikacijo teh ugotovitev v kliniki. Na tej točki bi radi poudarili različne rešitve, ki so jih predlagali že drugi: izboljševanje trenutnih metod [6], odprto deljenje podatkov [16] ter ustvarjanje standardnega formata korakov analize [17] [18]. Nadaljevanje na kritičnem raziskovanju delovanja metode fMR je torej ključnega pomena za nevroznanost.

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What Anime to Watch Next? The Effect of Personality on Anime Genre Selection

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ABSTRACT

Personality can affect people's entertainment preferences. This has been shown with TV shows, movies, books, and music. This study tries to see if there is also a connection between personality and anime watching patterns and preferences. The analysis was done on the reviews posted on the MyAnimeList website. The study shows, that personality has a small connection with what people watch and a somewhat bigger connection with what they like to watch as shown by higher ratings.

KEYWORDS

personality, genre, anime, LIWC

1 INTRODUCTION

People use different media, to satisfy different psychological and social needs [7]. But since different people can have different needs, these can also mean, that they choose different media to satisfy their needs. One of the ways to conceptualizes differences in people is through personality.

1.1 Personality

Personality can be defined as differences in how people think, feel, and behave in general [3]. The most popular personality model in science is currently the Big Five model. The model includes five traits [11]:

- Extraversion is defined by the frequency and intensity of positive feelings. These people are positively oriented, social, and assertive, as opposed to quiet.
- Neuroticism is defined by the frequency and intensity of negative feelings. These people are less resilient and more sensitive and nervous.
- Agreeableness is defined by the relative importance people place on other people when compared to themselves. These people are more cooperative, empathic, and likable, instead of competitive.
- Conscientiousness is defined by the need to follow a system and defined rules. These people are more efficient and organized, as opposed to spontaneous.
- Openness is defined by the number of associations with different ideas and concepts. These people are more curious and creative, as not as consistent as people on the other end of the trait.

1.2 Entertainment preferences

Personality can affect interests. Even an indirect indication of interest, for example, Facebook likes, can predict personality [9]. There are some studies, showing the connection between personality and entertainment that people choose.

The entertainment preferences were found to correlate with personality. When measured by questionnaires, Communal genre preference was positively correlated with agreeableness factors. Aesthetic genre preference was positively correlated with openness and agreeableness factors. Dark genre preference was negatively correlated with agreeableness and conscientiousness factors. And cerebral genre preference was positively correlated with openness factors [13].

The specific genres were also connected to personality when the later was measured with Facebook likes. For example, in books, openness predicted liking poetry and science fiction, while disliking drama, scary, and crime books. Conscientiousness predicted liking education books and disliking comics, fantasy, and poetry. Extraversion predicted liking scary and humor books and disliking fantasy, science fiction, and war books. Agreeableness predicted liking drama and education books and disliking war and crime books. And on the end, neuroticism predicted liking crime and poetry books, while disliking non-fiction, thriller, and mystery books [4].

Because of the size of the market, focus on mass media, and different levels of tolerance for foreign media, most of the media exports in the world comes from the USA [6]. But Japan held the primary role in the cartoon segment for decades. With animes popularity increasing outside Japan [10], this allows for study the mass media from a country that differs from the USA [2]. Since there is a lack of studies connecting personality and anime, I would like to see, if there is a connection there. For this purpose, I am going to try to answer two research questions.

Research question 1 Is personality connected with the anime genres people choose to watch?

Research question 2 Is personality connected with how much people like the anime genres they watch?

2 METHODOLOGY

Data were collected by scraping the reviews and anime metadata from the myanimelist.net website in August 2020. There were 138335 reviews for 7570 anime series written by 52235 users. Users were differentiated by their user name, there was no attempt made to figure out if one user is using multiple accounts. More than half of the users wrote only one review, while the user with the most reviews wrote 554 reviews.

By scraping the genre metadata for each anime, there were 43 different genres. Each anime can be in multiple different genres. The genres are comedy, school, shounen, supernatural, hentai, romance, seinen, dementia, a slice of life, kids, adventure, space, mecha, military, sci-fi, action, fantasy, magic, music, game, drama,

shounen-ai, harem, horror, historical, sports, mystery, cars, parody, shoujo, demons, martial arts, yaoi, superpower, ecchi, thriller, vampire, samurai, psychological, police, yuri, josei, shoujo-ai.

To get the personality scores of the people, I analyzed the content of the reviews with the LIWC [14, 12]. This is a program intended to study texts with the help of the word counts in different categories. The categories include function categories, like the number of pronouns, and the content categories, like social processes.

I concatenated all the reviews for each person in a separate file. I analyzed these files with the LIWC program. The commercial version also includes the Big Five scores, which is the most frequent way of how to use LIWC to get personality. But in the academic version, these are not available. So the personality was computed based on the correlations between LIWC categories and personality found in previous studies. Some studies used this method before [1].

I used the correlations from the Yarkoni study [15], where over 600 people's blogs were analyzed with LIWC and correlated with the Big Five traits from the questionnaire. I used only the categories, that were significant at the p=.001. Since the blogs were analyzed with the earlier version of the LIWC (version 2001) program, the equivalent groups from LIWC 2015 were used. If the category no longer existed, then it was dropped. The values were summed together to get the composite value.

Based on this method, the traits were calculated in the following way: Conscientiousness was calculated by summing achievement, anger (negative), negative emotions (negative), and negations (negative). Agreeableness was calculated by summing the words connected with home, leisure, motions, space, positive emotions, anger (negative), negative emotions (negative), and swear words (negative). Openness was calculated by summing the propositions, articles, words connected to death, home (negative), leisure (negative), motion (negative), time (negative), family (negative), social processes (negative), positive emotions (negative), first-person singular pronouns and all pronouns. Extroversion was calculated by summing words connected to sexualization, friends, social processes, and second-person pronouns. Neuroticism was calculated by summing anxiety, negative emotions, and second-person pronouns (negative).

The problem with this method is, that the result does not represent the real values, but only the rankings of the people. This is why the analysis will be done by comparing the highest 1/3 of the review authors with the lowest 1/3 of the review authors on each dimension.

3 RESULTS

3.1 Analysis of Review Presence

The first analysis is for the percentage of the reviews that each group wrote for each genre. If there are differences in the watching patterns of people with different personalities, then this would be reflected in the number of reviews that people write. The people usually only write reviews for the shows that they watched. So if there is a difference in ratios of reviews for different genres, this can be indicative of different watching patterns. The ratio of the reviews was analyzed with chi-square, while the effect size was calculated with ϕ.

Below are presented the results, where the p-value was lower than the threshold corrected with Bonferroni correction (1.136^{-56}). The results are also presented in a table, where for each trait, the average power for statistically significant results is presented, as well as the genre with the highest power among statistical results for both low and high levels of the trait. If there are more than three results, only the three strongest are presented.

Table 1: The summary of power results for review presence

trait	N	average	highest	high trait	low trait
A	11	0.00272	.02019	Slice of Life	Action
E	8	0.00170	.00864	Hentai	Action
N	6	0.00157	.01036	Action	Comedy
C	5	0.00143	.01108	Slice of Life	Action
O	10	0.00239	.01668	Sci-Fi	Shoujo

3.1.1 Agreeableness. People with higher agreeableness wrote more reviews for slice of life ($\chi^2 = 1087, p = .000, \phi = .014$), comedy ($\chi^2 = 931, p = .000, \phi = .012$) and music ($\chi^2 = 432, p = .000, \phi = .005$). On the other hand, people with lower agreeableness wrote more reviews for action ($\chi^2 = 1524, p = .000, \phi = .020$), horror ($\chi^2 = 623, p = .000, \phi = .008$) and psychological ($\chi^2 = 473, p = .000, \phi = .006$).

3.1.2 Extraversion. People with higher extroversion wrote more reviews for hentai ($\chi^2 = 673, p = .000, \phi = .008$), romance ($\chi^2 = 605, p = .000, \phi = .007$) and harem ($\chi^2 = 467, p = .000, \phi = .005$). On the other hand, people with lower extroversion wrote more reviews for action ($\chi^2 = 576, p = .000, \phi = .007$) and sci-fi ($\chi^2 = 455, p = .000, \phi = .005$).

3.1.3 Neuroticism. People with higher neuroticism wrote more reviews for action ($\chi^2 = 818, p = .000, \phi = .010$) and horror ($\chi^2 = 420, p = .000, \phi = .005$). People with lower levels of neuroticism wrote more reviews for comedy ($\chi^2 = 679, p = .000, \phi = .008$), slice of life ($\chi^2 = 572, p = .000, \phi = .007$) and romance ($\chi^2 = 438, p = .000, \phi = .005$).

3.1.4 Conscientiousness. People with higher level of conscientiousness write more reviews for slice of life ($\chi^2 = 817, p = .000, \phi = .010$), comedy ($\chi^2 = 348, p = .000, \phi = .004$) and sports ($\chi^2 = 341, p = .000, \phi = .004$). While people with lower conscientiousness wrote more reviews for action ($\chi^2 = 837, p = .000, \phi = .011$) and horror ($\chi^2 = 460, p = .000, \phi = .006$).

3.1.5 Openness. People with higher level of openness write more reviews for sci-fi ($\chi^2 = 1008, p = .000, \phi = .011$), action ($\chi^2 = 662, p = .000, \phi = .007$) and mecha ($\chi^2 = 369, p = .000, \phi = .004$). People with lower level of openness write more reviews for shoujo ($\chi^2 = 1450, p = .000, \phi = .016$), romance ($\chi^2 = 1302, p = .000, \phi = .014$) and school ($\chi^2 = 752, p = .000, \phi = .008$).

3.2 Analysis of Review Scores

In the next section, the scores of the reviews will be analyzed. For this analysis, only the main score will be used. The analysis will be done with a t-test, and the effect size will be calculated with Cohen d statistics. The results for five genres with the highest effect size are presented below. The results were presented, only if the p was higher than the corrected value mentioned in the previous section. If there were more than 3 results with p-value like that, only the 3 with the highest power were shown.

Table 2: The summary of power results for review scores

trait	N	average	highest	high trait	low trait
A	23	.61509	.86056	Harem	/
E	/	.14158	.34974	/	/
N	28	.71882	.83250	/	Game
C	28	.68101	.88185	Shoujo	/
O	17	.39967	.52882	/	Thriller

3.2.1 Agreeableness. People with higher level of agreeableness rate higher the genres of harem ($t = 31.1, df = 5424, p = .000, d = .860$), shoujo ($t = 29.0, df = 4467, p = .000, d = .851$) and school ($t = 53.1, df = 19349, p = .000, d = .753$). There were no genres, where people with a lower level of agreeableness would rate higher than people with a higher level of agreeableness.

3.2.2 Extroversion. There were no genres, that trait extraversion would be connected with at the corrected p level.

3.2.3 Neuroticism. There were no genres, that people with a higher level of neuroticism would rate higher than people with a lower level of neuroticism. People with lower level of neuroticism rate higher the genres of game ($t = -20.2, df = 2523, p = .000, d = .832$), harem ($t = -29.1, df = 5427, p = .000, d = .798$) and vampire ($t = -16.5, df = 2069, p = .000, d = .778$).

3.2.4 Conscientiousness. People with higher level of conscientiousness rate higher shoujo ($t = 29.1, df = 4345, p = .000, d = .881$), vampire ($t = 17.3, df = 2033, p = .000, d = .814$) and harem ($t = 26.1, df = 5303, p = .000, d = .740$). There were no genres, that people with a lower level of conscientiousness would rate higher than people with a higher level of conscientiousness.

3.2.5 Openness. There are no anime genres, that people with a higher level of openness would rate higher. But there are genres, that people with a lower level of openness would rate higher. Among these are thriller ($t = -16.5, df = 4565, p = .000, d = .528$) superpower ($t = -22.8, df = 8270, p = .000, d = .519$) and shounen ($t = -32.5, df = 19118, p = .000, d = .480$).

4 DISCUSSION

One can see in the results above, that personality is connected with both what the people are watching and how much do they like what they watch. But the statistical power with the former is much smaller than with the later. So this would mean that that personality does show some connections with the people's watching selection and a bit more connection to how much they like the genre.

When it comes to the anime series that people watch, the effect sizes are small. The averages are only approaching the cut-off for the small effect, while the strongest are all, sans extroversion, in the small effect size territory. There seems to be a bit higher for openness and agreeableness. But overall, none of them are big. So there seem to be other explanations for the selection of which show to watch, that would need to be discovered.

On the other hand, the effect sizes for liking the genres based on their personality are bigger. While the extraversion average effect size is approaching the small effect size, the rest are all

above it. With agreeableness, neuroticism, and conscientiousness being in the middle effect size territory. The genres with the highest effect sizes for these traits reach the high effect size territory.

Interestingly, that openness and extroversion have less connection to which genres the person likes compared to the other three traits. I don't know the reason, why this would be so.

Taking the more general picture of the results, there seems to be some possible connection between the groups of genres and personality. The agreeableness seems to be connected to positive social relationships, and negatively connected to conflict and negative emotions. The extraversion seems to be connected with more thrilling and positive genres along with relationship-based genres, while negatively connected to plot-driven genres. Neuroticism is connected to negative themes and conflicts and less connected with positive genres. The conscientiousness was connected to more positive, relationship-based, and supernatural genres. The interesting finding here was that some of the genres they enjoyed, they watched less of. This is unlike the finding for the former three traits. The openness also has this gap. They prefer to watch more ideas and plot-driven genres and less positive genres. But the people with a lower level of this trait seems to enjoy the genres with conflict and competition more.

The general results are more or less in line with what would be expected based on personality theory. Agreeableness' connection to empathy, extraversion's connection to positive emotions and sensation seeking, neuroticism's connection to negative emotions, and openness' connection to the creativity can explain a lot of the group genre preferences described above. Just conscientiousness does not have a very easy explanation for it.

There are a couple of things that I could do to improve the study. One of them is shown in the one-sidedness of the results for linking the different genres of the anime. While looking at all results, there are some results for low and high levels of traits, the results are still very biased in one direction. So agreeableness and conscientiousness are positively connected to liking most genres, just as openness and neuroticism are negatively connected to liking most genres. One interpretation of the results would be, that people that are higher on agreeableness and conscientiousness and lower on openness and neuroticism prefer anime. The other possible explanation, that I did not test, would be that different personalities are connected to different actions on the internet. In one study, the agreeableness and extroversion were connected with more frequent positive writing, conscientiousness with less frequent negative writing, and neuroticism and extroversion with more frequent negative writing [5]. And additional studies should try to separate the effect of personality on writing from the results.

This also leads to the second improvement. The results should be triangulated with data from different sources or, even better, with a different method. The users of one internet site are not always representative of even the whole sub-community on the internet. For example, some studies show, that websites people visit are correlated with personality [8]. So the caution should be exercised in trying to generalize the results.

The third way to improve this study would be to use multiple ways to measure personality. In this study, the correlation between LIWC categories and personality traits found in an unrelated study was used. But the correlations might not be the same if the study would be done on this dataset, so the results could be biased because of this. Confirming the personality of

a subset with questionnaires or using multiple methods would allow for a greater show of confidence in the results.

In conclusion, the personality seems to have a mostly predictable connection what people watch and how much they like it. With a stronger connection to the linking than general watching patterns.

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A   ONLINE RESOURCES

The files with all statistical results and the code that I used can be found on https://sarajaksa.eu/IS2020.

Zaznavanje lastnosti zdravil brez recepta

Perception of OTC medicine attributes

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POVZETEK

Pri zdravljenju ima pomembno vlogo jemanje zdravil brez recepta. Pacienti lahko dobijo informacije o teh zdravilih iz več virov. Poleg nasvetov strokovnjakov s področja zdravja je na razpolago tudi več pisnih virov. Razumevanje informacij o zdravilih vpliva na odločanje in vedenje pacientov in posredno na rezultate medikamentoznega zdravljenja. Raziskovali smo zaznavanje pomembnosti lastnosti zdravil brez recepta, ki so del uradnih dokumentov. Posamezne lastnosti smo sistematično združili v več skupin. V sedanjem razširjenem povzetku smo se osredotočili na zaznavanje učinkovitosti in možnih neželenih učinkov zdravil brez recepta. Za analizo podatkov smo uporabili »conjoint« metodo. V vprašalniku so respondenti z odgovori na vprašanja izrazili preference do posameznih lastnosti. Potrdili smo, da pacienti skupini lastnosti, ki opisuje tveganja, posebej resnejša, pripisujejo primerjalno večjo pomembnost kot skupini lastnosti z opisom prednosti zdravil brez recepta. Pripisovanje pomembnosti je del procesa odločanja, ki vodi v nakupno vedenje. Osnovni namen raziskave je določitev relativne pomembnosti, ki jih respondenti pripisujejo posameznim lastnostim oziroma skupinam lastnosti zdravil brez recepta. Na osnovi ugotovitev, katerim lastnostim pacienti pripisujejo prednost oziroma pomembnost, lahko strokovnjaki s področja zdravja z njimi bolj učinkovito komunicirajo. V več znanstvenih delih so opisane teorije, ki poudarjajo pretežno racionalno ali pretežno emocionalno odločanje pacientov. Odziv na tveganja je opisan kot emocionalen. Čeprav smo v raziskavi ugotavljali pripisano pomembnost tveganj in drugih lastnosti zdravil brez recepta, pa je potrebno nadaljnje raziskovanje, da bi potrdili odziv nanje kot racionalen ali emocionalen.

KLJUČNE BESEDE

Zdravila brez recepta, lastnosti, preference, pripisovanje pomembnosti, učinkovitost, tveganja

ABSTRACT

Taking OTC medicines has an important role in the treatment. Patients can obtain the OTC medicines' information from several sources. Besides the health experts' advices also several written sources are available. Comprehension of medicine information affects decision-making and patients' behavior and indirectly influences the results of the treatment with the medicines. We researched a perception of the importance related to the OTC medicine attributes, included in the official documents. Individual attributes were systematized into several groups. In the present extended abstract a focus is given to the perception of efficacy and possible side effects of the OTC medicines. A conjoint method was used for analyzing the data. The responders expressed the preferences toward individual attributes, by answering the questions in the questionnaire. It was confirmed that patients ascribe a higher importance to the attributes' group, encompassing the risks, especially the serious ones, in comparison with the group of attributes which describes the advantages of the OTC medicines. Ascribing an importance is a part of making decisions, leading to the consumer behavior. The main purpose of the research study is determining of the importance, assigned to the individual attributes and the groups of the attributes of the OTC medicines. On he basis of the findings regarding the attributes to which the preferences and the importance are assigned, more efficient communication between the healthcare experts and the patients is enabled. Several scientific publications describe the theories which emphasize mainly rational or mainly emotional decision-making by the patients. The response to the risk is described as an emotional one. Although an assigned importance of the risks and other attributes of the OTC medicines were determined, an additional research is needed in order to confirm the related response as a rational or an emotional one.

KEYWORDS

OTC medicines, attributes, preferences, ascribing an importance, efficacy, risks

1 UVOD

Zdravila brez recepta so pomemben del zdravljenja pacientov. Odločitev za nakup teh zdravil lahko temelji na nasvetu strokovnjakov, na primer zdravnika ali farmacevta v lekarni. Informacije o zdravilu brez recepta pacient lahko pridobiva tudi iz različnih pisnih virov. Poleg uradnih, odobrenih pisnih virov so razpoložljivi različna promocijska gradiva, s katerimi proizvajalci nameravajo vplivati na odločanje in nakupno vedenje pacientov. Za razliko od zdravil, ki se predpisujejo na recept, je dovoljena promocija oziroma oglaševanje zdravil brez

recepta splošni javnosti, ob upoštevanju zakonskih določil. Oglaševanje zdravil brez recepta pa mora biti skladno z določili Pravilnika o oglaševanju zdravil [1]. Pravilnik določa, kateri podatki o zdravilu brez recepta morajo biti zajeti v oglaševalskem sporočilu in katerih informacij sporočilo ne sme zajemati.

Pomembni uradni dokumenti, ki spremljajo zdravila brez recepta, na primer navodilo za uporabo zdravila in ovojnina zdravil, so v Sloveniji regulatorno urejeni. Vprašljivo pa je, ali je nadzor promocije zdravil brez recepta zagotovljen v zadostni meri, da nima negativnega vpliva na odločanje in vedenje pacientov, z verjetnim vplivom na rezultate zdravljenja. Ustrezno jemanje zdravil brez recepta je bistveno za doseganje pričakovanih rezultatov medikamentoznega zdravljenja. Zdravila, ki se ne predpisujejo na recept, imajo prav tako kot zdravila na recept pogosto močne učinke, pa tudi možne neželene učinke. Določene učinkovine v zdravilih brez recepta medsebojno učinkujejo z učinkovinami z zdravili na recept, ki jih pacienti sočasno jemljejo, pa tudi drugimi snovmi. Raziskovalci [2] so pokazali, da trditve o učinkovitosti niso v ravnovesju s trditvami o tveganjih v promocijskih materialih, ki opisujejo značilnosti zdravil brez recepta. Ustrezno ravnotežje trditev pa je pomembno za razumevanje in odločanje pacientov. Dobro razumevanje informacij o zdravilih vodi v pravilno jemanje in ravnanje z zdravili. Posebej na področju zdravil brez recepta odločanje pacientov in njihovo razumevanje informacij še ni dovolj raziskano.

V opisani raziskavi nas je posebej zanimal vidik zaznavanja pomembnosti posameznih lastnosti, ki se pojavljajo v uradnih dokumentih o zdravilih brez recepta. Medtem ko se z običajnimi raziskavami o ocenjevanju izdelkov ovrednoti celoten izdelek, pa smo v tej raziskavi ugotavljali pripisano pomembnost določenih lastnosti. To je bistveno tudi s praktičnega vidika komuniciranja strokovnjakov s področja zdravja s pacienti. Če se ugotovi primerjalno velika pripisana pomembnost neželenih učinkov zdravil brez recepta, je koristno, da strokovnjaki naslavljajo te lastnosti tekom svetovanja pacientom, prav tako pa v pisnih gradivih.

Pregled literature kaže več objavljenih znanstvenih prispevkov, ki pa se razlikujejo glede na to, ali poudarjajo vlogo razuma ali čustev pri odločanju. Proces odločanja je zapleten in natančnejšo povezavo zaznavanja lastnosti z emocionalnega oziroma racionalnega vidika bi lahko ugotavljali tekom nadaljnega raziskovanja. Joffe (2003) pa v objavljenem delu (3) poroča o čustveni vsebini odziva na tveganja, vključno z zdravstvenimi tveganji.

Osnovni raziskovalni problem je bil, da zaznavanje posameznih lastnosti zdravil brez recepta ni dovolj raziskano, čeprav vpliva na vedenje pacientov in lahko posredno vpliva na izide zdravljenja. Rezultati ugotovitev lahko pripomorejo pri komuniciranju strokovnjakov s področja zdravja s splošno javnostjo. Zavedanje o čustvenih in racionalnih vidikih zaznavanja lastnosti zdravil in poznavanje pripisane pomembnosti posameznih lastnosti zdravil brez recepta bi pripomoglo k učinkovitemu komuniciranja in posredno k uspešnosti zdravljenja.

Hipoteza: Neželenim učinkom zdravil brez recepta se pripisuje večja relativna pomembnost kot prednostim zdravil. Resnejši neželeni učinki se v primerjavi z drugimi neželenimi učinki zaznavajo kot bolj tvegani.

2 RACIONALNE IN EMOCIONALNE TEORIJE O ODLOČITVAH GLEDE ZDRAVLJENJA

Medtem ko nekatere objavljene teorije pripisujejo bistveno vlogo racionalnemu vedenju, pa druge teorije poudarjajo pomen emocionalnega vedenja. Sprva so se v večji meri uveljavljale teorije, ki so poudarjale racionalno vedenje. Kasneje so raziskovalci spoznavali pomen čustev pri zaznavanju lastnosti izdelkov, razvoj znanstvenih metod pa je omogočil tudi boljše spremljanje odziva organizma na lastnosti izdelka.

Raziskovalci [4] so ugotovili, da čustveni odzivi lahko povzročijo vedenje oseb, ki ne vodi v njihovo dobrobit. Avtorji trdijo, da se zaradi vpliva čustev zaznavanje tveganja ne sklada z racionalnimi, na znanstvenih ugotovitvah temelječimi analizami. Zaradi čustvene obdelave informacij osebe zaznavajo negativne strani kot bolj pomembne od prednosti. V raziskavi [4] je tudi opisano, da vedenje pod vplivom čustev povzroči slabše predvidevanje prihodnjih preferenc ter neustrezno oceno preteklih izkušenj in dejanskega tveganja.

Večina teorij torej odločanje opredeljuje s kognitivnega vidika. Avtorji teh teorij razlagajo, da odločitve temeljijo na ocenah prihodnjih izidov različnih možnosti, s pomočjo vrste analiz, kjer se tehtajo stroški in koristi. Določene teorije upoštevajo čustva, a le kot posledico neke odločitve in je ne povezujejo neposredno z odločitvijo. Vendar pa avtorji teorije, ki temelji tudi na fizioloških meritvah, čustvom pripisujejo večjo težo [5]. Osebe se odločajo ne le z ocenjevanjem resnosti izidov in verjetnosti njihovega pojava, ampak predvsem zaradi njihove čustvene vrednosti.

V raziskavi [6] so ugotavljali, kako osebe zaznavajo vsebino sporočila. Ko pacienti zdravljenje zaznavajo kot tvegano, so sporočila s poudarjenim vplivom tveganj bolj učinkovita. Ko pa neko zdravstveno obravnavo osebe zaznavajo kot varno, so sporočila s poudarjenimi prednostmi bolj učinkovita, saj osebe prednost namenijo pozitivnim informacijam, pred informacijam o tveganjih.

Raziskovalci [7] so preučevali sposobnost za odločanje (*decision-making capacity or competence, DMC*). Izhajali so iz že objavljenih ugotovitev ki sta jih zapisala Grisso in Applebaum [8] pri opredelitvi štirih poglavitnih dejavnikov. Razumevanje pomeni sposobnost dojemanja z zdravljenjem povezanih informacij. Ocenjevanje je povezano s sposobnostjo razpoznavanja posledic bolezni in koristi zdravljenja. Presojanje pomeni sposobnost racionalne obdelave informacij, tudi pri primerjavi tveganj in koristi zdravljenja. Dokazovanje pa se povezuje s sposobnostjo za komuniciranje. Hermann idr. [7] pa so poudarili tudi pomen čustev in vrednote v procesu odločanja o zdravju.

Hermann idr. [7] so prikazali drugačen vidik vloge čustev, posebej bolj intenzivnega čustvenega odziva oziroma neustrezne čustvene reakcije. Raziskovalci soglašajo s trditvijo, da je pri odločanju prevladujoč proces čustvovanja. Posamezniki morajo upoštevati čustva, jih priznavati kot pomembne informacije, jih povezovati s preteklimi izkušnjami in opredeliti, ali bo vedenje na osnovi takih izkušenj v prihodnje omogočalo dobro počutje. Če pa je čustven odziv intenziven, se zmanjša zmožnost za razumevanje in posvetovanje. Sposobnost za odločanje je povezano s primerno

stopnjo vključitve čustev. Pomanjkanje ali presežek čustev pa predstavlja težavo.

Raziskovalci upoštevajo različne nevrološke mehanizme v organizmu, ki vplivajo na čustvene oziroma racionalne procese ter sodelujejo pri odločanju o zdravju oziroma zdravilih. Prav tako pripisujejo različen pomen in vpliv racionalnih oziroma emocionalnih procesov na odločanje. Iz določenih raziskav [3, 4] je razvidno, da se odločanje o tveganjih v večji meri povezuje z emocionalnimi procesi.

3 ZASNOVA IN METODA RAZISKAVE O ZAZNAVANJU LASTNOSTI ZDRAVIL BREZ RECEPTA

3.1 Izhodišča

Odločanje pacientov o medikamentoznem zdravljenju je področje, ki je še premalo raziskano. Ne le pravilna struktura besedila o zdravju in zdravilih, ampak tudi ustrezno razumevanje teh informacij pomembno prispeva k pričakovanim rezultatom zdravljenja.

V tej raziskavi smo preučevali preference respondentov o lastnostih zdravil brez recepta. Skupine lastnosti so bile povezane s prednostmi zdravila, neželenimi učinki in ceno zdravil. Določili smo, katerim lastnostim so respondenti pripisali največjo pomembnost – učinkovitosti, komplianci, neželenim učinkom oziroma ceni.

3.2 Conjoint analiza

Conjoint analiza je sodobna metoda z zanesljivimi rezultati. S conjoint analizo raziskovalci ugotavljajo odločanje respondentov. V vprašalniku so navedeni različni scenariji, na osnovi katerih respondenti tehtajo med posameznimi nivoji lastnosti glede na preference. Respondenti z odgovori ovrednotijo različne značilnosti oziroma lastnosti izdelka po pripisani pomembnosti. V vedno večji meri se ta metoda uporablja na področju raziskovanja informacij o zdravilih. Conjoint analiza je vrsta evalvacije, pri kateri se uporablja vprašalnik, da bi določili tehtanje med lastnostmi in nivoji lastnosti in ugotovili preference pacientov za določene izdelke oziroma lastnosti izdelkov [9]. Tekom odgovarjanja na vprašanja se respondentu prikažejo različne kombinacije vprašanj z lastnostmi, med katerimi izbira. Računalniška obdelava podatkov omogoča določitev preferenc in določitev zaznane pomembnosti lastnosti izdelka.

3.3 Izvedba raziskave

V raziskavo je bilo vključenih 85 respondentov. 68 žensk in 17 moških. Starostna struktura respondentov kaže, da je bilo 40,0 % respondentov mlajših od 30 let, 38,8 % starejših od 50 let, 21,2 % oseb pa je imelo med 30 in 50 let.

Izbrali smo navodili za uporabo dveh zdravil brez recepta, ki sta na slovenskem tržišču. Navodila za uporabo zdravil brez recepta so uradni dokument, ki jih odobri JAZMP (Javna agencija Republike Slovenije za zdravila in medicinske pripomočke). Učinkovina v enem izmed zdravil je paracetamol. Zdravilo se uporablja za lajšanje bolečine in znižanje povišane telesne temperature, ki sta simptoma bakterijskega ali virusnega obolenja ali drugih bolezni. Drugo zdravilo brez recepta pa vsebuje tri učinkovine, to so paracetamol, psevdoefedrinijev hidroklorid in dekstrometorfan hidrobromid. To zdravilo ima širše indikacijsko območje od prvega, poleg znižanja povišane telesne in lajšanja bolečin izboljša simptomov bakterijske ali virusne infekcije v nosu ter za olajša kašelj.

V navodilih za uporabo smo kodirali trditve, ki smo jih umestili v tri skupine lastnosti. Skupina lastnosti, ki opisuje učinkovitost zdravljenja. zajema tri nivoje lastnosti in sicer olajšanje bolečine, lajšanje dihanja in zamašenega nosu ter lajšanje kašlja. Druga skupina lastnosti prav tako zajema prednosti zdravljenja, poleg znižanja povišane telesne temperature tudi dve lastnosti, ki sta povezani s komplianco zdravil: zdravila se zlahka zaužijejo in enkrat dnevno odmerjanje. V skupini lastnosti, ki zajema možne neželene učinke, je prva lastnost izpuščaj, srbenje in omotičnost. Druga lastnost so težave s srcem, tretja pa težave z dihanjem. Naslednja skupina lastnosti vključuje tri nivoje cene, ki temeljijo na realnih cenah izbranih zdravil.

4 POGLAVITNI REZULTATI RAZISKAVE

Z analizo smo dobili več rezultatov. S pomočjo računalniškega programa smo določili pogostnost izbire posameznih lastnosti in pomembnost, ki so jo respondenti pripisali lastnostim oziroma skupinam lastnosti.

4.1 Izbira lastnosti

Sprva smo določili delež izbire posamezne lastnosti s strani respondentov. V skupini z učinkovitostjo zdravila brez recepta so respondenti v povprečju največkrat (v 22 %) izbrali olajšanje bolečine in lajšanje dihanje pri zamašenem nosu [10]. To pomeni, da so izmed vseh prikazov tega nivoja lastnosti respondenti ti dve lastnosti izbrali v 22 % primerov. V manjši meri so respondenti izbrali olajšanje kašlja. V drugi skupini lastnosti je bila lastnost, ki opisuje znižanje povišane telesne temperature, izbrana v 25 % primerov, kar je presegalo izbiro lastnosti, ki so se povezovale s komplianco. Hi-kvadrat statistična analiza je pokazala, da je razlika med posameznimi lastnostmi v prvi in drugi skupini lastnosti signifikantna.

V skupini lastnosti z možnimi neželenimi učinki je bila lastnost, ki opisuje izpuščaj, srbečico in omotičnost, izbrana v 35 % in so jo v povprečju torej respondenti zaznali kot manj tvegano kot težave z dihanjem, ki so jih respondenti izbrali v 17 % in težave s srcem, ki so jih respondenti izbrali le v 7 %. Razlika med izbirami posameznih lastnosti v tej skupini je bila prav tako statistično pomembna. V četrti skupini s ceno kot lastnostjo je bila pričakovano največkrat izbrana najnižja cena (4,5 EUR), v 22 %. V manjšem deležu (20 %) je bila izbrana cena 6,5 EUR, v najmanjšem deležu (18 %) pa je bila izbrana cena 8,5 EUR.

4.2 Zaznana pomembnost lastnosti

Ugotavljali smo tudi pomembnost, ki so jo respondenti pripisali posameznim skupinam lastnosti. Primerjalno največjo pomembnost so respondenti pripisali skupini lastnosti o možnih neželenih učinkih, ki je po pomembnosti presegala pripisano

pomembnost obeh skupin lastnosti, povezanih s prednostmi zdravila, torej učinkovitosti in komplianci zdravil. Primerjalno najmanjšo pomembnost so respondenti pripisali ceni.

Tabela 1: Povprečna pripisana pomembnost skupin lastnosti

Št. skupine lastnosti	Skupina lastnosti	Pripisana pomembnost lastnosti (%)
1	Prednost: učinkovitost zdravila	14,61
2	Prednost: komplianca, učinkovitost	17,12
3	Možni neželeni učinki	59,05
4	Cena	9,22
Skupaj		100,0

V raziskavi smo pridobili in analizirali še druge rezultate, ki bodo predvidoma v prihodnje objavljeni. Poleg navedenih lastnosti smo ugotavljali tudi preference z ozirom na posamezne blagovne znamke oziroma lastniška imena zdravil brez recepta, tudi na večjem vzorcu respondentov.

5 RAZPRAVA IN ZAKLJUČEK

Izhajali smo iz trditve, da neželenim učinkom respondenti pripisujejo večjo pomembnost kot učinkovitosti, Kot posebej tvegani se zaznavajo resni neželeni učinki. Rezultati raziskave postavljeni hipotezi pritrjujejo. Predvidevali smo, da bodo ceni respondenti pripisali večjo pomembnost, kar pa rezultati raziskave [10] niso potrdili.

V sorodni raziskavi [11] so raziskovali preference o lastnostih zdravil brez recepta, predvsem za lajšanje bolečin. Ugotovili so, da sta cena in blagovna znamka najpomembnejši lastnosti pri izbiri zdravila brez recepta. Ti rezultati se ne skladajo z našimi rezultati, kjer ceni respondenti niso pripisovali velike pomembnosti. Vendar so Halme idr. [11] ugotovili razlike med respondenti glede njihovih preferenc za lastnosti zdravil brez recepta in jih na osnovi tega razvrstili v pet skupin. Glede na to razvrstitev so določili, katera skupina respondentov ceni pripisuje večjo pomembnost. V skupine so respondente razvrstili glede na to, ali upoštevajo predvsem učinkovitost, primerjalno nižjo ceno, blagovno znamko, ali pa uravnotežene lastnosti; slednji skupini respondentov so raziskovalci pripisali racionalno odločanje. V peto skupino so raziskovalci uvrstili respondente, ki v veliki meri upoštevajo nasvet strokovnjaka, zdravnika ali farmacevta.

V isti raziskavi [11] so avtorji ugotovili večjo pripisano pomembnost lastnosti, ki se navezujejo na učinkovitost zdravil brez recepta (25 %) kot pri naši raziskavi, kjer je bila nekoliko manjša kot 15 %. Vendar pa se je izbor lastnosti med raziskavama razlikoval.

Guo idr. [12] so raziskovali preference in pripisano pomembnost izbranih lastnosti zdravil in ugotovili, da osebe niso naklonjene neželenim učinkom, kar posebej velja za resnejše neželene učinke. Ti rezultati se skladajo z rezultati naše raziskave

Osnovna ugotovitev naše raziskave je, da je bila skupini lastnosti, ki se povezujejo z neželenimi učinki, pripisana večja pomembnost kot skupini lastnosti, ki opisujejo prednosti zdravil brez recepta, to je učinkovitost in dobro kompliance teh zdravil. Kot posebej tvegane so respondenti zaznavali resnejše neželene učinke. Ceni zdravil pa, nasprotno s pričakovanji, respondenti niso pripisali velike pomembnosti, morda tudi zaradi razmeroma majhne razlike med cenovnimi nivoji in razmeroma majhnega stroška.

Na osnovi rezultatov naše raziskave zaključujemo, da bi bilo v ustni in pisni komunikaciji s pacienti koristno naslavljati neželene učinke zdravil brez recepta in ovrednotiti in racionalizirati njihovo dejansko tveganje, posebej glede na prednosti jemanja zdravil brez recepta.

Ne glede na objavljene teorije o prevladujočem racionalnem ali emocionalnem odločanju velja, da na odločanje vplivajo racionalni in emocionalni mehanizmi. Natančnejša določitev emocionalnega ali racionalnega vidika pripisane pomembnosti lastnosti pa bi bila izvedljiva tekom nadaljnjega raziskovanja. V tej fazi raziskovanja le predvidevamo, da se možna tveganja zaradi jemanja zdravil brez recepta v večji meri povezujejo z vplivom čustev, tudi na osnovi ugotovitev predhodnega raziskovanja [3, 4]. Odločanje pa je celovit proces, na katerega učinkuje več dejavnikov in koristilo bi nadaljnje raziskovanje.

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Kognitivno–motivacijski model čustvovanja v vsakdanjem življenju

Cognitive–motivational Model of Emotions in Everyday's Life

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POVZETEK

V prispevku se ukvarjamo z vprašanjema, kaj so čustva in kakšna je vloga čustev pri našem vsakdanjem funkcioniranju. Pri tem nas zanima, katere psihološke entitete sodelujejo pri čustvovanju in pripomorejo k učinkovitemu in pozitivnemu delovanju. Postavimo hipotetični kognitivno–motivacijski model čustvovanja v vsakdanjem življenju, ki predstavlja podlago za empirično raziskovanje tistih vidikov čustvovanja, ki pripomorejo k pozitivnemu vsakdanjemu delovanju.

KLJUČNE BESEDE

Čustva, kognicija, motivacija, cilj, hipotetični model.

ABSTRACT

In this article, we deal with the question of what emotions are and what the role of emotions is in our daily activities. In doing so, we are interested in which psychological entities are involved in our emotions and contribute to effective and positive functioning. We set up a hypothetical cognitive–motivational model of emotion in everyday life, which represents the basis for empirical research of those aspects of emotion that contribute to positive everyday functioning.

KEYWORDS

Emotions, cognition, motivation, goal, hypothetical model

1   UVOD

V literaturi obstajajo številne opredelitve čustev. Kompleksnost njihovega definiranja ponazarjajo najrazličnejši poskusi kategoriziranja različnih opredelitev, med katerimi naj omenimo le poskus Paula R. Kleininna in Anne M. Kleininna [1], v katerem sta avtorja zbrala več kot 100 različnih definicij čustev in jih klasificirala v 6 kategorij. To so definicije, ki poudarjajo: fiziološke vidike čustev, motivacijo in vedenje, funkcije čustev, razlikovanje med drugimi pojavi čustvovanja, kot npr. razpoloženje, preference, strast oz. hrepenenje, afekt itd., psihopatološke oblike čustvovanja ter različne klasifikacije, kot so npr. pozitivne nasproti negativnim čustvom, ciljno skladne nasproti ciljno neskladnim ipd.

Plutchik [2] opozarja, da je zmeda na področju definiranja čustev posledica več dejavnikov. Prvi je v močni prevladi behaviorizma, ki je dominiral tja do 60. let prejšnjega stoletja in čustva niso bila predmet obravnave. Drugi je v psihoanalizi, ki je pokazala, da subjektivni opisi čustev niso nujno relevantni oz. da to, kar človek opisuje, da doživlja, ni nujno res. Nekatera čustva so potlačena,

druga modificirana in vprašanje je, kaj je pravo čustvo, ki ga posameznik doživlja. Tretji dejavnik je v besednjaku, kako opredeliti oz. s katerimi besedami opisati ustrezna čustva. Različne študije so poskušale prebroditi to vrzel s ti. vpeljavo »sodnikov«, največkrat študentov, ki so iskali najrazličnejše besede za opisovanje določenih čustev in skušali oblikovati nekakšen slovar čustev. Nobena klasifikacija se ni izkazala za bolj objektivno od druge. Četrti razlog je v različnih teoretskih pristopih, ki so se oblikovali skozi zgodovino psihologije, peti pa v nas samih, ki smo se s pomočjo vzgoje in težnje k prilagajanju okolju naučili potvarjati svoja čustva. Čeprav smo npr. žalostni, si v družbi »nademo« nasmeh, čeprav smo na nekoga jezni, zaradi neprimernosti izražanja jeze tej osebi, tega čustva ne izrazimo itd. [2].

Čustva opredelimo kot duševne procese in stanja, ki izražajo človekov vrednostni odnos do zunanjega sveta ali do samega sebe [3]. Posameznik spozna osebe, dogodke in situacije ter jih s čustvi ovrednoti, tako da jim subjektivno določi njihovo vrednost [3]. Čustva so torej kratkotrajni subjektivni, duševni, funkcionalni in ekspresivni pojavi, ki usmerjajo naše vedenje v smeri prilagajanja ali neprilagajanja danim okoliščinam [3, 4]. To pomeni, da so čustva evalvacije in se pojavljajo ob objektih, ki so za posameznika pomembni [4]. Funkcionalno imajo čustva adaptacijsko funkcijo, kar pomeni, da omogočajo učinkovito prilagajanje okolju, delujejo kot motivi, saj nas usmerjajo k objektom in situacijam, ki sprožajo pozitivna čustva, pomembno vlogo pa imajo tudi pri komunikaciji in uravnavanju socialnih odnosov [3].

Tudi na področju motivacije je razlag veliko, vendar se skladajo v opredelitvi, da je motivacija: občutena napetost, ki je usmerjena k ali proti nekemu cilju; notranji proces, ki vpliva na smer, vztrajnost in intenzivnost k cilju usmerjenega vedenja; specifična potreba, želja ali hotenje, ki spodbudi k cilju usmerjeno vedenje [5]. Motivacija je torej psihološki proces, ki spodbuja in usmerja naše vedenje [6].

Kognicija je izraz, ki se je v psihologiji pojavil razmeroma pozno, in sicer v 50. letih prejšnjega stoletja [7]. V nadaljnjih desetletjih pa je raziskovanje kognicije dobilo naslutene razsežnosti, še zlasti s pomočjo spoznanj iz nevropsihologije, kar so omogočile tudi kompleksne nevropsihološke tehnologije [4]. Kognitivni procesi so psihološki procesi, ki nam omogočajo odnos z okoljem, z njimi sprejemamo in predelujemo informacije, ki jih pridobimo s pomočjo različnih izvorov, kot npr. z zaznavo, izkušnjami, prepričanji ipd., nato pa jih pretvorimo v znanje. Kognitivni procesi so: občutenje, zaznavanje, učenje, spomin, mišljenje, jezik, govor in zavest [4].

V prispevku nas zanimata vlogi motivacije in kognicije pri našem čustvovanju. Pri tem izhajamo iz Reevovega [8] razumevanja povezanosti med čustvi, kognicijo in motivacijo, ki čustva in kognicijo razlaga kot sestavna člena motivacije, v čustvih samih pa vidi indikator prilagojenosti vedenja. Veselje npr. kaže na socialno vključenost in težnjo po doseganju ciljev, žalost pa, nasprotno, napotuje na socialno izolacijo in odmik od ciljev. Pozitivna čustva odsevajo angažiranost in zadovoljstvo z našim delovanjem in motivacijskimi stanji, negativna pa opustitev in frustracijo v zvezi z našim delovanjem in motivacijskimi stanji. Pozitivna čustva odsevajo našo uspešno prilagojenost danim okoliščinam, negativna pa kažejo, da se nanje nismo znali učinkovito prilagoditi. S te perspektive čustva nimajo enakega statusa v motivaciji kot potrebe in kognicije, ampak odločajo o tem, ali bo nek motiv sploh zadovoljen ali ne [8]. Pozitivna čustva torej spodbujajo zadovoljitev motiva, negativna pa ga preprečujejo.

2 KOGNITIVNE IN MOTIVACIJSKE RAZSEŽNOSTI ČUSTEV

Pri razlagi kognitivnih vidikov čustev nam je v pomoč ena od vodilnih kognitivnih teorij čustev ameriškega psihologa Richarda Lazarusa [9], ki predpostavlja dvoje:

a) čustva nastanejo kot posledica kognitivne ocene dražljaja oz. situacije

b) mediator med dražljajem in nastankom čustva je nezavedna avtomatična ocena

Lazarus [9] razlikuje med znanjem in oceno. Znanje naj bi bilo pogoj za oceno, saj ocena vedno vključuje subjektivno doživljanje in pomeni osebno mnenje, ki je osnovano na ustreznem znanju. Znanje je torej nujen, a ne zadosten pogoj za nastanek čustva. Ocena je lahko nezavedna ali zavestna, a svojo teorijo gradi iz pomena zavestne ocene. Ocena je torej kognicija, na osnovi katere nastanejo čustva. Vsaka taka ocena je subjektivna in hevristična. Brez kognicije ni čustva. Smith in Lazarus [10] prepoznavata dva tipa kognitivnih procesov, ki so povezani z nastajanjem čustev

a) procesi primarne ocene in

b) procesi sekundarne ocene

Procesi primarne ocene so tisti, s pomočjo katerih vrednotimo naravo situacije, v katero smo vključeni, pri čemer je ocena situacije vedno anticipirana v oceni cilja. Procesi primarne ocene so trije:

- motivacijski pomen cilja
- motivacijska skladnost s ciljem
- samovključenost ali motivacija za oceno

Motivacijski pomen in motivacijska skladnost sta po Lazarusu [9] primarni oceni, ki sta predstavljata temelj za razvoj visokega psihičnega blagostanja, ki se kaže v tretjem primarnem procesu ocene, to je v lastnem angažmaju za dosego cilja. Motivacijski pomen je stopnja pomembnosti situacije za posameznika glede na osebne cilje, motivacijska skladnost se nanaša na to, ali je situacija taka, da spodbuja ali zavira doseganje osebnih ciljev. Če je situacija konstruirana kot motivacijsko pomembna, bo ocena situacije kot motivacijsko skladne ali neskladne determinirala celotno valenco čustvene izkušnje [9].

Če je primarna ocena podlaga za nastanek valence čustva in torej odloča o tem, ali bosta za nas neka situacija in cilj prijetna ali ne, pa procesi sekundarne ocene sodelujejo pri specifični izraznosti čustva, se pravi, odločajo o tem, katero čustvo bomo doživeli in izrazili. Nanašajo se na procese kontrole nad situacijo in iskanje lastnih virov za spoprijemanje z nastalo situacijo, če jo ocenimo kot pomembno. Gre za štiri sekundarne ocene: samoodgovornost, osredotočenost na problem, osredotočenost na čustva in pričakovanje. Pri samoodgovornosti ocenjujemo, koliko smo sami odgovorni za nastalo situacijo, pri osredotočenosti na problem ocenjujemo, koliko lahko dano situacijo izboljšamo, ko smo osredotočeni na čustva, ocenjujemo, koliko se lahko sami prilagodimo na nastalo situacijo, torej ali lahko spremenimo odnos do nastale situacije, pričakovanje pa zajema oceno, ali lahko v prihodnje sami prispevamo k spremembi situacije. Vsakemu čustvu odgovarja specifična sekundarna ocena, ki jo Lazarus [9] metateoretično imenuje ključne teme, povezane z dogodkom Gre za tipične vsakdanje situacije, ki jih ocenjujemo glede na tipične hevristične kognitivne sheme. Vsaka od teh situacij je podvržena najprej primarnim, nato pa še sekundarnim procesom ocene, kar posledično vodi do specifičnega tipičnega čustva. Tako naj bi neugodne situacije odgovarjale ocenam ciljne pomembnosti, a hkrati neskladnosti, ocene razpoložljivosti notranjih virov za spoprijemanje s situacijo pa naj bi bile nizke. In obratno, pozitivne situacije naj bi se skladale z ocenami, ki so ciljno pomembne in skladne, zajemale pa naj bi tudi visoko vrednotenje razpoložljivih notranjih virov oz. spoprijemalnih strategij [9].

Sledi še proces terciarne ocene, ki ga Lazarus [9] imenuje ponovna ocena. Z njo presojamo pomen sekundarne ocene, pri čemer se skušamo psihološko spoprijemati s psihičnim in fizičnim stanjem napetosti zaradi nastale situacije. V ponovni oceni angažiramo vse svoje notranje vire, ki nam pomagajo k blaženju nastale napetosti ali pa celo omogočiti občutek ugodja in pozitivnih čustev [9].

3 HIPOTETIČNI MODEL ČUSTVOVANJA V VSAKDANJEM ŽIVLJENJU

Na osnovi zapisanega postavljamo hipotetični model čustvovanja v vsakdanjem življenju, ki nam pomaga razumeti, katere psihične komponente in kako so vključene v naše vsakdanje funkcioniranje in vodijo do bolj ali manj optimalnega delovanja. Za preverbo tega modela postavljamo naslednjo hipotezo:

H1: Kognitivna skladnost med oceno cilja in oceno situacije ojača ciljno skladna čustva, izpolnjenost temeljnih potreb se zviša, posledica je rast pozitivih vidikov jaza, kognitivna neskladnost med omenjenima ciljema vodi stran od cilja, negativna čustva se ojačajo, izpolnjenost temeljnih potreb se zniža, posledica je stres, lahko pa tudi psihopatologija.
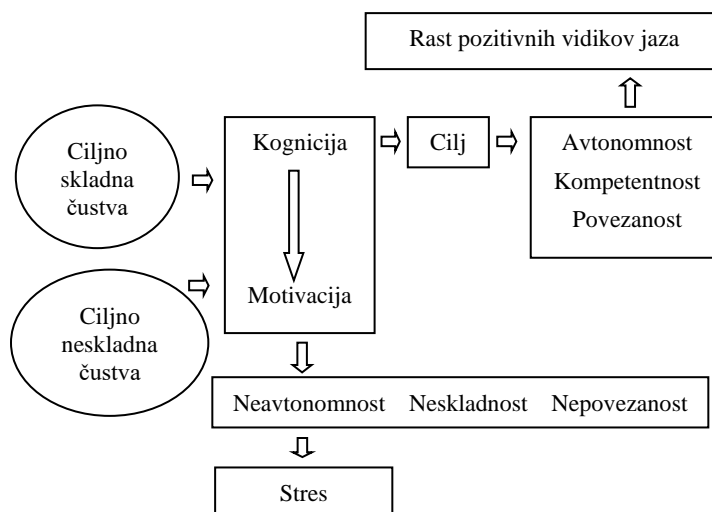
Slika 1: Kognitivno–motivacijski model čustvovanja v vsakdanjem življenju

Lazarus [9] razlikuje čustva glede na skladnost ali neskladnost s cilji: ciljno skladna čustva nas vodijo k cilju, ciljno neskladna pa nas od njega odvračajo, čeprav si ga želimo doseči. Avtorjeva [9] perspektiva se v tej točki močno sklada z različnimi teorijami motivacije, še posebej z motivacijsko teorijo postavljanja ciljev [11], ki opozarja na pomen ciljne motivacije pri našem mišljenju in vedenju. Robert Franken [12] v knjigi *Human motivation* poglobljeno razlaga hedonizem, srečo, upanje, optimizem pripadnost, navezanost in komunost, ki jih umešča med ciljno skladna čustva, ter strah, anksioznost, pesimizem, depresivnost, krivdo in sram, ki sodijo pod ciljno neskladna čustva. S cilji skladna čustva nam pomagajo, da želene cilje dosežemo, naš občutek splošne življenjske kompetentnosti se poveča. Če pa so čustva neskladna s cilji, teh ciljev kljub želji, da bi jih dosegli, ne dosežemo in naš občutek kompetentnosti se zniža.

V modelu predpostavljamo, da čustva omogočajo doseganje ali odvračanje od cilja, pri čemer je bistvena ocena cilja. Če ocenimo, da je cilj za nas pomemben, se bo ojačala motivacija za doseganje cilja. Pri tem se bodo pojavljala čustva, ki so skladna s tem ciljem, se pravi, ki nas vodijo k njegovemu doseganju. To so npr. veselje, ponos, optimizem ipd. Nastalo situacijo bomo doživljali kot prijetno. Naše temeljne potrebe, kot so: potreba po avtonomnosti, potreba po kompetentnosti in potreba po povezanosti [13, 14] bodo v tem primeru zadovoljene in posledično bomo občutili psihično zadovoljstvo in pozitivi vidika jaza se bodo krepili. Potreba po avtonomnosti se kaže v težnji po usmerjanju lastnega vedenja s strani lastnih želja, izbir, ciljev in odločitev. Če je potreba po avtonomnosti zadovoljena, doživljamo naše vedenje in posledice vedenja kot izbire, ki smo jih povzročili sami in nad katerimi drugi nimajo vpliva. Nasprotno pa se nezadovoljenost potrebe po avtonomnosti kaže v nesamostojnosti in odvisnosti pri odločanju ter doživljanju zunanje kontrole nad našim mišljenjem, čustvovanjem in vedenjem [13]. Potreba po kompetentnosti se izraža kot težnja po učinkovitem delovanju na najrazličnejših življenjskih področjih, ki ga realiziramo v skladu s svojimi zmožnostmi in sposobnostmi. Ta potreba je zadovoljena, kadar v svojem okolju uspemo poiskati ustrezne izzive, s pomočjo katerih realiziramo razvoj svojih sposobnosti in učinkovitega funkcioniranja. Če pa izzive ocenjujemo kot preveč enostavne ali preveč zahtevne, se na ravni kompetentnosti ta potreba izkazuje kot nizko zadovoljena ali pa celo nezadovoljena. Potreba po kompetentnosti se povezuje z občutkoma samoučinkovitosti in samozaupanja, kar posledično vodi do visokega samospoštovanja in psihičnega blagostanja [13, 14]. Potreba po povezanosti oz. pripadnosti pa se kaže kot težnja po izražanje naklonjenosti, sprejemanje, zaupanje v druge [13, 14].

V primeru, ko doživljamo s cilji neskladna čustva, ocenimo, da je zastavljeni cilj za nas pomemben, za njegovo dosego smo motivirani, a nam čustva, kot so npr. strah, tesnoba, žalost ipd. preprečujejo, da bi ga dosegli [12]. Tako se od cilja le še bolj oddaljujemo, nastalo situacijo doživljamo kot ogrožajočo, naša s ciljem neskladna čustva se poglabljajo, zadovoljenost temeljnih potreb se odmika in posledica je doživljanje stresa, ki lahko preraste v psihopatološke pojave.

Pri odnosu med ciljno skladnimi in ciljno neskladnimi čustvi se izkaže naslednje: univerzalna čustva so po definiciji tista, ki so nam kot človeški vrsti pomagala k preživetju, pa tudi na individualni ravni nam večkrat služijo temu istemu cilju, se pravi, preživetju, obenem pa z njihovim doživljanjem tvegamo, da cilja ne bomo dosegli [15]. Tako čustvo je npr. strah, ki ga Lazarus [9]umešča pod ciljno neskladna čustva, se pravi tista, ki nas vodijo stran od cilja, obenem pa vemo, da je prav strah tisto univerzalno čustvo, ki nam pomaga, da zbežimo oz. se odstranimo iz nevarne situacije in nam

tako zagotovi preživetje. Kaj pa druga čustva? Za veselje npr. ni nobenega dvoma: kot pozitivno in s ciljem skladno čustvo nas bo usmerjalo k cilju, zato se bomo doživljali kompetentnejše in učinkovitejše. Drugače pa je z jezo in gnusom. Jeza in njen vedenjski korelat agresivnost nista skladna s ciljem, saj nas tako doživljanje kot izražanje jeze vodita stran od želenega cilja [9, 12]. Z jezo in agresivnostjo, ki jo usmerjamo navzven (ali navznoter), tvegamo, da cilja ne bomo dosegli, posledično pa se bomo počutili nekompetentne in nesposobne spoprijemanja s težavami [9, 12]. Pri gnusu pa je bolj kompleksno. Gnus, ki ga doživljamo ob pogledu na npr. pokvarjeno hrano, nam pomaga, da se te hrane niti ne dotaknemo niti je ne pojemo, torej se od cilja odmaknemo, to pa nam omogoči preživetje, naš občutek kompetentnosti pa se poveča [16]. Če pa se nam npr. gnusi dotik osebe z nenalezljivo kožno boleznijo in se tako cilju (osebi) izognemo, tvegamo izgubo morebitnega kakovostnega medosebnega odnosa s to osebo, ki je zaradi kožne bolezni ne pripustimo k sebi, pa čeprav ni nalezljiva [16]. Posledično se naš občutek socialne kompetentnosti zniža, naše nezadovoljstvo s samim seboj pa zviša.

4 ZAKLJUČEK

Predlagani model čustvovanja, ki ga razlagamo z vidika kognitivno-motivacijskih razsežnosti, je hipotetični prikaz gradbenih prvin in njihovega delovanja. Namen modela ni v vključitvi vseh psiholoških razsežnosti, saj je to nemogoče, temveč predvsem tistih, ki prispevajo v smeri rasti pozitivih komponent jaza bodisi v smeri doživljanja stresa in pojavljanja morebitnih psihopatoloških pojavov. V nadaljevanju bo smiselno model tudi empirično preveriti, z namenom ugotoviti psihološke napovednike optimalnega delovanja v vsakdanjem življenju.

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Motor learning and cortical plasticity: TMS motor mapping using the pseudorandom walk method

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ABSTRACT

Motor recovery after stroke relies on the ability of the primary motor cortex (M1) to functionally reorganize and adapt the existing muscle synergies. M1 reorganization can be measured by mapping the cortical muscle representations using transcranial magnetic stimulation (TMS). A recently developed mapping technique, the pseudorandom walk method, significantly reduces time needed to perform TMS mapping without sacrificing the reliability of the measurements. Due to this faster technique, it is now possible to map several muscles at once, which was not viable before with the traditional mapping method. Furthermore, motor mapping of the proximal Medial Deltoid (MD) and the distal Brachioradialis (BR) muscle using this technique has not yet been performed. Therefore, the aim of this study is to investigate the use of pseudorandom walk method to measure the training-induced plasticity of the M1 while taking these two muscles into account. First, we will perform the baseline TMS motor mapping. Second, the participants will go through a six-week training period in a complex motor learning task performed with their non-dominant hand. After this training period, we will determine the training-induced plasticity by comparing the baseline and the post-training measurements. A control group will be included to control for the reliability of the measurements. Further, we will determine the training-induced change in the muscle synergies by comparing the overlap in cortical muscle representations. Finally, we will explore the training effect on the non-trained dominant hemisphere. We hypothesize to observe a training-induced change in the motor maps and an increase in the overlap between the two muscle representations in the training group. Based on the intermanual transfer we expect to find a training-induced effect on the dominant hemisphere.

KEYWORDS

Motor learning, plasticity, transcranial magnetic stimulation, pseudorandom walk, primary motor cortex

1 INTRODUCTION

One of the most common impairments after stroke is hemiparesis - weakness of one entire side of the body [1]. Patients' recovery relies on the motor system's capacity for functional reorganization [2]. A better understanding of the primary motor cortical (M1) reorganization and its' influence on the coordinated multiple joint movements could help improve design of therapies.

M1 plays a key role in the control of movement. Movement research has recently shifted from the traditional view that M1 controls limb muscles individually, towards the postulate that M1 controls limbs as whole segments [3]. It is suggested that this control is done via specific predefined modules, termed muscle synergies, that the central nervous system utilizes to accomplish a motor task. By using muscle synergies, instead of controlling each muscle individually, the central nervous system alleviates the computational burden of the movement execution [4].

In the proximal-distal muscle synergy, activation of both shoulder and forearm muscles are involved in a common motor cortical circuit in an integrated manner [5]. Activity-dependent couplings of networks are observed after extensive training of coordinated movements with these muscles [6]. Such changes in muscle synergies, when neurons adapt to an unfamiliar task, might reflect similar changes that occur during recovery from moderate stroke [7]. One way to measure such change is by TMS.

TMS and the pseudorandom walk method

TMS is a valuable tool to study M1 plasticity. This can be done by comparing the location, size, and excitability of cortical muscle representations before and after intervention [8]. The TMS stimulation produces motor evoked potentials (MEPs) in the muscles that can be measured with electromyography (EMG) (Figure 1B). By observing their latency and amplitude it is possible to determine the cortical area that is connected with the muscle of interest (Figure 1C). Plasticity can be determined by an increase in the number of cortical sites where MEPs are induced [8]. An increase in the mean MEP amplitude measured at the most responsive cortical site, called the hotspot, can indicate an increase in cortical excitability [10].

Muscles can be mapped at rest [11] or during low-level activity [12]. Low-level contraction permits the observation of MEPs at a lower rate of stimulation [12], especially for proximal muscles that are difficult to map at rest [13]. Distal muscle representations tend to be larger than proximal ones, and larger on the dominant side, contrary to proximal muscles [9]. Motor learning of a complex upper limb task leads to a common control of the proximal and distal muscles [8]. This results in an expansion of the muscle representations, an increase in their muscle representation overlap, and an increase in MEP's size [8,9]. Similar changes can be observed not only in the trained but also in the contralateral hemisphere [14], although some studies did

not observe that [9]. This reorganization of the non-trained hemisphere can be extremely useful for patients with hemiparesis for whom it is difficult to train the impaired side. Therefore, further research is needed in order to better understand how intermanual transfer in complex motor learning occurs.

Changes occurring as a result of motor learning can be measured using various TMS methods to map muscles of interest. In the traditional mapping method, multiple TMS stimuli are used at predefined grid points on the scalp at M1 to measure MEP size. Such mapping can take between 15 up to 60 minutes for one muscle [15].

A new pseudorandom walk method was recently developed that takes less than 5 minutes without sacrificing reliability [15,16,17]. In this method, one does not need to repeatedly place the coil in a predefined position when delivering the stimuli (Figure 1A). The starting point for the delivery of the stimuli is at the hotspot, out of which consecutive stimuli are delivered in eight straight lines. The lines are then connected creating an ellipsoid. The rest of the stimuli are randomly applied within this ellipsoid [17].

Overall aim and key objectives

The aim of this project is to map the proximal MD muscle and the distal BR muscle using the pseudorandom walk method. These maps will be used to measure plasticity in M1, induced after extensive training of a complex motor task. The complex motor task will be a darts-throwing task, in which all joints in an upper limb are involved in a specific coordination pattern and timing of proximal and distal muscles [7,3]. Changes in white matter can be induced after a minimum of six-week repetitive training [4]. Accordingly, participants will train darts at home for a period of six weeks using their non-dominant hand. The non-dominant hand has a lower level of baseline performance that can improve significantly more than the dominant hand, suggesting that the plasticity might be greater [18]. We will compare cortical muscle representations and their overlap before and after training.

The key objective is to map the MD and the BR muscle representations using the pseudorandom walk method. Supporting objectives are to determine the training-induced plasticity of the M1, the training-induced changes in muscle synergies, and the training-induced effect in the dominant hemisphere. We hypothesize that there will be a significant increase in the experimental group in the motor map area, volume, a change in the centre of gravity of the muscle representations, and a change in the mean MEP amplitude after training. We further hypothesize to observe an adaptation of the existing muscle synergies in the experimental group as shown by the increase in the overlap between muscle representations. We expect to observe changes not only in the non-dominant hemisphere but also in the dominant hemisphere.

Because of a significant reduction in time needed to perform the measurements, motor mapping can now be used not only in research but also in clinical practices. Additionally, understanding how the M1 reorganization after training occurs could help design better treatments for stroke patients.
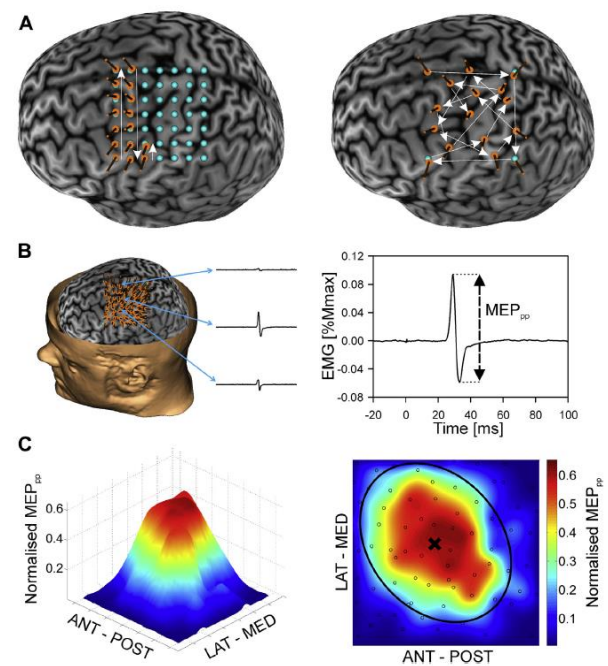
Figure 1: An illustration outlining the creation of a TMS map [15].

A: The traditional mapping method on the left and the pseudorandom walk method on the right. **B:** A square grid with each stimulation site is matched with the recorded EMG. MEP's peak-to-peak value is extracted. **C:** The surface is fitted through the 3D position data cloud to create a 2D plane. The 2D position data are matched with the MEP data to fit the surface map.

2 METHODS

Participants

We will measure two homogeneously matched groups of healthy participants based on their gender and age. We will include male and female participants aged between 18 and 45 years old. The sample size will be 30 participants per group (Cohen's d = 0.7419, power= 90%; α= 0.05, according to area sample size calculations [17]). All participants will be right-handed as measured by the Edinburgh inventory [20]. Participants will not be recruited if they report having any metal implants in the surrounding area of the head or any history of epilepsy.

Experimental protocol

Both groups will be measured twice with a six-week period in between. Control group will not perform any training in throwing darts. The measurements at each session will include TMS motor mapping and mean MEP acquisition of MD and BR on both hemispheres, as well as a measurement of darts performance (Table 1).

Table 1: A scheme of the experimental protocol

	Session 1	Training period	Session 2
Experimental group	TMS motor mapping MEP acquisition	Darts training (6 weeks, 15 – 20 mins, 60 – 80 throws)	TMS motor mapping MEP acquisition
Control group	Darts test	No training	Darts test

TMS measurements

The muscle motor maps will be determined by monophasic TMS pulses with a posterior-anterior current direction with the coil handle pointing 45° from the midsagittal line. The EMG electrodes will be placed on the MD and BR muscles in a belly-tendon montage. Participants will be seated with their hands relaxed on the table. First, the head of the participant will be co-registered to a stock MRI scan. Second, the hotspot, the location with the largest MEPs, will be estimated using the pseudorandom acquisition with 80 pulses and 2s interval [15]. The stimulation intensity will be set to 50% of the maximum stimulator output (MSO) and increased with 5% MSO if there will be no measurable MEPs after 15 pulses. Furthermore, the resting motor threshold (RMT), which is the lowest stimulator intensity with a 50% probability to produce the MEP at the hotspot, will be determined. EMG responses with a peak-to-peak amplitude 0.05mV, between 5 and 45ms after stimulation, will be considered MEPs. Finally, the motor maps will be acquired with a stimulation intensity of 110% RMT [17]. The pseudorandom walk method will be performed as described previously [17]. This measurement will be done on both hemispheres for both muscles in each session and will take approximately 30 minutes per hemisphere. Additionally, after motor mapping, 40 TMS pulses will be applied at the hotspot to obtain mean MEP amplitudes, which will take approximately 5 minutes per hemisphere [10].

We will first pilot the motor mapping of the MD and BR cortical representations under resting conditions before the experiment is carried out. We will switch to measurements performed under low-level active conditions if the motor mapping under resting conditions yields unreliable results [13].

Test and training protocol

The participants in both groups will do a test of dart-throwing skills at both sessions. The participants will stand with the left foot on a black line on the floor set at 2.4m from the dartboard. The center of the target will be 1.73m above the floor. They will be instructed to throw 15 darts and to aim for the center. The dartboard will have 10 concentric circles worth 10 points for the center and 1 point for the outer-most layer.

The participants in the experimental group will do training sessions at home. The place of the training was determined based on COVID-19 measures. This way the participants are not taking higher risks for infection by participating in this study (e.g. increased use of public transport). They will receive three darts, as well as several papers with the same dartboard design as used in the test. The holes in the papers will be considered as proof of training. Each training session will last 15 – 20 minutes and consist of 60 – 80 throws. They will be asked to perform the training consistently over the whole period and to keep a diary of their performance.

Outcome measures

For the key objective, four parameters from the TMS motor maps of each muscle will be calculated - the area, volume, and center of gravity (cog) in two dimensions. Additionally, the mean MEP amplitude at each muscle hotspot will be calculated.

The effects of the training-induced plasticity of M1 will be determined using the outcomes from the key objective. The repeated measures ANOVAs will be fitted to each variable separately to evaluate group (between factor: experimental vs control) and session (within factor: baseline and post-training). Additionally, a comparison of the baseline and post-training darts test scores will be done on both groups to determine the effect of training.

Training-induced change in muscle synergies will be measured by first superimposing the cortical motor maps of the two muscles and measuring their overlap. Then, the change in the overlap will be determined using the repeated measures ANOVA to investigate the interaction between groups (control, experimental) and sessions (baseline, post-training).

The contrast between the map areas of the dominant versus non-dominant hand will be compared between baseline and post-training using a paired t-test to determine if there is an overall effect on both hemispheres.

3 CONCLUSION

This research project exploits the novel TMS mapping procedure to further validate it on upper-limb muscles that haven't been mapped yet using the pseudorandom walk method. Furthermore, using this technique, the project also explores the effect of extensive motor learning on the M1 plasticity. The motor learning is approached holistically by analyzing motor maps, MEPs, motor performance, interhemispheric transfer, and the proximal-distal muscle synergy. The latter also adds to the developing paradigm of muscle synergies and explores ways in which the upper limb is controlled as a whole. Results from the project will contribute to our understanding of the proximal-distal synergy and its' involvement in reaching movements. Moreover, the results will contribute to a better design of rehabilitation therapy for patients with M1 impairment. Using the pseudorandom walk method, the therapy could become more efficient and quicker.

4 ACKNOWLEDGMENTS

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Chronotopic Maps in Temporal Processing and Perception

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ABSTRACT

Neurons maximally tuned to specific durations in the hundreds of milliseconds to seconds are widely observed in studies using monkeys. These tuned neurons are observed in areas that are previously known to be involved in timing research—pre-supplementary motor area and basal ganglia. However, the role duration tuned neurons, in these brain areas, play in temporal processing remains unclear. In this review, I present and discuss evidence from recent neuroimaging studies that show the presence of a topographical organisation of duration tuned neuronal populations in the human brain. The studies, using ultra-high field fMRI, have found that the duration tuned clusters at the voxel level in the occipital, parietal and frontal areas, including the supplementary motor area (SMA), are topographically organized as duration maps—chronomaps. Duration tuning and chronomaps could thus serve as a functional mechanism for the encoding and representation of abstract stimulus features such as time.

KEYWORDS

Time perception, temporal processing, duration tuning, fmri, chronomaps, supplementary motor area

1 DURATION TUNING

Interval timing refers to the behavior of perceiving, estimating, and representing durations in the hundreds of milliseconds to minutes range crucial for human behavior, in decision making, speech processing, motor activity and music perception [1]. Studies using functional magnetic resonance imaging (fMRI) have found brain activity in certain key brain regions to be correlated with interval timing behavior. These areas include supplementary motor area (SMA), intra parietal sulcus, basal ganglia, and cerebellum [1,2,4,5]. Electrophysiological studies on monkeys have found neurons from these timing brain areas to exhibit duration tuning [6,7]. When neurons are tuned, they preferentially fire for specific task durations. Mita *et al.* [6] found that neurons in the monkey pre-SMA (human SMA) fire

preferentially for task durations (Fig. 1). Two Japanese monkeys were trained to perform an interval-generation task that required them to determine a hold time of three different intervals of 2s, 4s and 8s, before initiating a key release movement LED lights indicated the specific waiting times before key release: yellow light indicated 2s; red light indicated 4s: and blue light indicated.
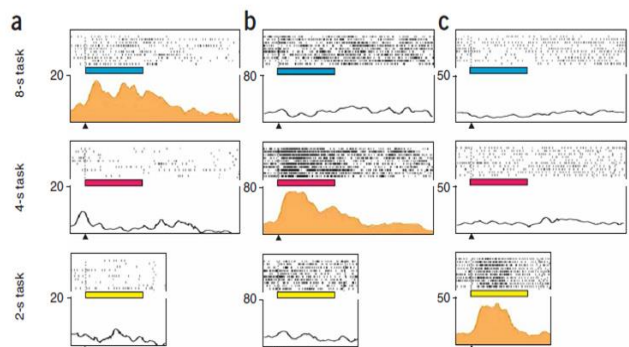
Adapted from Mita et *al.,*

Figure 1: Raster displays and spike-density functions illustrating selective neuronal activation during the 8-s task (a), 4-s task (b) and 2-s task (c). Mita et al. [6].

While duration tuning in timing brain areas associated with interval timing is well observed, the neuronal mechanisms linking the areas to the perception, estimation and representation of durations remain unknown [1,2,3]. One possible link between duration tuning to temporal processing could be that duration tuned neurons in the SMA, tuned to different durations, are topographically organised as functional maps. Such functional maps could then provide a mechanism for the perception, estimation, and representation of durations. Could such a topographic organisation of duration tuned neurons exist in the human brain? If so, could such a topographic organisation be studied non-invasively in humans?

2 REPRESENTATION OF ABSTRACT STIMULUS FEATURES THROUGH MAPS

Representation of stimulus features through topographically organised sensory maps is well known, such as, the tonotopic maps in the auditory cortex or the retinotopic maps of the occipital cortices. Could a similar topographical organisation of abstract stimulus features such as time and numerosity exist?

Further, could such a topographical organisation be studied non-invasively in humans?

Harvey *et al.* [10] using ultra high-field fMRI (at 7 Teslas) showed the existence of topographically organized numerosity maps in the human parietal cortex (Fig. 2). Numerosity refers to the size of a group of objects. Participants in the study were presented with visual stimuli of varying numerosity. The results showed that parts of the cortical surface corresponded to specific numerosity, in a topographical manner increasing from the medial to lateral ends. The results provided evidence that higher-order abstract features and their topographical organizational principles could be studied non-invasively in humans.

Adapted from Harvey et *al.,* 2013
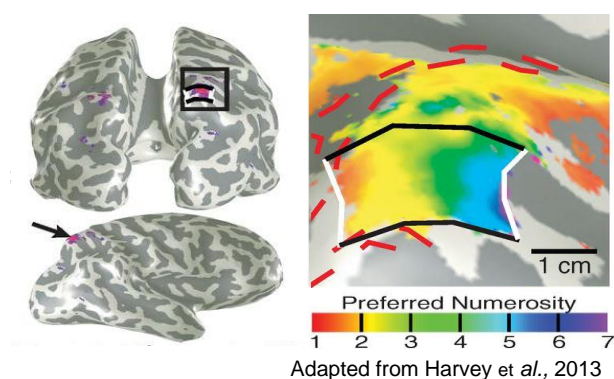
Figure 2: High-field fMRI data was acquired while subjects were shown visual stimuli of varying numerosity. Numerosity maps showing preferred numerosity increasing from the medial to lateral ends (white lines) of the region of interest (ROI) (black and white lines). Harvey *et al.* [10].

3 REPRESENTATION OF DURATIONS THROUGH CHRONOTOPIC MAPS

Like the topographical organization of numerosity, could task durations have a similar map-like organization? Protopapa et *al.* [8] provide the first evidence for a topographical representation of durations in the human supplementary area. Protopapa et *al.* [8] used data from ultra-high field fMRI (at 7 Teslas) and showed the results to be independent of task design and analysis approaches. In Experiment 1 of the study, volunteers participated in a visual, temporal discrimination task, where subjects had to compare and respond if the second stimulus lasted shorter or longer then the first. The resulting data were analyzed using a general liner model (GLM) approach. While in Experiment 2 of the study, participants performed a visual, temporal, and spatial discrimination tasks. In the temporal task, subjects had to compare and respond which of the two presented stimuli lasted longer. While in the spatial task, they judged which of the two stimuli underwent the largest change in orientation. The data were analyzed with neural population receptive field approach [9]. Chronotopic maps, topographic organization of durations in the range of 0.2 to 3s, was observed in the SMA both in the left and right hemispheres (Fig. 3). The progression of the maps was seen in a fixed, rostro−caudal direction, with vertices sensitive to the shorter duration located in the anterior and those sensitive to the longer duration in the posterior SMA. Chronomaps were also found in a task independent manner: topographic organization of durations

was observed even in a control condition when subjects were instructed to focus only on the spatial aspect of the stimuli and ignore their temporal properties.

Protopapa et *al.* [8] connected the previously reported neuronal duration tuning in monkeys' medial premotor cortex [6,7] to a representational format in humans. Although previous duration tuning seen in monkeys were exclusively associated with motor-timing behaviour, Protopapa et *al.* [8] showed the presence in human premotor cortex of a duration tuning mechanisms in a purely temporal perceptual task.

A recent study, Harvey et al. [11] has added to the evidence on chronomaps, and the topographic organization of stimulus frequency. In the study, high field fMRI (7 Teslas) data from volunteers were acquired while they were presented with a rapid succession of visual stimuli varying in duration, frequency, or both. The resulting data were analyzed using a population receptive field approach [9]. Topographic organization of voxels that were maximally responsive to stimulus duration and frequency was observed in ten different cortical regions, from occipital to parietal to frontal lobe. The duration and frequency maps were observed in both the hemispheres. Another intriguing finding of the study was that the orientation of the maps was found to be variable unlike, the fixed, anterior-posterior orientation from Protopapa et *al.* [8]. Thus, Harvey et al. [11] added to the evidence of existence of topographic maps linked to abstract stimulus features of numerosity, time and frequency.

Adapted from Protopapa et *al.,* 2019
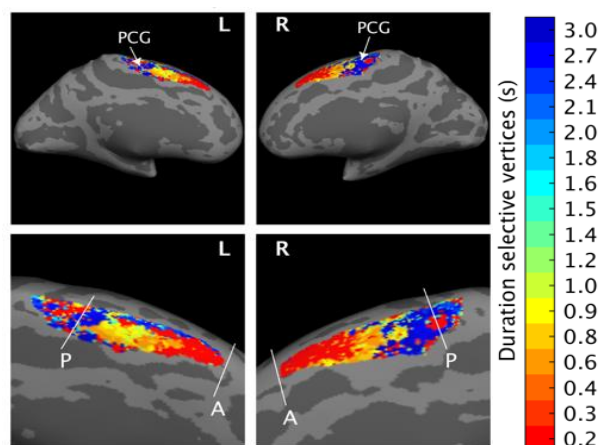
Figure 3: Chronotopic maps showing the topographic organization of duration-sensitive vertices in bilateral SMA with the progression in the rostro−caudal direction, with vertices sensitive to the shorter duration (vertices in warmer colors) located in the anterior and those sensitive to the longer duration (vertices in colder colours) in the posterior SMA. A, anterior; L, left; P, posterior; PCG, precentral gyrus; R, right; SMA, Supplementary Motor Area. Protopapa et *al.* [8].

4 PROPERTIES OF CHRONOTOPIC MAPS

Protopapa et *al.* [8] and Harvey et al. [11] were successfully able to show the existence of chronotopic maps. The two studies helped characterise the interesting properties of chronomaps: chronomaps exist in both cerebral hemispheres; chronomaps

exhibited variable orientations in their topographical organisation; chronomaps exist in multiple brain areas; chronomaps organise in a task-independent manner; and finally, chronomaps are linked to temporal perception and performance.

The results from Protopapa *et al.* [8] and Harvey et al. [11] further raise some interesting questions on other characteristics of chronomaps. Are the chronotopic maps organized in an absolute or relative manner (Fig. 4)? If duration clusters from an existing chronomap changes its spatial position based on a new duration range, then the durations are encoded in a relative manner. Next, are chronomaps amodal? If the maps are amodal, then the maps in Fig.3 resulting from tasks in visual domain, would not change if the durations were presented in an auditory domain. Next, are chronomaps experience based or present from birth? Lastly, Harvey *et al.* [10] showed the topographic organization in multiple areas, how do these representations vary and contribute to the encoding and perception of durations?

Adapted from Protopapa et al., 2019
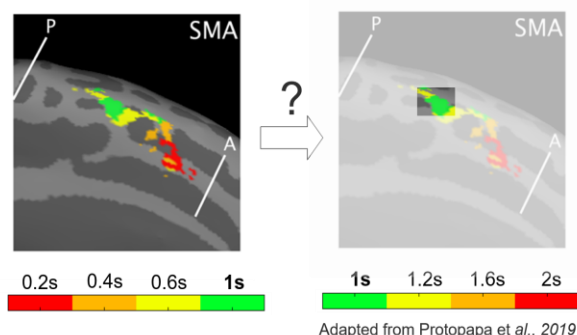
Figure 4: Are chronotopic maps encoding duration in an absolute or relative manner? The left panel shows the chrontopic map from Experiment 1 of Protopapa *et al.* [8]. How are the clusters encoded for 1s duration (in green)? If the range of durations that 1s is presented in changes (right panel), does the spatial position of the green clusters remain the same or change in the new chronotopic map? If the green clusters retain their spatial position, then the durations are organised in an absolute manner. If they change their spatial position based on the duration range the durations are encoded in a relative manner.

In summary, there is growing evidence that chronomaps could provide a possible mechanism for the encoding and representation of durations associated with temporal processing and perception. Despite the difficulty to link the voxel level chronomaps in humans to the duration tuned neurons in monkeys, these new findings are influencing and contributing to the field of temporal cognition.

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Being in Brackets: A First-Person Exploration of the Phenomenological Method of Epoché

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ABSTRACT

This article is an excerpt from the ongoing research exploring the experience of carrying out the phenomenological method of epoché from the first-person perspective. First, we outline the state of the field and then dive into the first-person exploration, describing the method used in gathering our experiential data. After that, we focus on presenting a data-derived first-person model that describes the experience of epoché as a diachronic process, comprised of five phases: 1) The pre-epoché phase and the experience of the natural attitude shifting; 2) Entering the experiential phase of the epoché; 3) The experiential phase of the epoché; 4) Exiting the experiential phase of the epoché; and 5) The post-epoché phase and how the natural attitude is experienced after the epoché.

KEYWORDS

Phenomenology, first-person research, epoché, natural attitude

1 INTRODUCTION

To better understand our enterprise, we must first familiarize ourselves with the concept of the "natural attitude". In *Ideas I*, Edmund Husserl [1] introduces the natural attitude as our everyday assumption that the world exists independently of our conscious awareness. In this attitude we take the world as always already present, prior to any reflection. Expanding on this conceptualization, in Eugen Fink's "Sixth Cartesian Meditation" [2, p. 166], Husserl goes on to say: "In the natural attitude, in which for ourselves and for others we are called and are humans, to everything worldly there belongs the being-acceptedness: existent in the world, in the world that is always existent beforehand as constant acceptedness of a basis. So, also man's being is being in the world that is existent beforehand. In phenomenology, this being-beforehand is itself a problem."

This everyday forgetfulness thus permeates our everyday life. We operate on the basis of natural naivety, assuming that reality exists 'out there' and is waiting to be discovered and explored. This reality is supposed to be independent of our experience and

exists as it is perceived even if there is no one to direct attention to it or perceive it [3].

The basic method of the phenomenological approach is to direct one's attention from what the experience is assumed to be about to the observation of the experience itself, as it is given in consciousness. In order to avoid succumbing to our everyday embeddedness in the natural attitude, we must bracket our presuppositions, values, judgments and opinions about the world. To do this, we employ a particular gesture of awareness – the epoché. Husserl [1] asserts that the epoché enables a return to "the things themselves", to the world as we directly experience it. In performing the epoché, we put in brackets, or "turn off" the whole world as we normally experience it. The task is to re-awaken us to recognize the meaning we bestow upon our experiences. As Maurice Merleau-Ponty [4, p. xv] puts it, performing the epoché does not mean to withdraw from the world or the phenomena, but to "slacken the intentional threads which attach us to the world and thus bring them to our notice".

1.1 State of the art in contemporary first-person research

The definition of the method of epoché as well as the question of its importance in phenomenology and the possibilities of implementation outside philosophical fields have been the source of many debates (e.g. [5,6]). Moreover, contemporary discussions [5,7] point to a lacking definition of the concept. In addition to problems of interpretation, there is also the question of how the realization of such a state takes place from the first-person perspective (i.e. what is it like for me, the experiencing subject, to perform the epoché). Similarities between the concept of the epoché and various Eastern practices have also been illuminated in recent decades, such as the yoga practice of prāṇāyāma (breath control) [8] and Samatha-Vipassanā meditation [9].

Due to the uncertainty that permeates the field and the various interpretations about what epoché is and how to carry it out, we have decided to investigate the experiential process from a first-person perspective in the hopes of providing more clarity and being able to better distinguish what it is we are talking about when we talk about the practice of epoché.

In this article we broadly focus on the following questions: what is it like to come into contact with the experience of epoché and what are the characteristics of carrying it out from a first-person perspective. We present the diachronic process involved in performing the method of epoché, focusing on a) how an

individual moves away from and back towards being immersed in the natural attitude; b) how an individual relates to her own experience and c) what changes in the process.

2 METHOD

The findings presented in this article are part of a broader study in which we are exploring epoché with the micro-phenomenological interview method [10]. The aim of the micro-phenomenological interview is to help co-researchers become aware of a past experience and access detailed descriptions of that same concrete experience, enabling the coming into contact with previously unattainable dimensions of lived experience and cultivate an individual's reflection and retrospective reporting of experiential data.

The co-researcher
Our co-researcher, a female aged twenty-seven, is trained in the micro-phenomenological method, has considerable phenomenological and first-person knowledge with more than 500 hours spent observing experience and participating in first-person and micro-phenomenological research (as interviewee and interviewer). She also has six years of meditative practice.

Selection of the explored experiences
What constituted the moment of epoché was partly decided prior to gathering the data, based on prior theoretical knowledge of the components of epoché provided by Depraz et al. [11]. This view was then modified during the study to incorporate the co-researcher's own individual perspective. The criterion for what constitutes the moment of epoché from the co-researcher's perspective was as follows: noticing a profound shift in the quality of one's experience of the world and relating towards the world, characterized by a lack of judgment directed towards the world.

Interviews and procedure
Altogether we have gathered nineteen journal entries describing experiences during meditative practice – either a Vipassanā meditation (with eyes closed), or a walking mindfulness meditation (with eyes open). After each meditation session, the concrete moment of what was experienced was written in the journal and later explored during the micro-phenomenological interviews in more detail. The interviews were carried out with investigators trained in the micro-phenomenological method. Eight interviews were conducted on eight selected journal entries, which were judged by the co-researcher to be the most vivid experiences of epoché. Two of the interviews were performed in Slovene, while the other six were conducted in English. The duration of the interviews ranged from 60 to 90 minutes. The interviews were audio recorded on a personal smart phone or a Zoom H4n audio recorder.

All of the investigated experienced have occurred within the past year. Five interviews were carried out within 24 hours of the experienced moment, two took place a few days after the experience and one experiential episode was investigated a few months after the experience took place.

The interviews were transcribed in full. Relevant parts of the interviews conducted in Slovene were translated into English for the purposes of this article.

3 RESULTS

The findings presented below are a tentative illustration of our research. Since the study is still ongoing, we have not yet carried out a systematic analysis of acquired descriptions and present here merely an excerpt of data collected so far.

Preliminary analysis of the transcribed texts focused on both synchronic and diachronic dimension of the experiential episodes and attempted to create an overview of which experiential moments were prevalent in all eight investigated journal entries and which were distinct. This has led us to propose the basic shape of a data derived first-person model, which frames epoché diachronically as a five-phase process.

Of particular note here is that these are preliminary findings meant to illustrate the experiential process of the co-researcher's individual experience and should be refined in future research with reports provided by other co-researchers to yield a more fruitful reflection of patterns and categories of carrying out epoché from a first-person perspective.

3.1 Pre-epoché phase and the experience of the natural attitude shifting

This phase is characterized by a gentle awareness of the co-researcher's surroundings (sensing them, but not engaging with them, letting them pass by). The experience of the natural attitude shifting was in all interviews accompanied by a relaxed and stable state of body and mind. In one particular interview it was described as follows:

> "And as I stand there, I also hear people, this soft shuffling of the people around me, silent, soft movements of feet shifting on the ground and shuffling on the ground. And there is this feeling in my body of stable ground. […] And I feel my body as a whole, just this being in the standing position. And a general calmness that comes with this feeling."

3.2 Entering the experiential phase of the epoché

The co-researcher has reported on experiencing an element of transition between the pre-epoché phase and the experiential phase of the epoché, which could be faster or slower. In the majority of the investigated experiences (6 out of 8), entering the epoché started by spontaneously "slipping into" the experience, whereby the experience of epoché seemed to arise by itself. Conversely, in the other two experiential episodes, there was a slow transition which took place either by remembering what it was like before and trying to follow that felt atmosphere, or by softly settling in the body (or a body part) and allowing the sensation to come, gently holding it in awareness. The co-researcher has reported on there being a feeling of tension in the body, which she was able to recognize and intentionally relax, for example:

> "I relax the shoulders, I let them [the arms] slump next to my body. Then there is this very soft, slow movement, with no pressure in it. As this relaxation of the upper part of the body and a move towards the

lower part takes place, I relax into this feeling. It is bodily, as I shift a bit with my shoulders, but also it is attentional – not focusing directly, just letting things go and flow down here [in the belly area]."

This settling into the (part of the) body was then followed by a feeling of space being more open, as though:

"My body can relax into this openness. Like, my body as a shape can flow into this [space], a boundary where my skin is can flow into this open, flowing, shimmering, static feeling [felt as the boundary, a space a few centimeters around her body and slowly entering the space further "away" from the body]. There is this feeling of being just open and relaxed, there is an openness at the sides."

The feeling described here as a shimmer, or a static-like feeling in quality, was in the majority of cases (5 out of 8) experienced as a sensation of spreading that lent itself towards lessening the sense of bodily boundaries.

3.3   The experiential phase of the epoché

We have found that the experiential phase of the epoché has a variety of dimensions often appearing together. Here we describe a few that have occurred throughout our investigation.

The phase of the epoché was in all investigated experiences characterized by a serenity and letting-be. The co-researcher was not actively searching for information or any type of stimulus in the world, rather the atmosphere was experienced as a calmness in being, an allowing of appearances. In six interviews a profound aspect of epoché was a felt sense of stability. It was described as a feeling of "sitting in myself" in the interview situations, yet it is important to note that this experience had very little to do with the experience of bodily sensations. Rather, it related more to the feeling of the body as a whole, to the gestalt of the body.

Another aspect that permeated all of the investigated experiences was no directedness of the co-researcher's attention towards the world or "towards the front of oneself". In an interview it was described as:

"Being directed towards the back and also being aware of the spinal cord, of the position of the spine."

The active engagement of the co-researcher was felt only in the act of sustaining awareness on the whole bodily gestalt. This act was in one of the interviews perceived as:

"It is effortless and feels like just being there with the awareness."

This type of awareness brought about a change in the co-researcher's visual field, if the eyes were open (this has occurred in 4 out of 8 investigated experiences). The world was perceived without its usual depth and was in the interview situation described as follows:

"I feel as if I am looking at a 'picture' in front of me, there is this lack of spatial depth in what I am seeing. And at the same time there is a feeling of seeing through this 'picture', this sensation. It feels as though my visual field is a veil and has its own dimension of depth and of spatiality being present in the natural, everyday world. But what I am sensing is that which is 'beyond it', 'through it' […] It is like another feeling of space around me that is at the same time dense, filled, thick, light, flowing, all-encompassing. I feel this spatiality as an atmosphere, it is primarily felt as air around me. And it goes on, it is felt as though the visual field [the veil] has a certain stopping point – it stops the perception on a certain point. But this denser spatiality is felt as limitless, it goes on, it feels as limitless potentiality all around me."

The phase of the epoché was in all instances also characterized by a feeling of a primordial space. This space was experienced as having the quality of density, thickness and sometimes warm air that is:

"Not visible, it is a felt air, felt as oneness around me [the felt location], to the sides, everywhere around me."

In three experiential episodes during meditation, in addition to what was described above, a feeling of space as a "background of holding" was identified. This background was felt by the co-researcher as being held by space, which had a profound quality of darkness and thickness.

The phase of epoché was in all investigated experiences also accompanied by the loosening of the sense of bodily boundaries and dissolving the separation between what is inner and what is outer, described in the interview situation as follows:

"There was no more separation, there was nothing out [there], there was just this blackness and this familiarity that was felt as and felt in this warm quality of blackness. And just the location that is this space where I feel my awareness to be and that is all."

3.4   Exiting the experiential phase of the epoché

Exiting the experience of epoché has occurred spontaneously and unintentionally in the majority of the investigated experiences (6 out of 8). The co-researcher has reported that the feeling of the world slowly began drifting back in as attention started to become more focused on the external world and she felt herself getting more directed towards it.

In a few examples (4 out of 8 investigated experiential episodes), there was a profound feeling of no separation between the co-researcher and the world during the experiential phase of the epoché, which was later contrasted by a feeling of separation on returning to a more "natural", habitual mode of being in the world. There were also a few (2 out of 8) instances of intentionally exiting, or rather of a feeling of "having to return", which was experienced as a desire, an anxiety or a nudge urging the co-researcher to return to the natural mode of being.

In all of the investigated experiences, a big part of exiting the epoché was for the co-researcher a felt sense of coming back to

her own body from the (above mentioned) primordial space. It was described as coming closer to a point where she feels herself to be situated in space and the space around that area becoming thicker and more condensed. This condensed and thicker feeling started in a part of the body (the area of the torso; 5 out of 8 explored experiential episodes) or was felt as the whole gestalt of the body becoming denser and heavier (3 out of 8 experiential episodes).

Heaviness and denseness also appeared to allow a sharper focus on the body in all of the investigated experiences of epoché, which began to separate the body of the co-researcher from the rest of the world. As she started to become more actively directed towards the world, stronger feelings of differentiation between form and background in the visual field become more noticeable to her. For example, she reported her environment began to hold more graspable and holdable possibilities, which came to the fore as the feeling of her body also shifted towards the background:

> "I am able to "pick out" a particular tree from a myriad of different trees, able to direct myself towards it and focus on it – making it stand out from the background as an entity."

3.5 Post-epoché phase and how the natural attitude is experienced after the epoché

Coming back from a profound phase of epoché has in all experiences left a mark on the co-researcher's way of interacting with the world and her way of being in the world. In all of the investigated experiences she reported on there being an immediate feeling of an increase in calmness, gentleness, contentment and a slowness of being after every experience of epoché. But also, a much more lingering feeling resounded through her being, namely the feelings of presence and the openness of space. She reported on experiencing a profound awareness of how her awareness shapes the surrounding world and how she is, in the end, inseparable from her surroundings.

4 CONCLUSION

In the article we have set out to enrich the traditional conceptualizations of epoché with in-depth descriptions of the first-person experiences of epoché elicited by micro-phenomenological interviews. In analyzing the experiential reports of performing epoché, we have made three notable observations. The first observation is a profound shift in the quality of experience, how one turns towards, notices and attunes herself to the world. The second and third observation are closely linked to the first one: the second one being a felt profound shift in how one experiences one's own existence, one's being in the world; and the third one being a profound shift in how the appearance of the world and its enclosedness appears to "the observer". Our preliminary analysis gave us a foundation for which experiential dimensions could be considered and additionally developed in future studies with more co-researchers. In addition, it would be fruitful to consider such endeavors more thoroughly in the frame of contemplative and

mystical traditions. It would also be interesting to design studies which bracket all such traditional presuppositions.

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A new study of expected human longevity

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ABSTRACT

In this paper we for the fifth consecutive year estimate the longevity of human civilization based on the absence of observable extraterrestrial civilizations. In addition to our previous studies, in this paper we add three more models and test all possible values of parameters and distributions. If there are not many advanced civilizations in our galaxy, as newest studies indicate, our longevity can again be estimated at up to 10 000 years. The consistency of studies may or even should shift focus of our civilization.

KEYWORDS

Human extinction, Drake equation, Civilization collapse, Rare Earth hypothesis

1 INTRODUCTION

After more than 50 years of searching for extraterrestrial civilizations there is only one thing we know for sure: we have not found any yet. After scanning more than 10 millions stars [14] we have not found any extraterrestrial life and that could indicate that the longevity of such civilizations might not be so long. While we know that we will die someday, we do not act like this. On the similar note we as civilization will also extinct someday in the future and that future might not be so far. Do we realise that we could be on the verge of the extinction? For that reasons the question about the longevity of human civilization is directly linked to the cognitive science.

In our previous papers [9, 17] we approached the question "Where is everyone?" and presented the Drake equation that could potentially solve the issue. In the first paper [9] we presented and analysed Sandberg [10] interpretation of the Drake equation [2]. In the last paper [17] we presented possible causes for human extinction and used the Drake equation to estimate longevity of human civilization. We concluded that our technical civilization will most likely survive just another 10 000 to 20 000 years.

In this paper we analyze three models. The second and the third model are based on Drake equation with some adjustments. The second model uses substantially less parameters and the

third model includes inhabiting neighbouring planets. The fourth model represents the "rare Earth" hypothesis [15]. For each model we represent all possible predictions from the pessimistic (there are no other civilizations besides us) ones to the optimistic (there are a few thousands civilizations) predictions with different probability distributions to more accurately estimate longevity of human civilization. In summary, we test 4 different models under all circumstances (parameters, distributions).

2 RELATED WORK

There are various estimations of possible number of civilizations; some propose between 600 and 40 000 technological civilizations in our galaxy [13]. The differences often stem from the number of Earth-like planets in the habitable zone around stars. One of the newest studies found that there should be around 36 civilizations in our galaxy if estimated time for a planet to form an intelligent life (life that could communicate with others in our own Galaxy) is between 4.5 to 5.5 billion years (like Earth), assuming that an average longevity of civilizations is 100 years [16]. Using three different principles, the paper by Engler and von Wehrden [3] represented that number of civilizations that have likely arisen in our galaxy to date is between 7 and 300. However, it is estimated that with our tehnology the likelihood of detecting intelligent life could be two orders of magnitude smaller in comparison to the detection of primitive life [8] (by primitive life are defined mostly microbes and multicellular life and intelligent life is technologically advanced intelligence - species that are capable of producing detectable signatures of their technology). Another issue is the detection of their radio signals [7]. In detail, if there are 5 civilizations, the chance of us detecting them is 0.012%, but if the number is 300, the probability is 95%. A great number of undetected civilizations in therefore unlikely. However, if longevity of civilizations is less than 100 000 years, the signals arriving at Earth may come from distant civilizations long extinct [5]. The extinction due to natural causes is less likely - one research shows that the yearly probability for that is most likely to be less than 1 in 87 000 using four different models [12].

As already mentioned, in our research we wanted to look the Drake equation from the other side. Using 4 different models of the Drake equation with modifications we ask about the longevity of human civilization instead of the number of other civilizations in our Galaxy. For that reason this research is unique and first in this topic.

Table 1: Probability densities for the parameters in equation (1).

Parameter	Distribution
R_*	log-uniform from 1 to 100
f_p	log-uniform from 0.1 to 1
n_e	log-uniform from 0.1 to 1
f_l	log-normal rate, described in paper [10]
f_i	log-uniform from 0.001 to 1
f_c	log-uniform from 0.01 to 1
N	point values: 1 to 10 000

3 ESTIMATING THE LONGEVITY OF HUMAN CIVILIZATION WITH FOUR BASIC MODELS

The Drake equation consists of several parameters:

$$N = R_* f_p n_e f_l f_i f_c L,$$

where R_* is the rate of star formation per year, f_p is the fraction of stars with planets, n_e is the number of Earth-like (or otherwise habitable) planets per star that has planets, f_l is the fraction of habitable planets with actual life, f_i is the fraction of life-bearing planets that develop intelligence (technologically advanced civilizations), f_c is the fraction of intelligent civilizations that are detectable and L is the average longevity of such civilizations. Finally, N is the number of detectable civilizations. We used the following equation for computing L

$$L = \frac{N}{R_* f_p n_e f_l f_i f_c} \qquad (1)$$

with the probability densities and limits from Table 1. In Table 2, the third column "stabilization" denotes the point where probability density stops decreasing, meaning that the major probability was up to this point.

3.1 Model 1

The first model was already fully described in [17].

3.2 Model 2

The main part of this model was inspired by [4]. It represents a simplified version of the Drake equation - parameters are reduced in just two: an astro-physical (presents total number of habitable zone planets) and a bio-tehnical (represents probability that a given habitable zone planet has ever evolved a technological species). The motivation for the introduction of the model 2 was smaller number of variables to avoid numerical problems.

We combined some parameters from the Drake equation and got the following equation:

$$N = [R_* f_p n_e][f_l f_i f_c]L = f_a f_b L \qquad (2)$$

- f_a is the astro-physical probability
- f_b is the bio-tehnical probability

The longevity is calculated as $L = \frac{N}{f_a f_b}$. Results can be seen in Table 2 and Figure 1.

3.3 Model 3

This model is based on [1]. The main upgrade from the original Drake's equation to this model is an added possibility to expand civilization to neighbouring planets. Each newly inhabited planet

is treated as another civilisation, therefore N corresponds to the number of inhabited planets. The obtained equation is

$$f * (L + EL^4) = N$$

where E represents the estimated numbers of planets like Earth and is calculated as $E = 5.1334 * 10^{10+f_p+f_c}S$ (S is the density of the stars and equals to $4.7233 * 10^{-42}$) and f is calculated as $f = R_* f_p f_e f_i f_c$.

Results can be seen in Table 2, Figure 2 and Figure 3.

3.4 Model 4

The fourth model is based on the "rare Earth" theory and assumes that - as name already suggests - Earth is a very unique and rare planet. We used the equation 3 and combined it with the Drake equation again using probability distributions.

$$N = N^* n_g f_p f_{pm} f_i f_c f_l f_m f_j f_{me} \qquad (3)$$

The parameters added to the Drake equation are

- N^* is the number of stars in the Milky Way galaxy, between 250 and 500 billion,
- f_{pm} is the fraction of planets that are metal-rich, between 1 and 10 percent,
- f_m is the fraction of planets with a large moon, between 0.3 and 3 percent,
- f_j is the fraction of solar systems with Jupiter-size planets, between 5 and 10 percent,
- f_{me} is the fraction of planets with a critically low number of extinction events, between 1 and 10 percent.

L is then calculated as $L = \frac{N^* f_{pm} n_g f_m f_j f_{me}}{N}$.
Results can be seen in Table 2 and Figure 1.

4 EXPERIMENTS

4.1 Single Models

To simulate longevity estimates L, we randomly generated values of each parameter for a chosen number N of advanced civilizations in our galaxy (civilizations that transmit electromagnetic signals to space) using the predefined probability density. Then, several derived graphs are generated, e.g. the one in Figure 1 (presented for models 1, 2 and 4, while model 3 is similar to 1).
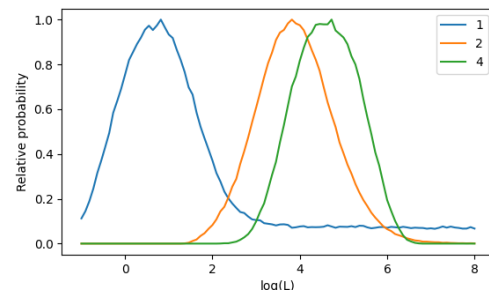
Figure 1: Probability density function of log(L), i.e. expected human longevity based on relative probability with N = 10 for models 1, 2 and 4.

Figure 2 and Figure 3 present the same relations as in Figure 1, but for model 3 and in different ways: Figure 2 presents a 3D view in the logarithmic scale, Figure 3 presents linear view on the same relation.

Table 2: Median and stabilization for different N for all 4 models.

	median				stabilization			
N \ model	1	2	3	4	1	2	3	4
1	2 200	200	720	1 070	13 600	9 200	61 400	9 200
10	22 000	900	2 060	8 320	11 100	1 500	20 100	1 500
100	220 000	7 000	5 930	77 640	9 300	100	2 800	100
1000	2 200 000	70 000	19 570	763 190	5 800	20	300	20
10 000	22 000 000	700 000	65 000	7 588 330	/	/	40	/
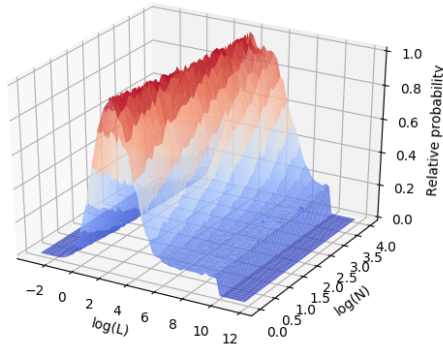
Figure 2: Longevity based on N, side view for model 3.
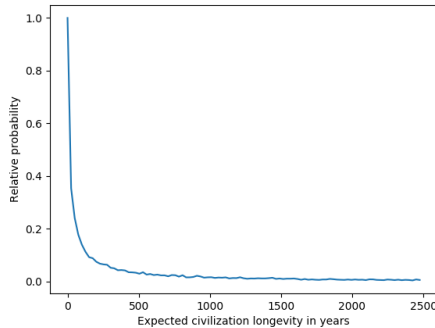
Figure 3: Longevity based on N for model 3, N = 1, median = 720, stabilization = 61400.

If we present the graph of probability densities in a linear (as in Figure 3) instead of logarithmic scale, we get quite different impressions: the majority of possibilities for greater N are at the left of the graph resulting in a faster decline and faster stabilization point. This relation is observable in Table 2 in the third, "stabilization" column, which denotes when a decline is less than 1 percent in a corresponding 100 years. It is important to distinguish between stabilization and median: the median presents a point dividing all simulations into two intervals that are equally frequent, and stabilization indicates the end of a steep dive. While the median is mainly linearly growing with the number of civilizations, the stabilization decline presents the point where probability "tail" smaller than 1 percent. At $N = 1$, the median is smaller than the stabilization, and at $N = 100$, the median is bigger for all models.

4.2 All Models Merged

In this section we combine results of all 4 models simultaneously and each parameter under 5 different distributions (log-uniform, uniform, half-normal, log-normal distribution and distribution with the most of the probability close to the upper bound). The results are presented in the form of histograms. We compute new linearly independent space pretending that a histogram is a vector using PCA - Principal component analysis. It turns out that the three dimensions with the biggest eigenvalue are informative enough, therefore we can draw 3D figures.

We compute some clusters using k-means algorithm and mean histogram for each cluster. Each cluster is approximated as a surface.

4.3 Results
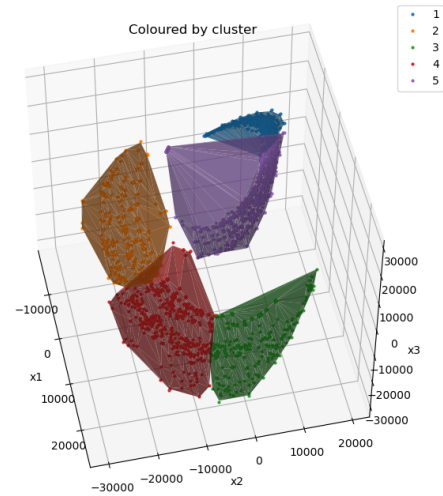
Figure 4: Transformed space clustered into 5 clusters. Each dot is a histogram transformed to a new space using PCA. We can see the first three dimensions of this space.

One point in Figure 4 corresponds to one histogram, and histogram are clusters into splines of five different colors. The first and the fifth cluster contain mostly histograms for the first and the third model. All the other clusters consist of the second and the fourth model. The expected human longevity will be higher for these thee clusters.

In Figure 5 we present properties of the clusters by their means. As expected the first and the fifth cluster have peak before the others but later they are still higher because of a theoretical step that gives some probability even to practically unimaginable values (numbers high as 10^8 years which is 20 times more than the occurrence of Australopithecus [6]).
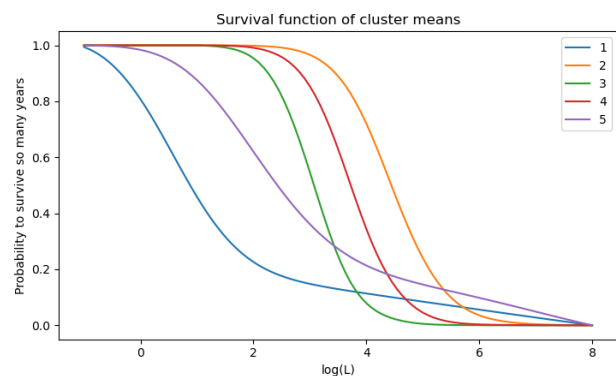
Figure 5: Mean survival function for each cluster.

Now we can compare a few distributions that are still different enough based on their peak density from lower to upper bound.

5 CONCLUSION AND DISCUSSION

Based on the research where several participants (general UK public, general US public, Oxford students) were asked about their view on the possibility of the human extinction, results show that they think it needs to be prevented [11].

This research designed models of probability densities of the longevity of human civilization in significantly more advanced ways compared to our previous studies. We generated all four models such that we distribute each parameter by all five selected distributions. To determine the realistic probability of longevity, Figure 3 is most relevant: after probability drops to low values and remains so for a long period of time. If integrated over a long period of time, it can result in big values as "mean" shows in Table 2. But in reality, the long close-to-zero tail seems more of a numerical curiosity. "Stabilization" is therefore the relevant indicator of civilization longevity.

The models analyzed here all show that if there are more civilizations, we have lower probability of living longer (column stabilization). Regardless of N and after initial fluctuations at the beginning, the curve of the longevity becomes static, monotonic, very slightly decreasing. From Figure 5 we can interpret that even the most optimistic cluster (cluster 2) gives us result that we will survive more 100 000 years with half probability and more than million years with 5% chances. Based on all of the clusters we can conclude that the highest probability is that we will survive at most 10 000 years.

In summary, this paper is relevant because it shows that we might not have a lot of time left, at least in terms of cosmic timing. Maybe we can buy us some time by taking better care of the Earth or by starting to colonizing other planets, but the most important thing is to start making more researches that could possibly help to prevent the extinction of human civilization or at least reschedule it later in the future.

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Does sight provide insight into Alzheimer's dementia?

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ABSTRACT

Alzheimer's dementia (AD) is the most common neurodegenerative dementia. Its timely and early diagnosis is of great importance, as it allows patients to plan ahead and improve life quality with different non-pharmacological approaches. Several biomarkers, which allow for such a diagnosis, are already part of everyday clinical routine. While their role in the patient's assessment is undoubtedly valuable, they bear certain limitations, such as invasiveness and price. A search for a novel, non-invasive and inexpensive biomarker is underway. Eye movements have recently been proposed as a promising candidate for such a biomarker. Here, we offer a brief overview of both: the biomarkers most typically used in the clinical setting, and the eye movements, as tracked via eye tracker—a method, which already has a long tradition in the field of cognitive science.

KEYWORDS

Alzheimer's dementia, early diagnosis, biomarkers, eye movements, eye tracking, structural MRI, lumbar puncture, FDG PET

1 INTRODUCTION

Dementia is a clinical syndrome that involves impairment in at least two cognitive domains (i.e. memory, attention, executive functions, visuospatial abilities or language) and interferes with individual's ability to function in their daily activities [1]. It can arise as a consequence of various pathophysiological processes in the brain that start decades before the appearance of the first cognitive symptoms. The most common cause of dementia is Alzheimer's disease that causes 60 to 80% of all dementias [2]. Alzheimer's dementia (AD) is a final stage of Alzheimer's disease whose pathological hallmark is accumulation of misfolded proteins: amyloid β (Aβ) and Tau protein in the brain, which in turn cause synaptic dysfunction and neurodegeneration [3]. AD is usually preceded by symptomatic pre-dementia stage termed mild cognitive impairment (MCI), in which the physician can observe cognitive impairment that does not interfere with individuals' functional abilities [4].

There is a common public misconception that early diagnosis of AD is not essential due to the current lack of a disease-modifying drug. But such diagnosis is of paramount importance. Firstly, it allows people with dementia and their caregivers to

plan ahead and thus ameliorate caregiver burden. Furthermore, certain non-pharmacological interventions are more effective in the earliest stages of AD and early diagnosis can lead to early involvement into drug trials [5]. Additionally, bearing in mind that about 5–10% of patients with MCI progresses to dementia per year [6], we can also highlight the importance of accurate diagnosis of Alzheimer's disease and accurate identification of MCI patients who will progress to AD.

2 DIAGNOSIS OF DEMENTIA

Diagnosis of dementia is inherently linked to firstly, ruling out potentially treatable causes and secondly, diagnosing the underlying neurodegenerative process. In this section, we will first briefly address other, potentially treatable causes of cognitive impairment and then present the biomarkers of the most common neurodegenerative cause of dementia—Alzheimer's disease.

Individuals with cognitive impairment firstly undergo blood screening for systemic abnormalities (vitamin B_{12}, folate, thyroid-stimulating hormone, calcium, glucose, complete blood cell count, renal and liver function) and structural imaging with magnetic resonance imaging (MRI) or at least computer tomography (CT) to exclude other causes of dementia (i.e., tumor, abscess, stroke or normal pressure hydrocephalus) [7]. Core diagnostic criteria for AD are still rooted in clinical presentation, meaning that the physician can make an AD diagnosis even without the use of biomarker information [1]. Because clinical diagnosis of AD is not in concordance with pathological diagnosis in around 30% of cases [8], there has been a shift towards promotion of biomarker-supported diagnosis in recent years [9]. Biomarker is a characteristic that can be measured objectively and reflects a certain biological or pathological process [10]. Various biomarkers are already a part of everyday clinical routine.

Structural MRI is a recommended and widely used imaging method that can be used to assess atrophy in medial and lateral temporal lobe, medial parietal cortices and hippocampi—structures that are affected early and disproportionally in AD. Atrophy reflects the loss of neurons and can be seen clearly as disease progresses, but patterns of atrophy often overlap between different dementia syndromes and changes can be very subtle in early stages. Furthermore, structural MRI is useful for the assessment of the vascular burden—an important co-morbidity in AD [11]. Two other commonly used biomarkers of AD are analysis of cerebrospinal fluid (CSF) and functional brain imaging with 2-[^{18}F]Fluoro-2-deoxy-D-glucose and positron emission tomography (FDG PET). Lumbar puncture is performed to obtain CSF from which concentrations of Aβ_{42}, phosphorylated Tau and total Tau proteins can be measured. Reduction in concentration of Aβ_{42} protein (due to increase in extracellular binding in the brain)

in CSF can be observed decades before appearance of first cognitive symptoms, but $A\beta_{42}$ concentration reaches plateau already in the pre-symptomatic disease stage [12] and is thus not a suitable biomarker of disease progression. Furthermore, lumbar puncture is an invasive procedure with a non-negligible percentage of mild complications such as back pain or headache, however the percentage of serious complications is very low (< 1%) in specialized institutions [13]. FDG PET is a non-invasive brain imaging modality that provides information about synaptic dysfunction, which precedes atrophy, and is commonly used in early detection and differential diagnosis of dementia. Furthermore, it also provides an important insight into disease progression [14]. Because FDG PET imaging involves radiation exposure, it is not recommended to be performed more than once per year. Additionally, FDG PET is a relatively expensive procedure [11].

In summary, while the current biomarkers are able to detect AD in the earliest stages, they are either invasive (e.g., lumbar puncture) or relatively expensive (e.g., MRI, FDG PET). A discovery of a reliable, noninvasive and inexpensive biomarker would thus greatly advance the availability of early diagnosis of AD [15]. The search for such an alternative biomarker has already begun, and the research of the past two decades has yielded important advancements. In the next paragraphs we offer a short overview of one such potential biomarker—eye movements, as tracked via eye tracker. In order to do so, we first need to shift our focus away from the most commonly defined features of AD.

3 VISON IMPAIRMENTS IN ALZHEIMER'S DEMENTIA

As reflected in the clinical diagnostic criteria for AD, described above, the primarily addressed disorders of AD are the disorders of cognitive functioning [1]. However, a common, yet largely ignored feature of AD are also alterations in sensory capacity, particularly in visual processing [16, 17]. These are of extreme importance especially when talking about timely diagnosis of the AD, since they are present already in the early stages of the symptomatic disease [16, 17]. Possibly, these changes are often overlooked due to the fact that they are not present in all types of visual processing. For example, visual acuity, which is most commonly tested when an individual initially complains that their vision is not quite right, is typically no more impaired than in healthy elderly individuals [16]. But additional deficits can be observed in other, more subtle types of visual processing, such as contrast sensitivity (i.e., the ability to distinguish gratings of varying spatial frequencies at different contrast levels) [16], color discrimination (i.e., ability to distinguish different shades of colors) [18, 19], and eye movements [19, 20].

Despite the fact that these deficits are traditionally still not dealt with in clinical environment [21], the last two decades of interdisciplinary research have brought to light numerous new findings, particularly about the eye movement alterations in AD. This field of studies has recently been gaining more and more attention, and has since largely progressed along two lines of research: while the first one deals with correlation of the eye movement alterations and the disease severity, the second one focuses on the applicability of the eye movement alterations for early detection of cognitive decline [e.g., 19, 20]. In the remainder of this abstract, we will address the latter in more detail, and explore the potential of the eye movements as possible biomarker for diagnosis of AD.

3.1 Eye movements and their alterations in AD

Unlike the other methods, described above, eye movements, as tracked and recorded via eye tracker, present a sensitive, non-invasive, and inexpensive method [22, 23, 15], which allows for testing in a simple and everyday-like setup. As such, eye tracking presents an ideal method for testing patients with cognitive decline, since the tasks they perform during testing are relatively natural and thus easily comprehensible, without complicated instructions. Additionally, the method is appealing to the patients also due to the fact that they are simply sitting comfortably in front of a computer screen, while their head is typically stabilized through a chin rest, allowing them to relax their posture without compromising the accuracy of the recording.

In healthy individuals, who are not experiencing any kind of processing difficulties, the typical oculomotor behavior can be described with a series of eye movement measures. Here, we offer a description of two of them as an example. When we, for example, look at a presented picture, search for an object or read a text in font of us, we continuously make rapid linear eye movements—so called saccades, which can reach velocities as high as 500° per second [24]. During a saccade, the sensitivity to visual input is reduced, thus we essentially do not obtain new information from our environment while our eyes are moving [25]. In order to obtain this information, we make a series of stops in between the saccades—so called fixations, which typically last about 250ms [25, 20]. During this time our eyes remain relatively still, focusing on the information that is available in the momentary foveal vision (i.e., the center of the visual field, with the highest visual acuity) [26]. The role of the saccades is thus to move our eyes onto a new region of the processed stimuli, where we make a fixation to bring new informaton into our foveal vision, and consequently into our attention.

The main reason why eye tracking can so readily be used for an early detection of the neurodegenerative alterations is that it allows for a simple investigation of complex viewing behavior that humans automatically engage in when they are driven by top-down, goal-directed processes. Given the intimate link between the eye movements and cognition, any alterations in the typical oculomotor behavior can thus be used to infer AD-related changes in cognitive processing [27]. Carefully selected tasks that trigger complex viewing behavior, in which attention and its allocation, inhibitory control, working memory, or decision-making are required to successfully accomplish a goal, thus present an ideal testbed for early detection of the AD, since all these processes are altered already in the early stages of AD [20]. Importantly, such tasks are already well-defined and well-explored in the frame of studies with healthy participants in the filed of cognitive science. Here, we offer a short overview of the patient's performance in three such tasks: visual search, natural reading and antisaccade task.

3.1.1 Visual search task. In essence, visual search task is goal-directed search for a target (e.g., a specific object) among a number of distractors in an environment [27]. Compared to healthy control participants, patients with AD exhibit delayed target detection [27, 20], longer fixation durations [20, 28] and longer and less systematic exploration [29, 30, 28], which is often described as stochastic [29].

3.1.2 Natural reading task. Despite the fact that reading is an activity in which (literate) humans engage in on an everyday

basis and without much effort, this is a very demanding cognitive task [31, 32, 33, 34]. Successful reading process demands not only simultaneous processing of different linguistic information (e.g., letter identification, morphologic and semantic processing), but also precise coordination, attention allocation and planning (e.g., where and when will the eyes move in the text) [33]. Compared to healthy control participants, patients with AD exhibit a reading pattern that noticeably differs from a typical one, and is similar to alterations described in visual search task: longer fixation durations, increased occurrence of several fixations on the same word (so called refixations), increased number of saccades, which are shorter than the typical span of 8-9 characters [30, 20]. Additionally, there is also an increase of word skips (i.e., number of times a word is not directly fixated) during the first reading, which is accompanied with a larger number of regressions back to the already read parts of the text [26, 20, 30].

3.1.3 Antisaccade task. In a typical anti-saccade task the participants are required to inhibit a reflexive saccadic eye movement towards a presented target. Usually, their eyes are fixated on the central point on the screen until the so called distractor target appears in the peripheral visual field, either left or right of the fixation point. At this timepoint, participants are required to make a saccade to the opposite direction of the screen. Failure to do so results in so called anticcade error. Compared to healthy control participants, patients with AD exhibit an increase in the antisaccade errors [35, 36], as well as also a decrease in the number of corrected errors [36]. A very recent study reveals that such eye movement alterations are already present in patients with MCI. Importantly, these alterations reliably differ between the patients with amnestic and non-amnestic MCI, where the former are at a much greater risk of progressing to AD [15].

4 CONCLUSION

In the recent years, AD research and clinical work is experiencing a shift towards early and biomarker-oriented diagnosis. We are now increasingly more aware of the importance of early detection of the disease, which would significantly contribute to ameliorating the disease burden, while timely and accurate diagnosis could also accelerate the research of disease-modifying drugs. As addressed in this review, several biomarkers which allow for such a timely diagnosis are already available and are an important part of clinical diagnostic. Recently however, a need for a non-invasive and inexpensive biomarker has been emphasized. Eye movements, as tracked via eye tracker, have been proposed as a promising candidate for such a biomarker, since a rapidly growing number of studies in the recent years have demonstrated that they offer a highly reliable and sensitive method for detection of impairment of cognitive control in AD. Importantly, studies demonstrate that the eye movement alterations can, at least in certain tasks, already be observed at the early stages of the AD and even in patients with MCI. Even more importantly, the recent findings indicate that they can also reliably distinguish between the patients with MCI who are at risk of progressing to AD, and those who are more likely to progress to other disorders.

But the gap between the interdisciplinary research and the application of this method to everyday clinical practice still looms large. In the future work, the eye movements should be studied in more detail in a variety of tasks and in patients in different disease stages. Furthermore, prospective longitudinal eye movement studies could offer us an insight into disease progression. This could lead to a development of a sensitive battery of simple tasks, tailored to detecting and monitoring the disease at its specific stages, and to the specific needs of the patients with dementia, who require natural and simple tasks, which do no trigger any discomfort or risk of misunderstanding the task instructions.

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Patterns of Mental Behavior During Psychological Task Performance

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ABSTRACT

Psychological tasks are one of the main instruments used in experimental sciences of the mind. Recent meta-psychological discussions have shed light on the phenomenology, research design structure, and generalizability of psychological tasks. However, it remains unclear how psychological task performance modifies consciousness. Subjective reports on the experience of psychological task performance were gathered. A constructivist grounded theory approach was employed for analysis. A number of patterns of mental behavior and experiential states associated with psychological task performance are discussed.

KEYWORDS

Psychological task, constructivist grounded theory, mental behavior

1 INTRODUCTION

Psychological tasks are one of the main instruments used in experimental cognitive science. They are typically relatively simple, computerized activities, whereby mental phenomena are isolated and made measurable [1]. It has long been understood that psychological tasks constitute a culturally specific and artificially constrained context of inquiry [2, 3]. Recent discussions have attempted to add to the meta-psychological and anthropological understanding of psychological tasks by explicating the general phenomenology associated with the performance of psychological tasks [1], their formal structure as it pertains to their research designs [4], their generalizability [5] and in what manner participants respond to them [6].

It has been noted by Froese and colleagues that specific types of complex systems are characterized by the *theory-experience gap;* i.e., we cannot claim *a priori* as to how the complex system will modify the structure of consciousness of the individual interacting with it [7]. In its original formulation, the theory-experience gap refers to novel systems, such as virtual reality. However, it has recently been shown that psychological task performance is associated with a relatively large array of unexpected experiential states as well [8].

The goal of this study is to contribute towards the general meta-psychological understanding of interacting with a psychological task in a research setup; i.e., what is the experience of performing a psychological task *as such,* rather than a *specific* psychological task. As the purpose of the psychological task is to elicit a specific cognitive function, this study is interested in the patterns of mental behavior when participants are exposed to any experimental setup.

2 METHOD

18 participants (10 females) gave their oral consent to participate in the study. The average age of participants was 27.2 (SD = 2.9). All the participants were right-handed. Except for one, all the participants were current or former students of cognitive science. The average total number of years of education for participants was 15.8 (SD = 1.15). The participants were informed ahead of time that they will be participating in a psychological study.

The participants sat in front of a laptop, displaying a blank screen. Throughout the study, the researcher sat behind them. They received the following set of instructions: *There will be an image displayed on the computer screen for 10 seconds. I would like you to observe the image without doing anything with it or performing any mental gestures upon it. All you have to do is to focus on it.*

A randomly selected stimulus appeared on screen. There were four possible stimuli. They were all composed of a grid with some boxes filled in black, and other boxes left empty (i.e., white). After 10 seconds elapsed, the participants were prompted to report on their experience of observing the stimulus.

The researcher guided the participant through the subjective report. Initially, the participant was asked to provide a rough overview of their experience of the observation of the stimulus. Afterwards, the researcher guided the participants through each salient event that was mentioned in the initial overview. The participant was asked open-ended follow-up questions regarding each event until a precise description of how it had been experienced was achieved. To promote a detailed account, the researcher consistently recapitulated parts of the subjective report under discussion. The descriptions were considered valid, if they were grounded in a) bodily feelings; b) sensory modalities; c) mental gestures; and d) attitudes. Descriptions of theoretical concepts, folk psychological assumptions, or metaphorical ideas were considered invalid.

After each mental event was grounded in a concrete description of experience, a debriefing interview about the interview itself was conducted. The participants were asked about how they experienced the interview and the research setting. If the participants reported an awareness of confabulating a specific aspect of the report or a social distance from the researcher, the sample was discarded. Three samples were removed. The entire interview was recorded on an audio recording device.

3 ANALYSIS

In total, 15 admissible samples were gathered. The samples were analyzed according to the principles of constructivist grounded

theory [9]. The audio recordings were transcribed verbatim. Descriptions of theoretical concepts, folk psychological assumptions, and metaphorical ideas were removed. The data were analyzed via coding: general descriptive tags were assigned to the concrete subjective reports. In order to minimize bias, a meaningful code was assigned to each line of the interview. The data were coded inductively: the codes emerged from the text rather than from the scientific literature. Each category was given a name and specified according to a) its salient phenomenological properties; b) relationships to other categories; and c) meaningful quotes from the transcripts.

The data were coded on two levels: a) relational and b) experiential. The former refers to the abstract relationships between types of mental behaviors relative to how the participants performed the task. The latter refers to the categories constructed on the basis of subjective reports relative to participants' bodily feelings; sensory modalities; mental gestures, and attitudes as they pertain to individual mental behaviors.

As individual samples displayed a high degree of variability (i.e., experience rapidly changed from moment to moment), each sample was assigned a number of both relational and experiential categories. Thus, a given category may have appeared more than once within a single sample. The number of categories assigned to each sample depended on the variability of experience and thus varied from sample to sample. For the sake of parsimony, relational categories - where variability was the highest - were grouped together into typical *patterns of mental behavior.* These patterns are presented in Section 5 in the form of grounded theory.

4 RESULTS

4.1 Relational categories

Four categories of mental behavior were induced from the data:
a) *nominal task performance*;
b) *constructed task performance*;
c) *mind-wandering*;
and d) *ambiguity*.

Nominal task performance (NT) refers to situations in which participants' phenomenology is congruent with the phenomenology expected by the design of the task. In the case of the simple observation task used in this study, *nominal task performance* refers to experiential states that amount to a disengaged, receptive observation of the stimulus. NT was observed 13 times (on average 0.86 times per participant).

Constructed task performance (CT) refers to situations in which participants deviate from the task that was created by the researchers. Phenomenologically-speaking, *constructed task performance* is characterized by goal-oriented mental behavior, however, the goal itself is something that the participants constructed anew. As participants had a background in cognitive science, they constructed a novel task because they were distrustful of the researcher's instructions. Thus, the tasks that were typically constructed were associated with well-known cognitive functions (e.g., pattern recognition, geometric analysis of stimuli, working memory). CT was observed 12 times (on average 0.8 times per participant).

Mind-wandering (MW) refers to situations in which participants engage in mental behavior that is unrelated to the *nominal task performance* but is itself not oriented towards a task. Participants engage in remembrance (i.e., contemplating various memories from their own life), reverie (i.e., engaging in fantastical stories about their own life), planning (i.e., thinking about the future), and, interestingly, theorizing about the nature and purpose of the psychological research design and/or the algorithmic structure of the code running the task itself. MW was observed 6 times (on average 0.4 times per participant).

Finally, *ambiguity* (AM) refers to moments of disengagement from any explicit mental behavior. Participants find themselves unsure as to what they are supposed to do. AM therefore amounts to an attitude of searching for the appropriate mental behavior. AM was detected 14 times (on average 0.93 times per participant).

4.2 Experiential categories

Qualitatively, the most salient aspects of experience in relation to mental behavior were the *sense of agency* and *attentional dispositions.* Three experiential categories of *sense of agency* were induced from the raw data:
a) *willful;*
b) *automatic;*
and c) *vetoable.*

Willful sense of agency refers to the experience where participants felt that a particular event that occurred in their awareness was the result of their action. In total, *willful sense of agency* was observed 15 times (on average 1.0 times per participant). *Automatic sense of agency* refers to the experience where participants felt that a particular event that occurred in their awareness was something that happened to them. In total, *automatic sense of agency* was observed 19 times (on average, 1.27 times per participant). Finally, *vetoable sense of agency* refers to situations where participants felt that a particular event that occurred in their awareness was something that was happening to them; however, they had the capacity to continue to enact this event or terminate it. *Vetoable sense of agency* was observed 15 times (on average 0.4 times per participant).

Attentional disposition is an aspect of experience that refers to an attitude taken in attention to a particular object of one's perception. Based on this attitude, the object itself may be experienced differently. Three experiential categories of *attentional dispositions* were induced from the raw data:
a) *progressive;*
b) *receptive;*
and c) *distant.*

Progressive attentional disposition is an aspect of experience wherein participants experience themselves going towards the psychological task. While mostly attentional, this experience can be so salient that it is experienced as a force, located beyond one's body, going forward or bodily sense of leaning forward. *Progressive attentional disposition* was observed 24 times (on average, 1.6 times per participant). *Receptive attentional disposition* is an aspect of experience wherein participants experience the psychological task coming towards them. While mostly attentional, this experience can be so salient that it is experienced as a force, located beyond one's body, pulling them

away from the task, or a bodily sense of leaning backwards. *Receptive attentional disposition* was observed 10 times (on average 0.67 times per participant). *Distant attentional disposition* is an aspect of experience wherein participants experience an attentional disconnect from the task. Commonly described as "looking but not seeing," this experience may be so salient that the psychological task fades from participants' awareness. *Distant attentional disposition* was observed six times (on average, 0.4 times per participant).

5 GROUNDED THEORY

Individual states relative to the performance of the psychological task did not appear in isolation. Rather, within a single performance, participants underwent a number of states of mental behavior. The manner in which states followed each other formed a number of patterns. These patterns are outlined in this section. Six patterns of mental behavior relative to the performance of the psychological task were detected:

a) *simple coalescence*;

b) *complex coalescence*;

c) *simple tangentiality;*

d) *complex tangentiality*;

e) *digression*; and

f) *separation*. On the basis of reports from the literature, another pattern of mental behavior is conjectured:

g) *breakdown*.

Coalescence is a descriptive tag for a pattern of mental behavior that tends towards NT. *Simple coalescence* refers to situations in which participants transition directly from AM towards NT. *Complex coalescence* refers to situations in which participants begin with AM, transition towards a number of states unrelated to NT, but ultimately tends towards NT.

Tangentiality is a descriptive tag for a pattern of mental behavior that tends towards CT. *Simple tangentiality* refers to situations in which participants transition directly from AM towards CT. *Complex tangentiality* refers to situations in which participants begin with AM, transition towards a number of states unrelated to CT, but ultimately tend towards CT.

Digression is a descriptive tag for a pattern of mental behavior that initially tends towards NT, digresses into mental behaviors unrelated to NT, and ultimately returns to NT.

Separation is a descriptive tag for a pattern of mental behavior that tends towards MW.

Finally, a hypothetical pattern of mental behavior needs to be addressed. While not observed in this study, empirical phenomenological studies report on the category of *informational chaos* [8, 10]. It refers to experiences of extreme AM. The participants feel that the psychological task is too complex to be solvable. This feeling may be associated with negative emotional valence. Based on these reports, another pattern of mental behavior is conjectured: *breakdown*. *Ex hypothesi*, *breakdown* refers to the pattern of mental activity that begins with AM and tends towards the experience of *informational chaos*. In these cases, individuals cannot tie the psychological experience to a mental strategy known to them from everyday life [1]. Depending on the task design, this outcome may be undesirable.

6 CONCLUSION

The study represents a continuation of qualitative inquiries into the meta-psychology of psychological task performance (e.g., Morrison et al., 2019). A grounded theory is proposed that may assist in future understanding of psychological tasks, in particular, what is the dynamics whereby they isolate the intended cognitive functions or an unrelated self-imposed task.

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Vpliv posturalnih perturbacij na stresni odziv pri človeku

Effects of Postural Perturbations on Human Stress Response

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POVZETEK

Namen tega dela je bil opazovati stresni odziv, ki se pojavi takoj po motnji stabilnosti. Zanimalo nas je i) kako se stresni odziv spreminja s spremembo smeri posturalne motnje in ii) če pride do prilagoditve po več (devetih) zaporednih posturalnih motnjah. Za oceno stresnega odziva smo uporabili meritev elektrodermalne aktivnosti. Analiza je pokazala, da se splošno vzburjenje ni spremenilo s spremembo začetne smeri motenj. Ko pa se je smer posturalne motnje spremenila iz naprej v nazaj, so se udeleženci odzvali hitreje in močneje. Pri ponavljajočih se posturalnih motnjah se je splošno vzburjenje zmanjšalo, udeleženci pa so se po deveti zaporedni motnji odzvali hitreje in močneje. Nobena sprememba v tej pilotni študiji ni bila statistično pomembna. Znanje, pridobljeno s tem delom, prispeva k boljšemu razumevanju stresnega odziva človeka na posturalne motnje.

KLJUČNE BESEDE

Elektrodermalna aktivnost (EDA), posturalne perturbacije, posturalne motnje, stresni odziv, motnje stabilnosti

ABSTRACT

The purpose of this work was to observe the human psychophysiological stress response, which occurs right after a stability disturbance. We were interested in i) how the stress response changes with the change in direction of a postural perturbation and ii) if there is any adaptation after several (nine) consecutive postural perturbations. Electrodermal activity was used to assess the stress response. The analysis showed that the general arousal did not differ with the change in the initial direction of perturbation. However, when the direction of postural perturbation was changed from forward to backward, subjects reacted faster and more strongly. In recurrent postural perturbations, general arousal decreases, and subjects respond faster and stronger after the ninth consecutive perturbation. Since this was a pilot study and only four healthy volunteers participated, none of these results were statistically significant. The knowledge gained from this work contributes to a better understanding of human stress response to postural perturbations.

KEYWORDS

Electrodermal activity (EDA), postural perturbations, stress response

1 UVOD

Zmožnost ohranjanja stabilne, pokončne drže med soočanjem z motnjami ravnotežja je kritična komponenta vsakdanjega življenja. Motnje ravnotežja so lahko zunanje (npr. neravna podlaga, slaba osvetljenost okolice, obutev) ali notranje (npr. stanje ravnotežnega organa, posledice starostnih degenerativnih bolezni, utrujenost, posledice zdravil). Padci in poškodbe, povezane s padci, predstavljajo globalno skrb za javno zdravje naših starajočih se družb [1].

Za nadzorovanje stabilnosti in orientacije človeškega telesa skrbi posturalni nadzorni sistem. Posturalna orientacija je definirana kot sposobnost vzdrževanja primerne poravnave med deli telesa in poravnave telesa glede na okolje [2]. Posturalna stabilnost ali ravnotežje telesa je sposobnost nadzorovanja središča mase (ang. Centre of Mass – CoM) oz. projekcije CoM glede na podporno ploskev (ang. Base of Support – BoS) [2]. Podporna ploskev zajema območje pod predmetom ali osebo, ki vključuje vsako točko stika, ki jo predmet ali oseba naredi s podporno površino in vso površino vmes. Te točke stika so lahko deli telesa (npr. stopala ali roke) ali predmeti (npr. stol, na katerem oseba sedi) [3].

Center mase - CoM je definiran kot točka v središču celotne mase telesa [4]. Določimo ga kot uteženo povprečje centrov mas vseh segmentov telesa. CoM ni fizična spremenljivka, ampak virtualna točka v prostoru, ki je odvisna od položaja vseh delov telesa. CoM je ključna spremenljivka, ki jo nadzira posturalni nadzorni sistem [4].

Središče pritiska (ang. Centre of Pressure – CoP) je vsota vseh sil in navorov, ki jih povzroča telo na podporno površino [2]. Pri izgubi nadzora položaja telesa se projekcija CoM premakne iz mej podporne ploskve. Meje stabilnosti predstavljajo območje, znotraj katerega lahko telo ohrani stabilno lego brez dodatne spremembe BoS.

Predhodni dokazi kažejo, da se lahko po nestabilnosti pojavi simpatična modulacija, ki podpira hipotetično vključenost avtonomnega živčnega sistema (AŽS) v posturalno kontrolo [5, 6]. Simpatična modulacija oz. kompenzacijski posturalni odziv

je po motnji stabilnosti pomemben za ohranjanje ravnotežja in preprečevanje padca.

Avtonomni živčni sistem se deli na parasimpatično in simpatično živčevje. Fiziološke posledice aktivacije simpatičnega živčnega sistema so npr. pospešeno bitje srca, pospešeno in bolj globoko dihanje, razširjene zenice, povečan krvni tlak, upočasnjena presnova hrane, zakrčenost mišic ter povečana prevodnost kože [7]. Našteti pojavi so del stresnega odziva. Nacionalni institut za javno zdravje je stres definiral kot:

»… normalen odziv posameznika, kadar je začasno porušeno njegovo ravnovesje (telesno ali duševno) zaradi notranjih ali zunanjih vplivov (stresorjev). Stresorji so lahko pojavljajo v različnih oblikah. Lahko so manjši (npr. gneča na cesti) ali večji (npr. smrt v družini), zunanji (npr. kratek časovni rok za določeno delovno nalogo) ali notranji (npr. skrbi, črne misli), negativni (npr. prometna nesreča) ali pa celo pozitivni (npr. rojstvo otroka). Enak dogodek bo nekomu predstavljal stresor, drugemu pa spodbudo, odvisno od posameznikove osebnosti, izkušenj.« [8]

Kot stimulus, ki sproži stresni odziv opazovane osebe, lahko obravnavamo tudi posturalno motnjo, ki vpliva na premik osebe iz ravnotežja. V tej študiji nas je zanimalo, kakšni so psihofiziološki odzivi človeka ob nepričakovanih motnjah stabilnosti, da bi potrdili domnevno vključenost AŽS pri posturalnem nadzoru.

Oblikovali smo naslednji hipotezi: i) stresni odzivi se razlikujejo glede na začetno smer posturalne motnje (H1) in ii) stresni odziv se spremeni po več (devet) zaporednih motnjah enake amplitude in smeri (H2). Če bi hipotezi potrdili, bi pridobili še dodatne informacije o opazovani povezavi med stresom in posturalnim nadzorom. Ugotovili bi, kako sprememba smeri posturalne motnje in kako ponavljajoče posturalne motnje vplivajo na stresni odziv.

2 METODE

2.1 EKSPERIMENTALNI PROTOKOL

Štirje mladi odrasli (povprečna starost; standardni odklon (SD): 22,3 leta, SD = 2,4 leta), dva moška in dve ženski, so prostovoljno sodelovali pri eksperimentu. Vsi so bili zdravi, brez nevroloških in mišičnih posebnosti. Kandidati so bili seznanjeni s potekom meritev in podpisali so izjavo o prostovoljni in zavestni privolitvi po poučitvi.

Pred prihodom udeleženca sta bili izmerjeni temperatura in vlaga v prostoru (povprečna temperatura = 24,3 °C; STD: 0,5 °C, povprečna vlaga 42,2 %; SD = 1,9 %). Udeležence smo stehtali (povprečna teža = 65,6 kg; SD = 14,3 kg) in nanje namestili merilno napravo za merjenje elektrodermalne aktivnosti (EDA) Shimmer GSR Plus (Shimmer Sensing, Dublin, Ireland. Frekvenca vzorčenja: 504,3 Hz). Elektrodi za merjenje EDA sta bili nameščeni na proksimalni prstnici kazalca in sredinca njihove nedominantne roke. Za preprečevanje motenj v signalu elektrodermalne aktivnosti zaradi drgnjenja prstov smo jim uporabljena prsta (sredinec in kazalec) stabilizirali z lepilnim trakom. Med nameščanjem merilnih naprav so udeleženci odgovorili na nekaj vprašanj o svojem splošnem počutju, kar jim je omogočilo, da so se lahko privadili na laboratorijsko okolje in prisotnost vseh naprav. Udeležencem smo namestili še prilagojen

pas, ki omogoča priklop jeklenice. Jeklenica je bila del sistema za izvedbo posturalnih motenj z določeno silo, ki jo generirata dva električna servomotorja (Festo model EMMS-AS-100 z nazivnim navorom 5,69 Nm). V pasu je bil nameščen tudi aktivni optični marker, ki je bil del optičnega sistema Optotrak 3D Investigator (Northern Digital Incorporated, Kanada. Frekvenca vzorčenja: 1000 Hz), s katerim ocenjujemo položaj približka centra mase udeleženca.

Pred začetkom eksperimenta smo vsem udeležencem podali enotna navodila o njihovi nalogi, ki je bila, da v primeru posturalne motnje poizkusijo ohraniti svoj položaj na mestu, kjer stojijo. Merjenje se je začelo z dvominutno stojo na dveh pritiskovnih ploščah (Kistler Instrumente AG, Winterthur, Switzerland. Frekvenca vzorčenja: 1000 Hz) za zajem začetnega stanja. Prva motnja (prvi poteg jeklenice) je bila prožena ročno, ko smo sami ocenili, da je vrednost signala EDA, izrisana v realnem času, razmeroma konstantna (ni več sunkovito naraščala ali padala). Vsaka naslednja motnja je bila ročno prožena, ko se je udeleženec umiril (relativno gledano glede na začetno stanje vrednosti EDA). Motnje so bile izvedene v smeri naprej – nazaj. Vsi udeleženci so skupno prejeli deset motenj. Smer začetne sile je bila naključna, dva udeleženca sta začela z motnjami naprej in dva nazaj. Preostalih devet motenj je bilo izvedenih v nasprotno smer od tiste, s katero so udeleženci začeli.

Profil generirane sile električnih servomotorjev, prikazan na sliki Slika 1, smo časovno razdelili na tri dele v razmerju 3:2:1, kjer v prvem delu sila narašča, v drugem delu je konstantna in v tretjem pojema. Amplituda sile je določena z enačbo:

$$F = m * g * k = m * 9,81 \frac{m}{s^2} * 0,11, \tag{1}$$

kjer F predstavlja amplitudo sile v N, m je masa v kg, g je gravitacijski pospešek v m/s^2, k pa koeficient, ki predstavlja delež telesne mase preiskovanega udeleženca in je brez enote.
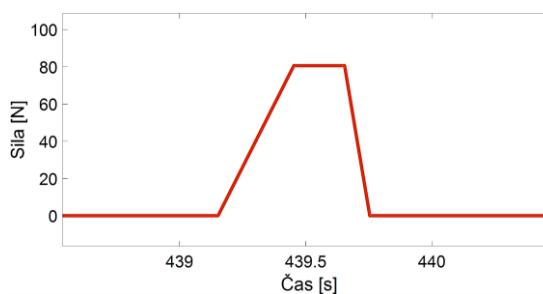
Slika 1: Profil uporabljene sile generirane na električnih servomotorjih.

Konstanta 0,11 izhaja iz ugotovitev študije [9], kjer so izvajali podobne posturalne motnje in uporabili koeficiente od 2,75 % do 22 % telesne mase. V rezultatih so predstavili, pri katerem koeficientu mora po povzročeni sili oseba narediti korak, da ohrani ravnotežje. Mejna vrednost, ko osebi še ni potrebno narediti koraka, je glede na njihove ugotovitve znašala 0,11 za motnje v smeri naprej. Za motnje v smeri nazaj smo sami preverili mejno vrednost po principu preizkušanja, ki pa se je izkazala za identično smeri naprej. Izbrani vrednosti koeficientov za smeri naprej in nazaj k(naprej) = 0,11, k(nazaj) = –0,11.
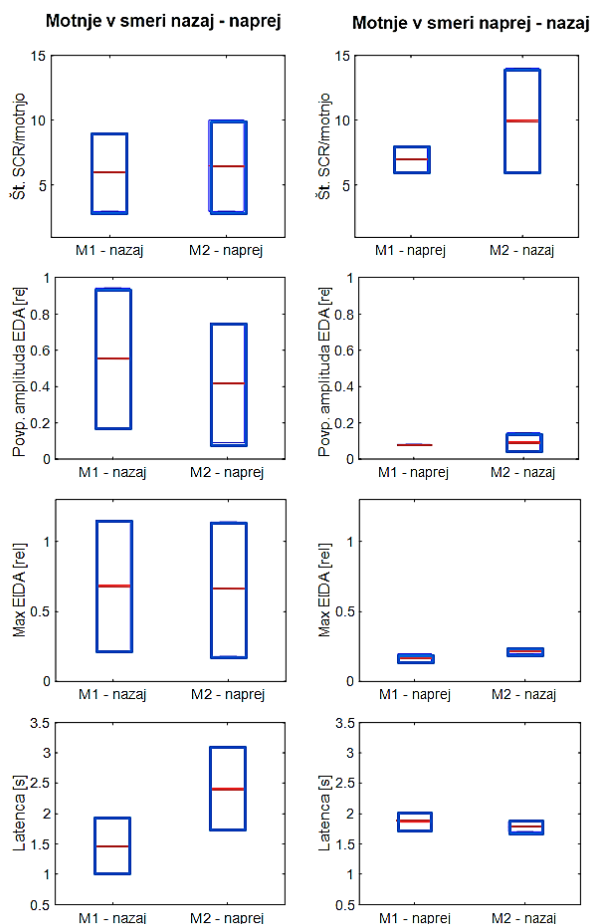
Slika 2: Rezultati analize EDA pri protokolu menjava smeri motnje.

Slika 3: Rezultati analize EDA pri protokolu ponavljajoče motnje.

2.2 OBDELAVA PODATKOV IN ANALIZA

Merilnik Shimmer GSR+ za merjenje EDA zajema upornost kože v kΩ, zato smo najprej naredili pretvorbo upornosti v prevodnost (v µS). To smo naredili zato, ker je prevodnost v µS standardna veličina za opazovanje stresnega odziva. Zaradi razlik v tonični komponenti, ki so posledica različnih medosebnih lastnosti, smo celoten signal EDA normirali na začetno vrednost. Vzorčna frekvenca, ki smo jo uporabili za zajem tega signala, je bila 1000 Hz, nato smo jo pred začetkom analize zmanjšali na 100 Hz. Sledi segmentacija glede na dovedene posturalne motnje. Segment je bil definiran kot območje od začetka motnje do začetka naslednje motnje.

Za nadaljnjo analizo smo uporabili program Acqknowledge 4.1 (Biopac Systems Inc., USA), ki nam omogoča takojšnji izris, raznovrstne transformacije in specifične analize različnih bioloških signalov. Najprej smo ločili signal na fazično in tonično komponento s funkcijo »Derive Phasic EDA from Tonic«, ki uporabi visokoprepustni filter z mejno frekvenco 0,05 Hz, da pridobi novo fazično komponento iz podanega začetnega toničnega signala [10]. Uporabili smo algoritem »Locate SCRs«, ki na podlagi pragovne vrednosti signala (v našem primeru 0,02 µS) v fazični komponenti poišče odzive prevodnosti kože (SCR), ki so definirani od trenutka, ko pulz EDA prekorači to pragovno vrednost v omejenem časovnem intervalu (npr. pulzi, ki se

pojavijo v manj kot 9 s od začetka naraščanja) pa do padca na vrednost nič. Nastavili smo tudi zavračanje vrhov, ki so manjši od 10 % največjega vrha. Parametri, ki smo jih pridobili za posamezno opazovano motnjo:

- Število SCR-jev na motnjo je mera trenutnega vzburjenja udeleženca in je število vrhov signala prevodnosti kože. Vrednost nekaj SCR/min nakazuje, da je udeleženec miren, vrednost nad približno 20 SCR/min pa nakazuje na stanje vzburjenosti [11].
- Latenca je časovno trajanje med začetkom dražljaja in začetkom prvega odziva SCR (v sekundah).
- Amplituda SCR je razlika med največjo vrednostjo, ki jo doseže posamezen vrh, in vrednostjo pred začetkom odziva oz. naraščanja signala EDA. Iščemo povprečno in največjo amplitudo.

3 REZULTATI

3.1 Vpliv spremembe smeri posturalne motnje na stresni odziv

Za preverjanje H1 smo prvo in drugo motnjo izvedli v različnih, nasprotujočih si smereh. Dva udeleženca sta začela z motnjo v smeri naprej, nato pa sta prejela vse preostale motnje v smeri nazaj. Preostala dva udeleženca sta naredila ravno obratno. Na

sliki Slika 2 so prikazani rezultati analize EDA pri protokolu menjava smeri motnje. Prva vrsta prikazuje število odzivov prevodnosti kože (SCR) [št. SCR/motnjo], druga vrsta prikazuje povprečno amplitudo odzivov prevodnosti kože (SCR) [μS], tretja vrsta prikazuje največjo amplitudo odzivov prevodnosti kože (SCR [μS]), četrta pa latenco [s] prvega odziva SCR. Vsi grafi prikazujejo vrednosti, ločene za prvo in drugo dovedeno motnjo. Parametri v prvem stolpcu so rezultati udeležencev, ki so prejeli prvo motnjo v smeri nazaj. Drugi stolpec vsebuje rezultate udeležencev, ki so prejeli prvo motnjo v smeri naprej.

Stopnja splošne psihofiziološke vzburjenosti se s spremembo smeri začetne motnje ni razlikovala. Kljub temu pa vidimo, da so se udeleženci ob spremembi naprej – nazaj pri drugi motnji hitreje in močneje odzvali, na kar nakazujeta zmanjšana latenca in večja vrednost stresnega odziva.

3.2 Vpliv ponavljajočih posturalnih motenj na stresni odziv

Na vsakega udeleženca je bilo v eni smeri (naprej ali nazaj) izvedenih devet zaporednih posturalnih motenj iste amplitude, za preverjanje H2. Ker je bila med prvo in drugo motnjo prisotna sprememba smeri, smo za analizo ponavljajočih se motenj iste smeri vzeli drugo in deseto izmed vseh motenj, ki predstavljata prvo in deveto motnjo v isto smer (naprej ali nazaj). Na sliki **Error! Reference source not found.** so prikazani rezultati analize EDA pri protokolu ponavljajoče motnje. Prva vrsta prikazuje število odzivov prevodnosti kože (SCR) [št. SCR/motnjo]. Druga vrsta prikazuje povprečno amplitudo odzivov prevodnosti kože (SCR) [μS]. Tretja vrsta prikazuje največjo amplitudo odzivov prevodnosti kože (SCR [μS]). Četrta vrsta prikazuje latenco [s] prvega odziva SCR. Vsi grafi prikazujejo vrednosti ločeno za prvo in drugo dovedeno motnjo. Parametri v prvem stolpcu so rezultati udeležencev, ki so prejeli ponavljajoče motnje v smeri naprej. Drugi stolpec vsebuje rezultate udeležencev, ki so prejeli ponavljajoče motnje v smeri nazaj.

Splošna vzburjenost se je po devetih zaporednih motnjah zmanjšala ne glede na smer perturbacije. Zmanjšanje splošne vzburjenosti je bilo manjše ob perturbacijah v smeri nazaj. Udeleženci so se hitreje in močneje odzvali na stimulus po deveti zaporedni motnji, na kar nakazujejo povišana povprečna in največja amplituda ter zmanjšana latenca.

4 RAZPRAVA

Rezultati prvega dela nakazujejo, da so bili udeleženci po drugi motnji bolj vzburjeni, če so najprej izkusili posturalno motnjo v smeri naprej in nato še v smeri nazaj. Sklepamo, da je vzburjenost narasla po motnji v smeri nazaj, zato ker udeleženci niso imeli vizualnega nadzora nad okolico v smeri premika. Vizualni nadzor (vid) zagotavlja dodatne informacije o dogajanju v okolici. Iz rezultatov drugega dela sklepamo, da se po deveti zaporedni posturalni motnji vidi adaptacijo udeležencev na to posturalno motnjo. Zaradi majhnega števila udeležencev v tem pilotskem eksperimentu so naši rezultati omejeni in niso bili statistično značilni. Nekateri parametri sicer nakazujejo razlike med spremembo smeri posturalne motnje in izvajanjem več zaporednih posturalnih motenj, vendar ne moremo nobene hipoteze potrditi ali ovreči. Z eksperimentom

smo nakazali smernice za nadaljnje raziskave. Za zanesljivejšo in bolj statistično značilno študijo bomo testirali več oseb. Eksperiment bi v prihodnje lahko razširili še z motnjami v smeri levo-desno in tako upoštevali, da se oseba v realnem okolju giblje v vseh smereh. Znanje o spremembah stresnega odziva med soočanjem s posturalnimi motnjami lahko prispeva k izboljšavi aplikacij meritev stresa v realnem okolju in odpira nove možnosti uporabe ter razumevanja človeškega telesa.

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Facial skin temperature during deception

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ABSTRACT

Measuring peripheral tissue temperature is a well-known methodology to assess different physiological states of a body. It is also widely used in a clinical environment. On the other hand, measuring facial skin temperature for the identification of the psychological state of a person is not so common. This article will provide information on non-contact measurements of facial temperature in comparison with established psychophysiological measuring systems (electro-dermal activity and heart rate) for 24 participants. The experiment consisted of two different states of cognitive loads which were expressed through the narration of a true and untrue story. During a narration, on selected regions of interest (ROI), subjects were monitored using a thermographic camera. Although the results did not show statistically significant differences between the true and untrue story for facial thermal measurement (in inter-person and intra-person comparison), some differences did appear. Results of this study showed, a critical approach using information on a camera's accuracy, human skin properties, and other technical concerns) is needed when using facial temperature measurements with a thermographic camera for a reliable evaluation of different psychological states or loads.

KEYWORDS

Psychophysiology, thermal imaging, facial temperature, deception

1 INTRODUCTION TO THERMAL IMAGING

Historically, body temperature measurement for monitoring illness was very important. In early examinations, physicians observed mud when applied to the skin, on areas over the tumor mud was drying faster. First clinical thermometer was developed by Carl Wunderlich in 1868 and its principle is still in use [1]. Thermal imaging camera was invented by Hungarian physicist Kalman Tihanyi in 1929 for anti-aircraft defense in Britain [2]. Firstly thermal imaging cameras were long been in use for specialized law enforcement and military applications and soon later by the fire services [3]. A major development of electronic sensors for infrared radiation was in the early 1940s with indium antimonide, and the first medical images were made in London in 1959 – 1961 by a technique called thermogram [1]. Articles with thermal imaging correlating of psychophysiology are not so common but some studies have proven that with thermal imaging one can detect deception or lie with great accuracy [4–8].

2 METHOD

Research is based on an experiment with various measurements of physiological parameters. As a baseline method for psychophysiological measurements, electrodermal activity measurements were used [9–12]. In the experiment volunteered 24 healthy participants, of those 15 men and 9 women aged from 20 to 45 years old $23,9 \pm 5,0$. After reviewing the measured parameters, we included data from 9 persons in further analyzes, because, due to incomplete data or inadequately measured parameters. Monitoring parameters were: electrodermal activity, skin temperature, and heart rate. Psychological evaluations were done through interviews and standardized STAI-X1 agitation questionnaires.

2.1 ELECTRODERMAL ACTIVITY

Electrodermal activity (EDA) is a dermal property that is caused by different responses in electrical characteristics of the skin [13]. EDA has two components, the skin conductance level (SCL) and skin conductance response (SCR). SCL value describes the level of person psychological excitement, and SCR is the number of responses to the stimulus. The peak amplitude is typically reached within 1 to 3 s after the onset of the response [14]. EDA was measured with Biopac MP150 system (BIOPAC Systems, Inc., USA) and unit Biopac GSR 100C connected to silver electrodes on index and ring finger pads of nondominant hand as shown in figure 1. EDA data was processed by BIOPAC AcqKnowledge 5.0 software.

Figure 1: Illustrated human hand with corresponding signals measured on finger pads. Electrodermal activity on the index and ring finger, heart rate on the middle finger, and skin temperature on the little finger

2.2 SKIN TEMPERATURE

Skin temperature depends on the blood flow to the subcutaneous tissue. It may also depend on external factors such as exercise, ambient temperature, or medical condition. The temperature was measured on a little finger pad of the non-dominant hand (Figure 1). Contact temperature measurements were done with Biopac SKT 100C connected to the thermocouple. Contactless skin temperature measurements were done with a black-body calibrated Flir 650sc camera (FLIR Systems, USA). Camera uses a microbolometer type of detector with a resolution of 640 x 480 pixels. The camera was positioned 1 meter in front of the participant. Emissivity was set to 0.98 [15]. We have analyzed three main regions on the face. Size of regions of interest (ROI) were 2512 pixels for the forehead, 445 pixels for the nose, and 710 pixels for cheeks as seen in figure 2. Sampling frequency was set to 15 frames per second. Temperature was recorded as mean value with standard deviation for each ROI last 100 frames of each story and analyzed with FLIR ResearchIR Max software.
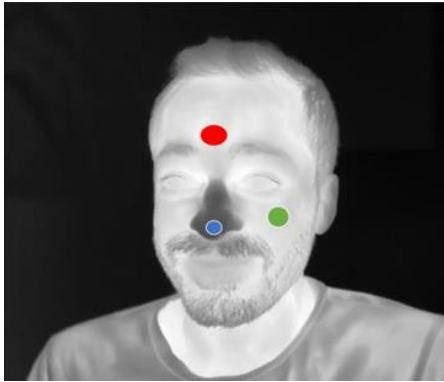
Figure 2: Capture from video taken with Flir 650sc, marked with positions of ROIs (red - forehead, blue - nose, green – cheeks)

2.3 HEART RATE

The heart cycle is the action of the human heart from one heartbeat to another. The cardiac cycle consists of two periods of time when the heart muscle relaxes and fills with blood (diastole) and the time of intense contraction and pumping of blood (systole). Heart rate is stable in a healthy adult at a rate of between 60 and 100 beats per minute. Heart rate was measured with Biopac module PPG 100C and an optical sensor placed on the middle finger pad of the nondominant hand (Figure 1). Heart rate and heart rate variability were processed with BIOPAC AcqKnowledge 5.0 software.

2.4 EXPERIMENTAL SETUP

Prior measurements, the experimenter records the temperature of the room, prepares a statement, psychological questionnaires, and calibrates the electrodes to measure the electrodermal activity of the skin. Participant is invited to the room and is asked to turn off cellphone and any other potentially disturbing factors. Experiment begins with an introduction interview, sensors placement on the participants hand (Figure 1), and STAI-X1 agitation questionnaire followed by the experimenter's general

neutral questions designed to relax participant. During this period participant also acclimatizes to room temperature. Participant is asked to tell two stories, one true and the other untrue. The stories should last for a maximum of 2 minutes each and should relate to the events of participants previous day. The participants choose the order of true and untrue stories by themselves. Before storytelling, a thermographic camera is set to recording. The recording was started remotely via a computer, eliminating the disturbance of the experimenter. After storytelling was completed, participants revealed which story was true and which not, at the same time, experimenter stopped all measurements. At the end of the experiment, participants resolved the STAI-X1 agitation questionnaire.
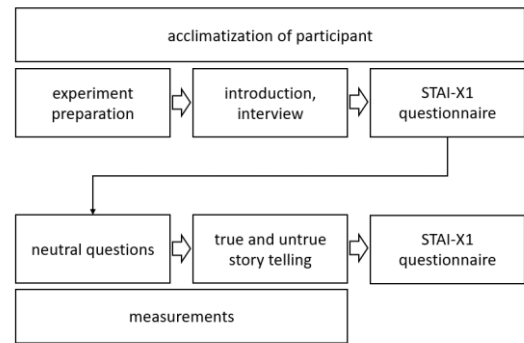
Figure 3: Block diagram of experiment flow

3 RESULTS

Measurements for forehead and nose were calculated with statistical Wilcoxon signed-rank test. Results showed that forehead temperature between untrue story (Mdn = 35.13) and true story (Mdn = 35.17) does not show statistically significant differences, $Z = –0.451$; $p < 0.652$; $r = 0.101$. Also, temperature of a nose between untrue (Mdn = 28.54) and true (Mdn =28.53) did not show statistically significant differences $Z = –0.568$; $p < 0.570$, $r = 0.127$. For temperature of the cheeks we used two-tailed test for the dependent samples which showed us there is no statistical difference between the untrue story M = 34.04; SD = 1.77) and true story (M = 34.07; SD = 1.60) $t(8) = –0.214$; $p = 0.836$.

For the EDA, two-tailed paired t-test did not show statistical difference between untrue story (M = 6.22; SD = 3.03) and true story (M = 5.78; SD = 2.59) $t(8) = 0.627$; $p < 0.548$.

For the finger temperature calculated with statistical Wilcoxon signed-rank test we did not find statistical difference between untrue story (Mdn = 24.49) and true (Mdn = 24.88) story, $Z = –1.035$, $p < 0.301$, $r = 0.231$. Also, we did not find statistical difference for heart rate between untrue story (Mdn = 95.66) and true (Mdn = 93.12) story, $Z= –0.339$; $p < 0.734$; $r = 0.0759$.

4 DISCUSSION

The major limitations of this study are: i) complexity of the psychological phenomena under observation (lying is difficult to induce), ii) moving artefacts due to the physical movement of the

face, iii) small number of participants, errors in measurements (EDA electrodes, calibration interval of IR camera).

Measurements were performed with different techniques to prove different psycho-physiological responses between true and untrue storytelling. The sample of 24 participants decreased to a total of 9 participants due to incomplete data or inadequately measured parameters. For thermal camera measurements, we excluded data of persons wearing glasses. Glass is not transparent for IR waves, and the method for measuring minimum temperature of a nose compromised the measurements. Also, there was a lot of face movement present in IR video and this made it difficult to determine temperature of an ROI. In some cases, camera performed calibration and focus corrections when recording in this case we excluded measurements for those participants. For EDA measurements we excluded participants with poor contact with silver electrodes. Although none of the tested parameters showed significant statistical differences, there are some differences between untrue and true storytelling. The temperature of the forehead ROI was 2,0 % lower, temperature of a cheek 0,1 % lower, and a nose 1,7 % higher, respectively there are more SCRs in EDA data and the finger temperature is lower when telling an untrue story.

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Cognitive, Psychological and Social Influence on Spread of COVID-19

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ABSTRACT

We investigated and confirmed the hypothesis that cognitive, psychological and social features of citizens in each country influence the spread of COVID-19 more than any other semantic feature group. Additionally, we investigated five sub-hypotheses in regards to socio-psychological traits of people and the spread of COVID-19, confirming two and rejecting three. Finally, we attempted to obtain deeper understanding of our results by finding which individual features within the social psychology group are most important.

KEYWORDS

psychology, sociology, covid-19, machine learning, feature analysis

1 INTRODUCTION

Since the spring of 2020, Coronavirus disease 2019 (COVID-19) has increasingly influenced our daily lives. The first wave of infections started to manifest globally around March, and different countries reacted differently and with different amounts of success in order to stop the early exponential growth. Countries differ from one another in many aspects, such as weather, demographics, development, economic strength, etc. Another important but often overlooked difference between countries is in the cognitive, psychological and social features of their citizens. We argue that these are some of the most important factors that might influence the spread of COVID-19, as they in turn influence how much people spend time with each other, how often they attend social and cultural events, etc. Thus, we focused on analysing these features in terms of their influence on spread of COVID-19 and their importance compared to other groups of features. Additionally, we investigated the importance of individual features that comprise the category of cultural features in an attempt to investigate if there is a single defining trait that dominates others.

The rest of this paper is structured as follows: we first investigate the related work in Section 2, then we list hypotheses in

section 3 and describe the data in Section 4. We continue with the methodology and experimental setup in Section 5, and conclude with results and discussion in Section 6.

2 RELATED WORK

We focused on COVID-19 related work that deals with some properties of different world regions (typically countries) and compares them to a target variable related to the spread of COVID-19 in that region – with the goal of establishing the relationship between the two.

Many authors defined the spread of the disease in different ways. Most commonly researchers simply used the number of daily infections as the metric, which has the weakness of being biased towards countries with higher population, but can be normalized per capita [1]. Some other options are also possible, such as computing the reproductive rate of the virus, as proposed by Gupta et al. [6].

The country properties used to investigate the influence on virus spread were also varied. Most commonly, weather attributes were investigated [6], as well as indicators of development [1] and demographics [8].

In terms of machine learning (ML) methods, classical regression (e.g., linear regression) was used predominantly [6], while others used traditional statistical approaches [8], testing for statistically significant correlation between features and target variables.

Despite the large amount of research conducted in regards to COVID-19, the aspect of cognitive, psychological and social influence on the potential spread of COVID-19 has been poorly researched thus far, to the best of our knowledge. We aim to investigate and highlight the importance of the aforementioned influences and hopefully motivate more researchers to consider this important area.

3 RESEARCH HYPOTHESES

Unlike the various different influences on COVID-19 spread that related works focused on, the aim of this study was to concentrate on human behavior in terms of their social psychology, or interaction between their cognitive and psychological features and their social behavior. Generally, we believe that these significantly affect COVID-19 spread and should therefore be investigated to further understand not only this particular pandemic, but the influence of human behavior on pandemic in general.

Our primary research hypothesis is that human behavior statistically significantly affects COVID-19 spread. Furthermore, we have five secondary hypotheses:

(1) People with higher tendencies for social activities (higher extraversion) correlate with higher COVID-19 spread.
(2) People with higher tendencies for social compliance (higher agreeableness) correlate with lower COVID-19 spread.
(3) People with higher tendencies for being careful (higher conscientiousness) correlate with lower COVID-19 spread.
(4) People with higher tendencies for group consideration (lower individualism) correlate with lower COVID-19 spread.
(5) People with higher tendencies for desire gratification (higher indulgence) correlate with higher COVID-19 spread.

To investigate our research hypotheses, we turned to data repositories with psychological, cognitive and social features across countries. Since our final dataset will contain other features as well, those will be also investigated. The next section describes this data.

4 DATA

As our aim was to use ML algorithms to investigate the potential relationship between cognitive, psychological and social features of citizens and the spread of COVID-19 on per-country basis, we had to obtain and structure suitable data. The cognitive, psychological and social features were used as input features and were obtained for as many countries as possible. The spread of the virus itself was modelled using several binary classes, which were the targets of our classification.

4.1 Features on social psychology

To research our hypotheses, we did a limited literature review to find data spread between features that describe individual behavior and features that describes group behavior of societies as a whole. We selected three frameworks with which to work in this research. To account for individual behavior, the Big Five personality traits model [5] was selected, along with a feature on preferred interpersonal distances [11]. To account for group behavior, Hofstede's cultural dimensions theory [7] was selected.

The Big five personality traits model (B5) identifies five orthogonal dimensions which supposedly reflect an individual's personality and psyche. B5 is measured with a questionnaire. Extensive research has found significant statistical connections with a number of human behaviors (decision-making, crime, voting, health behavior, educational outcomes, etc.) [2]. B5 includes the following dimensions:

(1) Openness: describes how inventive or curious someone is.
(2) Conscientiousness: describes how careful, efficient or organized someone is.
(3) Extraversion: describes how outgoing or energetic someone is.
(4) Agreeableness: describes how friendly or compassionate someone is.
(5) Neuroticism: describes how sensitive or nervous someone is.

Data on preferred interpersonal distances comes from human spatial behavior research [11] and describes how comfortable people are in regards to different distance boundaries when in contact with other people.

Hofstede's cultural dimensions theory (HCDT) identifies six orthogonal dimensions that describe a country's values that drive their group behavior. They have been found to correlate with a number of social phenomena (security, progress, environmental outcomes, etc.) [7]. HCDT includes the following dimensions (we did not include *Power distance* as it did not relate to our goal of finding data that describes phenomena that lie between individual and group behavior):

(1) Individualism-collectivism: describes how citizens of a country prefer and care for their in-group.
(2) Uncertainty avoidance: describes how averse citizens of a country are to uncertainty.
(3) Long-term orientation: describes how traditional citizens of a country are in terms of solving society's questions and their proclivity for change and adaptation (higher score means more long-term thinking, more adaptation and change).
(4) Indulgence: describes the degree to which citizens of a country seek desire fulfilling behavior.
(5) Task- vs. person-orientation: describes preference of citizens of a country towards tasks versus towards people.

Data on B5 questionnaire answers, which was collected from Open-Source Psychometrics Project's public database [9] (under "Answers to the IPIP Big Five Factor Markers"), had to be additionally pre-processed for this research. We processed the answers to the questionnaire to get individual personality profiles with the five dimensions for every person. Then we filtered the data by only keeping the countries where we had 100 individuals answering the questionnaire. Afterwards, we averaged the scores by countries to get group personality profile, each country having five dimensions.

Finally, we also considered data on levels of a nations' strength of social norms – referred to as (cultural) tightness-looseness. We used the tightness measure from Gelfand and colleagues [3]. The measure captures the strength of norms in a nation and the tolerance for people who violate norms. The final dataset we constructed contains 59 countries (meaning 59 instances) with 11 features.

The dataset can now be related to the hypotheses: 1) for secondary hypothesis 1, extraversion will be used for correlation; 2) for secondary hypothesis 2, agreeableness will be used for correlation; 3) for secondary hypothesis 3, conscientiousness will be used for correlation; 4) for secondary hypothesis 4, individualism-collectivism will be used for correlation; 5) for secondary hypothesis 5, indulgence will be used for correlation.

4.2 Virus spread classes

We chose three distinct binary classes, each having two possible values: a country is considered positive if its infection rate, given the chosen metric, is faster than half the countries analyzed. The class value was always computed in country-specific time frame, starting when the testing was adequate in a country according to the recommendation given by the World Health Organization (WHO), and ending when at least 3 countermeasures of sufficient intensity were applied. This intensity was marked with an integer in the range from 0 to 4 in the Oxford Covid-19 Government Response Tracker [12], and we took value 2 as the threshold.

4.2.1 Daily number of infections (daily average). The first calculated metric was the daily number of infections, averaged over the appropriate time interval and normalized based on the country population. This metric is the most intuitive and commonly reported.

4.2.2 Reproductive rate. The reproductive rate R_0 is a metric commonly used by virologists to determine the severity of an infection. Simply put, it estimates how many new infected are generated by each currently infected.

To estimate the reproductive rate we used the SIR model [10]. For details on the computation of the values, we refer the reader to the original paper.

4.2.3 Exponential shape. The last metric we calculated was the shape of the infection time series. An exponential shape indicates that the number of infections is raising fast, and is likely to continue. To determine if the growth is exponential, we fitted both a linear and an exponential curve to the data. After both were fitted, the one with the lower error was chosen as the better fit. If the exponential fit was better, the class value for this metric was positive.

Once the class was determined, we could split the countries into infected, non-infected and those for which we do not have enough data, based on each of the three classes. An intuitive display of the split is shown in Figure 1, where countries are colored based on the number of positive virus spread classes.
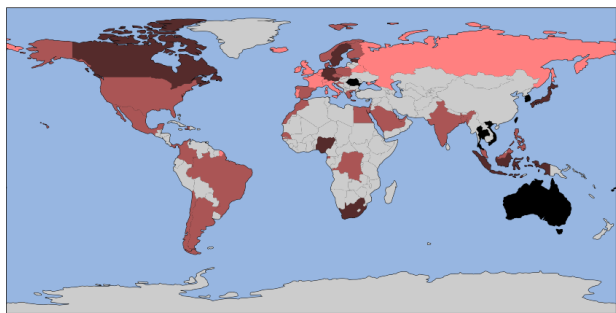
Figure 1: All countries, colored based on how many infection classes are positive. If all of them are positive, the color is light red, and conversely gets darker for every negative one. Countries without sufficient data are gray. Note that the data is from spring 2020, showing only the early spread.

5 METHODOLOGY

We first focused on testing our hypothesis of social psychology feature group being among the most important in the spread of COVID-19 compared to other feature groups describing a country. After confirming our initial hypothesis, we then investigated importance of individual features within this group.

5.1 Feature group importance

We obtained over 100 different country-describing features in order to compare them against the social psychology group, and to investigate our primary hypothesis, which was that the social psychology group is highly important. To do this, we first grouped all other individual features into the following semantic groups: weather, travel, health, economy, development, geography, countermeasures. We then evaluated the importance of each feature group using a Random Forest (RF) classifier. The model was trained using all the features and individual feature importances were obtained out of the box via the *feature_importance* property of the model, which is available in the scikit-learn implementation. In summary, this metric trains an RF classifier consisting of a number of different trees. When training a tree,

it computes how much each feature decreases the weighted impurity in this tree. This impurity decrease is then summed up over all the trees in the forest to form the feature importance. We then summed feature importances within each previously defined group to compare the aggregate importance of groups. This was done for each of the three virus spread classes.

5.2 Individual feature importance

Once we estimated feature groups importance, we turned our focus to analysis of individual features within social psychology group. We investigated whether an individual or small set of features dominate a group in regards to importance, or is the importance rather evenly spread. We did this for each of the three classes using three different methods. Additionally, this gives us information about specific best features within the group, which allows for potential expert interpretation.

(1) **RF feature importances**: First, we again used the out-of-the-box feature importances of RF to compare the importance of individual features.

(2) **Statistical testing**: Second, we used statistical tests depending on the type of feature (continuous, categorical, binary, normally distributed, non-normally distributed). The feature values of countries positive with respect to a class were compared to those negative with respect to a class. We used the T-test, Mann-Whitney U-test and Fisher-exact test, respectively, for continuous normal features, continuous non-normal features, and binary features.

(3) **Wrapper method**: Third, we developed a custom feature selection wrapper method similar to the one used in our related work [4], which did the following: the features were first sorted using RF feature importance (as before). Then, if two features were correlated (Pearson coefficient > 0.7) we discarded the lower ranking one. We started by using only the best feature for the classification. Then, we iteratively added the next best one, but only kept it if it did not decrease the classification accuracy by more than two percentage points. This method improves upon the first one by considering internal correlations between features.

The five secondary hypotheses were investigated using correlation analysis, by computing the correlation between the values of the selected individual feature relevant for the hypothesis, and the daily average class. We did this to get a deeper understanding and potentially new knowledge of exactly which features influence acceptance or rejection of our hypotheses.

6 EXPERIMENTS AND RESULTS

Aggregate RF feature importances for each group and each class are given in Table 1. Looking at the average importance, we see that the social psychology group of features proved the most important, alongside development, confirming our initial hypothesis.

The importances of top 5 individual features within the social psychology group for all three classes is given in Table 2. The importances were evaluated using the three different feature importance methods described previously.

Finally, the evaluation of our initial secondary hypotheses using correlation analysis is given in Table 3.

7 CONCLUSION

We investigated the cognitive, psychological and social influence on spread of COVID-19. Comparing against other semantic

Table 1: Aggregate feature ranking using RF feature score. Values are normalized (sum to 1).

	Repr. rate	Exp.	Daily avg.	Average
Weather	0.09	0.08	0.09	0.09
Social psychology	0.18	0.21	0.14	**0.18**
Travel	0.12	0.08	0.18	0.13
Economy	0.15	0.13	0.09	0.12
Development	0.16	0.18	0.12	0.18
Geography	0.12	0.06	0.11	0.10
Health	0.11	0.19	0.11	0.14
Countermeasures	0.04	0.02	0.06	0.04

Table 2: Individual feature ranking using RF feature score, statistical testing and wrapper method. Top 5 features and corresponding scores are shown.

RF feature importance (higher is better)		
Repr. rate	*Exp.*	*Daily avg.*
Tightness (0.071)	EST_perc (0.053)	AGR_perc (0.032)
EST_perc (0.014)	Masculinity (0.017)	Individual. (0.024)
OPN_perc (0.013)	Individual. (0.015)	OPN_perc (0.014)
Future ori. (0.013)	CSN_perc (0.015)	Future ori. (0.012)
Masculinity (0.07)	Tightness (0.014)	Masculinity (0.011)
Statistical significance (lower is better)		
Tightness (0.010)	EST_perc (0.076)	Individual. (0.030)
Future ori. (0.064)	Tightness (0.148)	AGR_perc (0.045)
OPN_perc (0.171)	CSN_perc (0.148)	Indulgence (0.112)
EXT_perc (0.259)	Uncert. avoid. (0.2)	OPN_perc (0.134)
AGR_perc (0.259)	Masculinity (0.241)	EXT_perc (0.147)
Wrapper method (higher is better)		
Tightness (0.071)	EST_perc (0.053)	AGR_perc (0.032)
CSN_perc (0.005)	Masculinity (0.017)	Individual. (0.024)
/	Individual. (0.015)	OPN_perc (0.014)
/	CSN_perc (0.015)	Future ori. (0.012)
/	Tightness (0.014)	CSN_perc (0.005)

Table 3: Correlation analysis of our secondary hypotheses in respect to the daily average virus spread class.

Hypothesis	Correlation	Accept/Reject
Higher extraversion correlates with higher virus spread	0.33	ACCEPT
Higher agreeableness correlates with lower virus spread	0.40	REJECT
Higher conscientiousness correlates with lower virus spread	0.04	REJECT
Higher individualism correlates with higher virus spread	0.46	ACCEPT
Higher indulgence correlates with higher virus spread	0.09	REJECT

groups of features describing countries, we showed that the social psychology group has the highest feature importance alongside development. Additionally, we found that there is no single dominant feature in our set of 11 in the social psychology group, but instead the importance is spread among several. We also used correlation analysis to confirm two out of our five hypotheses,

showing high correlation between extroversion and individualism and higher virus spread. This shows that the cognitive, psychological and social features are among the most important in relation to spread of COVID-19 and should be investigated more thoroughly.

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Od orodja do umetnika

From Tool to Artist

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POVZETEK

V prispevku se ukvarjam z odnosom med umetnostjo in umetno inteligenco (v nadaljevanju tudi UI). Podrobneje se ukvarjam z odnosom med orodjem pri umetniškem ustvarjanju in samim ustvarjalcem. To me pripelje do vprašanja avtorstva ter primerjavo med umetniškim ustvarjanjem kot obrtjo ali kot produktom umetniškega genija (tudi Genij)1.

KLJUČNE BESEDE

umetnost, umetna inteligenca, avtorstvo, ustvarjanje, orodje

ABSTRACT

In this paper, I deal with the relationship between art and artificial intelligence (hereinafter also AI). I deal in more detail with the relationship between the tool in artistic creation and the creator himself. This brings me to the question of authorship and a comparison between artistic creation as a craft or as a product of artistic genius.

KEYWORDS

art, artificial intelligence, authorship, creation, tool

1 Umetna inteligenca na področju umetnosti

Sprva želim orisati zgodovinski preplet med umetniškim ustvarjanjem in razvojem umetne inteligence ter opozoriti na ključne mejnike na tem polju.

V osnovi umetniška dela temeljijo na fikcionalnosti in možnosti ustvarjanja dogodka, sveta, ki nastane pod točno določenimi, zapisanimi pogoji, kar definira literarna teorija. Da ne gre za željo po napovedovanju prihodnosti ali izdelovanju čim bolj natančnih modelov prihodnosti, ampak bolj za umetniško obdelavo informacij o družbi in svetu ter z domišljijo kreiranje najrazličnejših svetov. Zato tudi ne preseneča uporaba oz. povezovanje umetne inteligence z razvojem tehnologije in umetnosti, čeudi se na prvo roko zdi umetnost zelo konvencionalna. Takšno prepričanje je morda nekoliko naivno, saj je že samo risanje na stene, ohranjanje snovne kulturne dediščine zahtevalo uporabo *novih tehnologij*, zato morda ni odveč razmišljanje s perspektive, da kot civilizacija nismo na povsem novem prelomu.

Na spletni strani združenja UI-umetnikov je kot začetnik na časovnici UI umetnikov naveden Thomas Bayes, ki je "z uporabo matematike razvil okvir za sklepanje o verjetnosti dogodkov, upoštevajoč pogoje ali druge dogodke, ki lahko na dogodek vplivajo. Zahvaljujoč njegovemu delu je Bayesov sklep vplival na pristope pri strojnem učenju in predstavlja enega najzgodnejših mejnikov na časovni premici umetne inteligence.(op. prev. p.) [4]" Njegova spoznanja so nato v 50. letih prejšnjega stoletja nadgradili in so vplivala tudi na razvoj računalništva – v tem času, in sicer leta 1950, pa je tudi pomemben avtor Isaac Asimov izdal zbirko kratkih zgodb *I robot*, v kateri se poigrava z možnimi scenariji inteligentnih strojev v prihodnosti.

V zadnjem času beležimo še nekaj pomembnih mejnikov, in sicer so leta 2018 na dražbi prodali sliko UI, ki se je učila od številnih umetnikov, za 432.500 $. AIVA velja za prvega virtualnega umetnika, čigar dela so registrirana kot avtorska (z avtorskimi pravicami) pri SACEM (Société des auteurs, compositeurs et éditeurs de musique – Združenje glasbenih avtorjev, umetnikov in založnikov). Dokončanje *10. simfonije* Ludwiga van Beethovna s pomočjo UI pa pričakujemo v letu 2020.

2 Umetna inteligenca – orodje ali umetnik
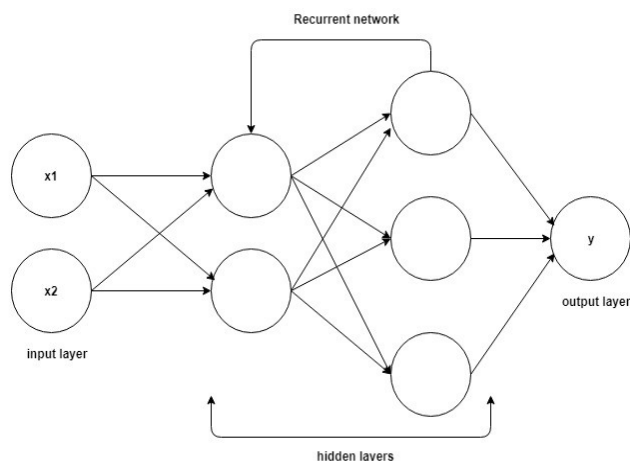
Slika 1: Shematični prikaz rekurzivne nevronske mreže, na kateri temelji delovanje UI. [16]

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1 Pri tem je genij razumljen po konceptu Denisa Diderota, ki ga je oblikoval v 18. stoletju. [11]

Za začetek se mi zdi za razumevanja samega koncepta binarne opozicije med umetnikom in orodjem potrebno izpostaviti temelje tega odnosa, ki nas lahko v nadaljevanju pripelje do natančnejše opredelitve razmerja med njima. V osnovi je pomembno, da umetniki vedo, s čim delajo in kaj so prednosti in slabosti tega. Nevronske mreže so danes najbolj napredni strojni "možgani" in osnova delovanja v razvijanju umetne inteligence, saj "imajo sposobnost razločevanja in izločevanja informacij iz kompliciranih in nejasnih vzorcev" [18]. Katarina Mramor opozarja tudi na njihove kritične točke – učni primeri, ki morajo biti zelo pozorno izbrani, saj je od njih odvisno, kaj bo končen rezultat nevronske mreže. Učne primere izbirajo ljudje, zato je treba biti pazljiv, da nenamerno ne vnesemo preveč črno belih primerov, ki bi temeljili na kupu subjektivnih predpostavk, ki se jih mogoče niti ne zavedamo in lahko vsebujejo problematične etične odločitve; česar se potem nauči tudi nevronska mreža in jih nadalje širi brez problematiziranja, dokler se v praksi (npr. pravu, varnosti …) odločitve ne izkažejo za problematične ali vsaj vprašljive.

Tudi združenje umetnikov UI se ukvarja s problematičnimi točkami v interakciji med umetno inteligenco ter človekom. Pri tem združenje nagovarja neodgovorjena vprašanja, kjer vidi izzive na področju definiranja vrednot (kaj so človeške in kaj so nečloveške), obdelavi oz. naboru podatkov, ki jih damo učiti nevronskim mrežam, varnosti osebnih podatkov ter samem delovanju nevronskih mrež. [5]

Nekateri znanstveniki na naštete izzive odgovarjajo zelo proaktivno in programirajo "okvirje" oz. načela, ki naj bi poskrbela za "samoodgovorno vedênje" UI. Primer slednjega je raziskovalni center "The Institute for Ethical AI & Machine Learning", ki je formalno stacioniran v Veliki Britaniji, vendar ga sestavljajo raziskovalci, prostovoljci različnih strok (inženirji strojnega učenja, podatkovni znanstveniki, pisci pravilnikov in profesorji skupine STEM[2], humanisti in družboslovci). Njihova vizija je: "Minimizirati tveganja **UI** in omogočiti njeno polno delovanje znotraj okvirjev, ki zagotavljajo **etični** in **zavedni** razvoj projektov, povezanih z UI na vseh področjih delovanja, v vseh industrijskih panogah" (The Institute for Ethical AI & Machine Learning).

2.1 Vprašanje zavesti in svobodne volje – kako preseči *orodje*

Kljub izjemnemu tehnološkemu napredku še vedno ostaja odprto vprašanje, ki si ga znotraj kognitivne znanosti zastavljajo znanstveniki, programerji, filozofi …, če bomo lahko kadar koli umetno inteligenco razumeli povsem samostojno, neodvisno, samozavedno. Torej, če bomo vedno lahko govorili le o vse bolj dodelanih, izboljšanih in uporabnih orodij (človeka) ali dejansko o nečemu/nekomu, ki je zmožen tega "samoustvarjanja", ustvarjanja iz sebe v ideji bolj kot v izvedbi, saj takoj, ko preidemo na zmožnost nečesa izvesti, že govorimo o (bolj ali manj samostojnem) orodju. Kot najbolj znan primer poskusa odgovora na to vprašanje je Turingov test, kjer naj bi se stroj obnašal tako "človeško", da bi pretental samega človeka.

Na področju filozofije tako pridemo do problema (upravičenja) zavesti. Odgovor na to je v pričujočem prispevku

pomemben z vidika, da nam dejstvo, da *nekaj* lahko okličemo za zavestno entiteto, takoj preseže pojmovanje *tega* kot samega orodja. Z drugimi besedami, če lahko UI v katerem koli smislu jemljemo za kaj več kot le orodje, predhodi vprašanju, če lahko UI okličemo za umetnika, za nekoga (nekaj), ki ustvarja iz lastnega navdiha oz. predvsem lastne želje po ustvarjanju. Pri tem tudi ni zanemarljivo vprašanje, ki si ga je zastavil Hartman, profesor angleškega jezika in kreativnega pisanja na Connecticut College New London, in sicer: "*čemu* in *komu* bi bil tak program [ki bi generiral poezijo samostojno (iz nič)] sploh potreben" [15].

V združenju UI-umetnikov na vprašanje, če so lahko stroji kreativni, odgovarja umetnik Ahmed Elgammal, ki se ukvarja s točno tem področjem. Ahmed Elgammal izhaja iz ideje, da strojev ne moremo imenovati za inteligentne, dokler ti ne bodo razumeli in ustvarjali tudi "kulture" (vizualno, zvočno umetnost, literaturo in šale).

Izhodišče za stroje se loči od človeka po tem, ker lahko UI prečeše čisto vse, kar je kadar koli nastalo, v nasprotju s človekom lahko pozna čisto vsa dela ter ve informacije o nastanku, kritike in razlage, ki so ob tem nastale. Vendar se Elgammal zaveda, da ta baza in potem posnemanje še ne pomeni ustvarjanje nečesa novega, kar želi doseči s svojimi projekti. Nadalje pa na vprašanje, kako želi to doseči ponudi odgovor, ki pravzaprav ponovno vodi k razvoju orodij. UI predstavi predvsem kot partnerja (z moje perspektive še vedno orodje), ki bo umetniku (človeku) odkrivalo nove umetniške poti in ideje. To utemelji s primerom fotoaparata, ki je pomenil zelo pomembno revolucijo sprva v vizualni umetnosti, kasneje pa veliko širše – zvok, film, fotografija … Tako naj bi tudi tehnološki razvoj v prihodnje nudil revolucije v umetnosti, vendar če natančno beremo, še vedno govorimo o pripomočkih, ki jih upravlja in si jih želi, razvije, potrebuje človek. [1]

Ob tem, ko smo s pomočjo namere in želje po umetniškem ustvarjanju skušali pokazati, da je za to potrebna zavest; se pri tem kot še bolj problematično pokaže pomembno filozofsko vprašanje svobodne volje. Na tem mestu moj cilj ni raziskovati širine tega vprašanja, ampak na podlagi petih Hodgsonovih trditev ugotoviti, v kolikšni meri te veljajo za sodobno umetno inteligenco.

"Kaj torej pomeni 'govorjenje o svobodni volji'? Kakšne so zdravorazumske intuicije o svobodni volji? Intuicije človeka, ki ni filozof ali kognitivni znanstvenik, in ni pristranski. Hodgson (2005) meni, da bi taka oseba podala naslednji fenomenološki opis, kako je biti svoboden, zavesten akter (Hodgson, 2005, p. 3):
- Zavedamo se izbiranja odločitev.
- Imamo občutek, da smo mi začetniki naših dejanj.
- Včasih tehtamo alternative, včasih sledimo navadam.
- Zavedamo se posledic dejanj, ki smo jih storili.
- Imamo se odgovorne za svoja dejanja" [17].

Na podlagi zapisanega ne moremo najnovejšim nevronskim mrežam pripisati niti ene od petih trditev zares, saj se nevronska mreža še vedno niti ne zaveda, ampak skuša čim bolj učinkovito

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izvršiti ukaz, opraviti nalogo. Po drugi strani, pa bi zelo težko sploh v umetnosti lahko rekli, da ne gre pri ustvarjanju za svobodno voljo umetnika.

3 Kje se konča programiranje in začne umetnost?

Če se na tem mestu ne ukvarjamo s tem, kako čustva vplivajo na odločanje, ne moremo prezreti dejstva, da je v umetnosti v ozadje postavljeno samo razumsko reševanje nalog, saj postane zgolj racionalnost v okviru umetnosti banalna. Na umetnost se že dolgo več ne gleda zgolj obrtniško, ampak se ji pripisuje estetsko vlogo in vpliv "čustev na čustva". Pravzaprav je včasih merodajna uspešnost prevoda ustvarjalca, da čim uspešnejše preda svoja občutja. Razvoj UI zaenkrat temelji na prepoznavanju človeških čustvenih odzivov na podlagi fizičnih znakov (prepoznavanja gest, obraza, glasu, …), kar je še daleč od človeške empatije in predvsem daleč od čustvenega doživljanja oz. odzivanja same UI.

Je pa razvoj umetne inteligence poleg inovativnosti v umetnosti prinesel tudi ogledalo, saj nam nudi reflektivni premislek o tem, kdaj umetnost preseže obrtniškost, kdaj preseže programiranje, do katere mere so ljudje, ki ustvarjajo z UI programerji, kdaj pa postanejo umetniki oz. ali lahko tudi umetno inteligenco okličemo za umetnico? Kdaj delo upraviči estetsko funkcijo[3], da ga lahko imenujemo umetnost?

Konkretno lahko odgovore iščemo pri samih dosežkih UI zadnjih let. Oktobra 2018 je bil v *Timu* objavljen članek, kjer piše, da so na dražbi Christie's prvič prodali delo, sliko, ki jo je ustvarila UI. Prodali so jo za 45-kratnik izhodiščne cene (za 432.500 $). Slika nosi naslov *Portret Edmonda Belamyja*. Algoritem se je učil na 15.000 portretih različnih slikarjev od 14. do 20. stoletja, v desni spodnji kot pa se je tudi podpisal – v ležeči gajici je izpisal svoj algoritem [21]:

$$\min_G \max_D \mathbb{E}_x[\log(D(x))] + \mathbb{E}_z[\log(1 - D(G(z)))]$$

Nadalje predstavljam projekt AIVA (Artificial Intelligence Virtual Artist). V opisu piše, da gre za virtualno umetnico, ki je zmožna komponiranja glasbenih podlag za filme, video igre, oglase in nasploh prosti čas. Algoritem se je učil od številnih del klasičnih skladateljev (Mozarta, Beethovna, Bacha, …), iz česar se je razvil model, ki naj bi razumel, kaj je glasba. Ta model uporablja Aiva za komponiranje povsem edinstvene glasbe. Aiva je postala prvi virtualni umetnik, katerega stvaritve so avtorsko priznane s strani združenja SACEM. Na uradni spletni strani dodajajo, da ti dosežki ne pomenijo, da bo Aiva zamenjala glasbenike, skladatelje, ampak gre za nadaljevanje sodelovanja med človekom in strojem. Ustvarjalci menijo, da komponiranje z UI omogoča nove pristope v glasbi. Zato jo tudi oglašujejo za primerno za vse vrste uporabnikov (od preprostih poslušalcev, novincev v komponiranju do profesionalnih glasbenikov) – AIVA asistira pri kreativnih procesih človeka, tako kot so v zgodovini veliki umetniki imeli svoje učence, lahko imajo zdajšnji umetniki UI pomočnike, ki jim pomagajo skrajšati čas za dokončanje skladb. Aiva lahko komponira v že ustaljenih stilih ali po vzoru "vpliva", ki ga naložimo sami [3]. Če kritično presodimo prebrano, lahko ponovno ugotovimo, da ne govorimo

o umetniku, ampak o človeškem pripomočku, ki ga razvijalci razumejo kot del razširjene kognicije (človeka), saj ima podobno funkcijo delovanja pri pisanju glasbe, kot jo lahko ima npr. zemljevid na telefonu pri orientaciji.

Trenutno najbolj znan projekt je dokončanje Beethovnove desete simfonije, kar bodo naredili s pomočjo umetne inteligence. Informacija o tem se je razširila konec leta 2019, simfonijo pa naj bi izvedel simfonični orkester 28. aprila 2020 v Bonnu (rojstnem mestu skladatelja). Zaradi pandemije je bil koncert odpovedan, novic o tem, kako napreduje ta projekt, pa mi ni uspelo zaslediti. Nekaj vzorcev komponiranja UI je moč slišati na spletni strani: telekom.com/de/konzern/themenspecials/special-beethoven-jahr-2020/beethovens-unvollendete. Pri projektu sodeluje oz. je sodelovalo (poleg vseh strokovnjakov UI) veliko število muzikologov in poznavalcev Beethovnove glasbe in obdobja, zato je projekt skrbno nadzorovan in voden tudi s strani umetniške stroke, ki opozarja na nepogrešljive dele. Želja je namreč pokazati, da je pri tovrstni uporabi stroj lahko tako dober in učinkovit kot človek, saj tovrsten pristop predstavlja za številne konvencionalne klasične strokovnjake zelo grob poseg, ki nima možnosti za uspeh.

Na tem mestu se lahko vprašamo, zakaj smo prepričani, da bi človeški obrtniški prepisovalci, dokončevalci umetniških del bili uspešnejši od UI, saj gre v obeh primerih za zelo podoben način učenja (nadaljevanja vzorca glede na pravila in vhodne podatke), pri čemer lahko strojni algoritmi hkrati obdelujejo in delajo z veliko več (specifičnimi) podatki kot učenci, ki so to počeli pred stoletji. Ob tem se ne ukvarjamo z vprašanjem Genija – torej, v čem je genialnost samega Beethovna in zakaj on to je, medtem ko ostalim njegovim sodobnikom to ni uspelo – ampak povsem obrtniškim vprašanjem, nadaljevanje glasbenega vzorca, kjer mnogokrat ni nujno potreben kreativni proces, ampak predvsem natančnost. Zato sem mnenja, da se mora včasih tudi človek zavedati svojih omejitev oz. egoizma. Z uporabo UI lahko tudi v umetnosti odkrivamo nove, še nepoznane svetove, pri čemer se moramo tako, kot se zavedamo vseh omejitev UI, zavedati tudi svojih, človeških.

4 Zaključek

V prispevku sem orisala veliko podpodročje kognitivne znanosti – umetno inteligenco – in jo umestila v kontekst umetniškega ustvarjanja. Ugotovila sem, da z vključevanjem UI v umetnost postaja ta interdisciplinarna v širšem smislu, kot je bilo to do sedaj, saj zahteva tudi veliko tehnološkega, programerskega znanja. Vračajo se številni etični pomisleki, do katerih se je treba opredeliti, ter filozofske predpostavke, ki se jih mora zavestno sprejeti, zato da se lahko UI nadalje uspešno razvija.

Ključno in osrednje vprašanje prispevka je bilo, ali je lahko umetna inteligenca, ki ustvarja, že sama po sebi umetnik? Ali smo že presegli uporabo stroja kot orodja ali je ta še vedno v domeni človeka in njegovega uporabljanja?

V samem bistvu še ne moremo govoriti o samostojni umetni inteligenci, ampak govorimo o vse bolj in bolj izboljšanih orodjih, človeških pripomočkih, katerim v vsakem primeru predhodi človek (kot programer ali s podatkovno bazo, iz katere

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[3] Sklicujem se na definicijo estetske funkcije po Romanu Jakobsonu, ki jo je opredelil v *Lingvistiki in poetiki*.

se UI uči), pri čemer lahko dopustimo misel, da so tudi ta orodja že del *razširjene kognicije*, saj odpirajo tudi v svetu umetnosti povsem nove pristope, načine dela in svetove, ki jih do sedaj še nismo videli. Karas v svoji diplomski nalogi:

"smiselnost računalniških generatorjev poezije vidi predvsem v obliki 'pametnih orodij', s katerimi človeški pesnik ustvarja poezijo, narejeno *s pomočjo računalnika:* 'Kot povsod drugje, hibridni pristop združuje (domnevno) najboljše vseh različnih svetov. Računalniki kljub napredku UI še ne 'razumejo' jezika, kot ga *razumemo* ljudje, toda po isti logiki se ljudje težko primerjajo (z računalniki, op. p.) po lahkotnosti igranja na polju jezika.'" [15]

Ob tem je takoj sledilo še vprašanje, kdaj lahko govorimo o resnični umetnosti, o umetniškem delu. Čeprav je to vprašanje prisotno, odkar rečemo nečemu umetnost oz. od začetka človeštva, se je pokazalo, da nam nudi svež pogled ravno umetna inteligenca, saj se kot očitno pokaže, da ne moremo soditi samo po končnem izdelku, da lahko UI ustvarja določene generične izdelke enako dobro ali še boljše kot ljudje. Zato moramo odgovore ponovno iskati v sami funkciji umetniškega dela in avtorja, iskati moramo pri izvoru in namenu ustvarjanja in ne zgolj presojati rezultata. V luči tega se je v zaključku izrisal še en premislek, in sicer po ponovni človeški samorefleksiji – ali je sploh nujno, da UI jemljemo kot konkurentko in nanjo gledamo kot človek na človeka, ali gre mogoče za nov odnos?

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Social Media Use & Digital Stress Among Adolescents

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ABSTRACT

This is a case study presenting ways in which adolescents perceive social media as a stressor, at the empirical example of Snapchat. Despite the overall positive or neutral reception of social media, in semi-structured expert interviews (N=6), Viennese adolescents shared about various stressful experiences that can be summarized under the following categories: feeling smothered by peer pressure to be constantly available online/ respond to messages; being upset over losing a streak or being scolded for it; being annoyed when receiving pointless content and feeling as if they spend too much time online. These stressors are discussed with regard to existing digital stress and Snapchat Streaks literature, with a particular focus on the issue of maintaining closeness between peers online.

KEYWORDS

social media, digital stress, Snapchat, gamification

1 INTRODUCTION

By removing ''*spatial and time constrains that were inherent in traditional methods of communications''*, social networking sites (SNS) are nowadays becoming the primary medium for a plethora of activities, such as accessing information, passing time, working on one's representation of reality and communicating with peers [1]. SNS such as Facebook, Instagram and Snapchat are attracting billions of daily active users of all ages and shape communication cultures especially among the so called "*digital natives*" [2] - adolescents growing up with social media as one of the default ways to connect to others. Adolescence is a particularly sensitive period for ''*personal and social identity formation''* [3], and, nowadays social media are being integral part of this development and teens' social experience in general. Seeking to shed light on the role social media play in the emotional life of youths, we investigate which aspects of gamified social media [4] are perceived as stressful by them. Based on an analysis of six semi-structured expert interviews with Viennese adolescents, this paper presents situations, in which adolescents experience social media as a source of stress, which could potentially lead to experiencing

psychological distress and various negative effects or emotions connected to it [5][6][7][8].

2 THEORETICAL BACKGROUND

2.1 Social media as stressors

A stressor can be described as a trigger that afflicts an organism and is capable of causing internal physical, mental and emotional responses. Social media can be understood as a social stressor defined as any environment that an individual considers demanding, challenging, or in any way threatening [9].

A growing body of literature on the intersection between social and clinical psychology shows possible connections or correlations between the new information and communication technologies – social media platforms, and an increased risk of emotional problems, e. g. psychological distress [5][6][7][8][10]. Considering SNS's pivotal role in the life of adolescents, it is crucial to scrutinize the effects of social media usage on youth (SMU), as well as their evaluations of their own SMU.

2.2 Social media & psychological distress among teens

The term psychological distress refers to an ''*unpleasant feeling or emotion often characterized by symptoms of depression and anxiety*'', e. g. loss of interest, sadness, restlessness [11]. Usually described as ''non-specific mental health problem'', it covers a wide spectrum, ranging from ordinary feelings of vulnerability and negative emotions to fears or problems that can become disabling [12].

The section below describes evidence from psychological research that social media platforms, may be experienced as stressors potentially leading to psychological distress and various negative effects associated with it [10].

Keles et al. did a systemic review of the influence of social media on depression, anxiety and psychological distress in adolescents [7]. Although the link between social media usage and mental health problems is not always straightforward, their research clearly indicates ''*a meaningful relationship between social media use and depression*'' [13]; ''*a statistically significant relationship between social media use and depressive symptoms in children and adolescents*'' [14]; ''*a correlation between problematic use and psychological distress in adolescents and young adults*'' [15].

A combination of various causes such as unrealistic expectations of one's own performance, heavy SMU, specific changes in adolescents' brain linked to ''*limited capacity for self-regulation*'' and ''*vulnerability to peer pressure*'' makes teens particularly vulnerable group for potential experience of negative

effects or emotion, e. g. lack of control, sadness, frustrations, fears etc. [7].

Agrawal and Singh did a systematic review of research related to social media and psychological distress among adolescents. They conclude that the results ''*clearly indicate that* (frequent) *use of social networking sites is directly related to psychological distress among youth*'' [5]. With that in mind, we believe it is crucial to investigate youth's social media experience and to analyze the ways in which they may perceive social media as a stressor.

3 METHODS

The analyzed data is a randomly selected subset (N=6, 15-18 years old, the average age of participants was 16.33, SD=1.10) of a larger set (N=26) of semi-structured expert interviews with Viennese adolescents in which they reported on their social media use, with a focus on Snapchat. The interviews focused on the practice of participant's daily routine with social media: their specific actions, skills and SMU experience. The participation in the individual interviews (60-90 minutes) was voluntary and a signed parent consent form was collected from each informant. The data were anonymized and relevant quotes were translated to English for the purposes of this publication. The interviews were coded (in Atlas.ti) using a modified grounded theory approach [16]. The analysis then focused on the codes related to ways in which youths experiences social media as stressful.

4 RESULTS

In line with previous research [17], our data reveals the near omnipresence of social media use in our participants' daily lives, and especially to communicate with their peers. All participants regarded social media use as regular means to connect with others daily, be it about school obligations, setting up meetings, passing time, or bonding with peers. Their overall impressions about social media usage were positive or neutral. Connecting with others on social media was seen as one of the main ways to communicate and as such its fundamental functions remained largely unquestioned. However, in agreement with previous research [18], our data also indicates that youths reported about both positive and negative experiences on the platforms. Participants associated SNS, and Snapchat in particular, with mostly positive effects on their everyday life, e.g. as digital media enable their daily communication with peers outside of school or with friends from other countries. Nevertheless, five out of six participants reported experiencing stress related with their use of social media. We will now present the main categories of SMU related stressors that we encountered in our data (with respective empirical examples): feeling smothered, losing Streaks, receiving pointless content and feeling they spend too much time online.

- feeling "smothered" [17]: the pressure of compliance in the form of being constantly available to others. The pressure to be available is also linked to expectations of "responding immediately" and, should this expectation not be met, peers would also actively comment on it: "people have already told me that I don't answer". Hence, our informants were stressed out by the pressure for instant availability in form of in-short-time replying to texts or snaps. It also seems critical to note that in

order to offer this availability, "some are on the phone all the time" which irritated our informants. A participant reported that she was feeling stressed out because friends insisted on maintaining the Snapchat streaks, counting the consecutive days of snapping, which requires the conscious effort of recalling to snap at least once per day with no preset expiration date – the streak partners are trying to keep the streak going for as long as possible, often reaching years of ongoing maintenance. Our informant shared that the feeling of compulsion spoiled her appreciation for Streaks: "in the end I didn't feel like it and felt compulsion, I thought it was stupid".

- losing streaks: adolescents report being mildly upset themselves when losing a streak, as well as their peers being upset by a streak loss: "One was already mad that he had lost the streaks. It wasn't with any of them that they would never speak again, but yes, there was something". "Losing" the gamified challenge is reported to incite frustration though it is rather game-related than full-blown negative emotions. Commonly, the intensity of the reaction is proportional to the height of the streak - the higher the streak, the more severe the loss: "With two friends of mine, one was really very pissed off, she had 300 streaks or something, abnormal, and the other didn't send back".

- receiving "pointless" content: feelings of annoyance and frustration upon receiving boring or pointless content. Adolescents complained of annoyance at receiving pictures of floors, walls, good morning / good night pictures and black pictures, all mostly are aimed at keeping Snapchat Streaks. Since the Streaks counter only quantifies the number of days of snapping, but has no criterion as to the quality of content sent, our informants said that they receive pictures containing "just the ground or something like that. Just to keep the streak, they sends something stupid", "just take the cell phone and take pictures of what's there, floor, table, it doesn't matter". According to them, this happens because "you don't have much to communicate about and you only do it because of the streaks". Although they send and receive such messages, adolescents conclude that "those are the unnecessary snaps", "they think it s stupid but still do it".

- too much time spent online: Participants reported being aware that time spent on social media platforms corresponds to less real-life activities involvement and school disturbance, due to e.g. the constant checking for new messages or content. When asked how much time he spends on social media, an informant answered "Far too much, I don't know, six or more hours a day. I use it far too much". Another adolescent shares that, although they were still active on social media, SMU was proven to be too much for them in their busy daily life: "That was the time with the school work, I had to learn a lot and in the evening I was already very tired, and with the last of my strength I was able to snap but it was too much for me". Yet another contemplates to limit her SMU time: "Maybe I would restrict it, I like YT very much, but it takes a lot of time. With IG there are videos that will be presented to you, 30 min + I should stop that. YouTube and Instagram rob me most of the time. Time is actually wasted because I could use it better … I often think the day could be more productive".

In addition to these main categories, individual participants also mentioned feeling: envious of others' streak count and social status; disappointed over inappropriate videos or pointless arguments online, or being bored by receiving pointless

repetitive content. In the following section, we are going to discuss the main categories in more detail.

5 DISCUSSION

The main types of stress we derived from the data – such as feeling smothered, losing Streaks, receiving pointless content and spending too much time on social media – highlight different relational aspects of online communication with peers. It is evident that informants' experience of stress sprouts not from hostile interactions with peers (e.g. cyber bullying) but are commonly caused by aspects of ''*maintaining closeness in digital space*'' [17]. **Feeling smothered** is caused by excess in the extent to which one is or should be making themselves available for communication with peers: how quickly they should respond to messages, how often should they check the phone, whether one should try to commit to longitudinal projects such as Streaks that require daily effort [4] [19]. Weinstein & Selman [17] discuss this stressor in its duality – as controlling and expressing desire for closeness. They report that while closeness is mutually desired and the content of messages is not problematic, "*the sheer quantity of the messages is itself described as a burden*" (ibid).

Being upset because of **losing streaks** or being scolded at for it are reactions to losing the shared project in which the daily effort was invested. Keeping a streak consciously is a task that requires both partners' devotion and daily effort and can, hence, spark a sense of solidarity and intimacy [19]. That is why, the abandonment of the gamified challenge of maximizing the Streak count might be seen as a sign of not caring about the other person's importance or feelings, which then requires the negotiation of the relation between peers (e.g. apologizing, breaking contact).

Youths are not only concerned when relations prompt constant availability and "overdoing communication" till one starts feeling smothered. Conversely, they express concerns over the drop in the quality of communication such as the one signaled by **reciving "pointless" content**. Being annoyed at boring or meaningless content one receives can be hedonic (being annoyed that the content one views is not entertaining) or relational (being upset over the inadequate communication which that signals disrespect towards the relationship). The latter may cause worries over interpreting the signs or the need to re-negotiate the relationship (by discussing it, dropping contact online or offline, or both). Hristova et al. report that the so called "streak snaps" (an umbrella term for black pictures, goodnight pictures etc. sent not as a part of conversation but for the purposes of gamification) are perceived as less valuable than snaps sent within a conversation. They report that adolescents often drop their streak with people who send them the gamified snaps without being involved in a conversation or asking one how they are doing [19].

Adolescents exhibit metacognition concerning the extent of their social media use, as exemplified by their worry over **spending "too much time" on social media** and realizing that this robs them of their time for other tasks they would find more "productive". This type of psychological distress is connected to an estimated excessive personal investment (time, effort, attention), leading SMU to be perceived as threatening [9]. It is somewhat similar to worrying over the time and effort needed for maintaining a long streak, that was already mentioned earlier in the discussion. The discussion about how much digital media is too much [20] seems to perpetuate itself to contemporary discussions of how much time makes up for a balanced social media use [21]. The adolescents in our sample go one step further by contemplating actively changing their social media consumption to mitigate aforementioned excessive expenditure of time resources.

To sum up, the aforementioned types of stress are sparked by the desire to form a close relationship on social media and by its implications: the time, effort and quality of involvement needed for this. The need or wish to be involved in their peer's online social life daily likely comes from adolescents' offline desires to ''*attract others*'', ''*gain acceptance*'' and ''*fit in*'' and ''*keep in touch*'' [22][23][24][25]. In this, the very principles may be considered an extension of pre-existing concerns over the ways and extent of closeness to peers.

However, specific social media features such as Snapchat's gamification element Streaks impose further specific constraints on rules of social conduct. In order to preserve the streak, one needs to snap and receive or view at least one picture or video within the frame of each day (24 hours), thereby adding further time pressure to the communication. While our participants do get involved with Streaks, the practice also adds more stress to their already complex temporal landscape of online interaction, requiring them to be available round the clock and respond right away after receiving a message. These contemporary challenges structure daily routines and experiences and, hence, need to be studied in more detail by researchers.

6 CONCLUSIONS

In post-industrial cultures, social media and its use are nowadays becoming a days-to-day feature in the life of individuals and especially adolescents. These online platforms represent an important tool of communication with their peers, as well as a major part of youth's social experience.

The goal of the study was to better understand SMU aspects which can be perceived as stressful by adolescents. While our research was based on self-report measures, posing the risk of bias, and was limited by small sample size, which cannot be representative and generalized to a larger adolescent population, it offers a categorization of stressors: feeling smothered, losing Streaks, receiving pointless content and feeling they spend too much time online; all of which stem from the wish to uphold closeness online. Based on the importance of the role that social media plays in most adolescents' lives nowadays, we emphasize the importance of further exploration of the stress-inducing aspects of maintaining online closeness.

7 ACKNOWLEDGMENTS

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Special Sciences: Still Not Reducible after All These Years

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ABSTRACT

The paper introduces the problem of multiple realizability (MR), followed by the examination of conditions for MR, as presented by various philosophers working on it. They arrive at opposing conclusions regarding MR despite accepting similar criteria for it. The paper analyses their conditions and compares them to Fodor's original motivation for MR. An alternative solution to the Fodor's problem, which also explains the aforementioned different conclusions, is introduced.

KEYWORDS

Multiple realizability, special sciences, reductionism, metaphysics.

1 HISTORY AND CRITERIA FOR MULTIPLE REALIZABILITY

The most influential argument of the 20th century against psycho-neural identity theories in philosophy of mind is probably the multiple realizability argument. The argument, first advocated by Putnam [1][2] and later by Fodor [3][4], can be succinctly summarized as the thesis claiming that the same mental kind can be realized by different physical kinds (or more simply, that the same mental state can be realized by different physical states). The ubiquitous example in philosophy of mind is the example of pain: pain can be realized by some neural/brain state in humans, by some other neural/brain state in reptiles, by some other neural/brain states in Martians etc. So, according to proponents of the multiple realizability thesis (MRT), the mental kind pain can be realized by various physical kinds. The kind pain therefore, cannot be reduced to a single neural kind, and it follows that identity theory regarding the mind-body problem is false.

The MRT seemed to go unchallenged throughout the second part of the 20th century; however, it has recently been problematized by various authors in philosophy of mind (Kim [5], Bechtel and Mundale [8]; Shapiro [9] [5], Polger [6]). There are many approaches to argue against MRT, but the most important one seems to be defining when kinds are in fact multiply realized. Two sets of authors (among others) have presented their criteria for multiple realizability (MR), with both

coming to opposite conclusions. The first pair, Shapiro and Polger [10] come to the conclusion that MR is very rare in nature, whereas Aizawa and Gillet [11] come to the conclusion that MR is rather omnipresent. How is this possible? Throughout the paper, we will use Shapiro and Polger's (S&P) example of corkscrews to illustrate the mentioned curiosity. In the end we will introduce an explanation of it which is in the same time also an alternative solution to the Fodor's original problem of MR.

2 SIMILAR CONDITIONS: DIFFERENT CONCLUSIONS

In short, S&P argue that for MR to be an obstacle to psychophysical reduction, the realizers have to be "different in ways that are relevant to their performing the same function" [10]. What this means is that not just any difference will do. They develop criteria for MR that are comprised of four necessary and jointly sufficient conditions (As and Bs represent the two candidates for MR, e.g. pain in Martians and pain in humans, and S1 and S2 designate distinct taxonomic systems, e.g. psychology and neurophysiology): "(i) As and Bs are of the same kind in model or taxonomic system S1. (ii) As and Bs are of different kinds in model or taxonomic system S2. (iii) The factors that lead the As and Bs to be differently classified by S2 must be among those that lead them to be commonly classified b S1. (iv) The relevant S2-variation between As and Bs must be distinct from the S1 intra-kind variation between As and Bs" [10].

We can illustrate how these criteria work in practice using corkscrews, a paradigmatic example used by S&P [10]. To fulfill the first two criteria, the MR candidate corkscrews A and B have to be classified as the same by one taxonomic system, and as distinct by a lower-level taxonomic system, thus being 'same but different' [10]. The third criteria is not as straightforward: two differently coloured corkscrews are not MR because colour is not causally relevant to performing the function of the corkscrew (does not meet condition iii). On the other hand, two different kinds of corkscrews, a winged and a waiter's corkscrew, which use different mechanisms to remove a cork, do count as MR, because they perform the desired function in different ways. So, to fulfill the third criterion, the corkscrews A and B have to perform the same function in different ways. The fourth condition is a safeguard that prevents intra-kind realizer differences to count as MR, namely, if, e.g. two winged corkscrews had levers that were of a different length, then the differences in length would translate into differences in function – perhaps a really sturdy cork could only be removed by a corkscrew with a longer lever.

However, Aizawa and Gillet (A&G) developed different criteria for MR, namely: "A property G is multiply realized if and

only if (i) under condition $, an individual s has an instance of property G in virtue of the powers contributed by instances of properties/relations F –F to s, or s's constituents, but not vice versa; (ii) under condition $* (which may or may not be identical to $), an individual s* (which may or may not be identical to s) has an instance of a property G in virtue of the powers contributed by instances of properties/relations F* –F* of s* or s*'s constituents, but not vice versa; (iii) F –F ≠ F* –F* ; and (iv), under conditions $ and $*, F –F and F* –F* are at the same scientific level of properties" [11].

The first two conditions are similar: two corkscrews are in a certain state, removing corks (property G), which is, in the first subject, realized by some physical realizer (F –F), and by a different physical realizer (F* –F*) in the second (or the same) subject. The third condition states that the two realizers are not the same (F –F ≠ F* –F*). Since G is realized 'in virtue of the powers contributed' by F –F or F* –F*, this excludes irrelevant properties (similar to S&P's approach, the colour in the aforementioned cases). The first three conditions are roughly the same as in S&P's criteria. Furthermore, the fourth condition only states that the analysed physical realizers should be at the same scientific level of properties. This criterion is, of course, "usually implicitly accepted as a shared background condition in earlier discussions of multiple realization in the sciences" [11].

Even though the criteria are similar, the conclusions could not be more different: one side argues that two corkscrews made of different materials, e.g. aluminium and steel, are not multiply realized, whereas the other side says that they are. Why? One possible answer is offered by Gillet [12], where he argues that S&P, compared to A&G, use a different view of realization. Namely, S&P adopt the *flat* view of realization, whereas A&G adopt the *dimensioned* view.

Shapiro concludes that, "Steel and aluminum are not different realizations of a waiter's corkscrew because, relative to the properties that make them suitable for removing corks, they are identical. The fact that one corkscrew is steel and the other aluminum is no more reason to characterize them as different realizations than the fact that one might be yellow and the other red"[7]. Whereas Gillet argues that, "For with one corkscrew the properties/relations of steel molecules result in the powers individuative of the property of removing corks, while in the other corkscrew the distinct properties/relations of aluminium atoms play this role. We should carefully mark that this judgment accords with the criterion-for only properties/relations that result in the powers of the realized property are taken to be relevant to MR" [12].

3   FODOR'S PROJECT

The case is analogous to Putnam's famous example of mammalian and octopus's eyes. Putnam [2] claims that the differences in materials are not relevant to the realized function

(the structures of the eyes is virtually the same, only the material is different), and Shapiro (and Polger) [10] would agree that it is not a case of multiple realizability, whereas Fodor and Block [13] (and Aizawa and Gillet [11][12]) would argue that it is.

Gillet further argues that the flat view, which S&P adopt, is not what some proponents of MR, Fodor and Block, had in mind. If that is the case, then S&P's argument, so says Gillet, is moot, as it rests on the wrong view of realization (i.e. flat instead of dimensioned). That is obviously correct: if Fodor had the dimensioned view in mind, then S&P's attempts to refute the flat view of MR is sterile.

However, things are not as simple as they seem. A&G allegedly adopt the 'correct' view of realization, yet their conclusions about special sciences are far from that of Fodor's. Namely, they imply that "multiple realization simply does not establish the methodological autonomy of cognitive science" [11]. This is a strange consequence, considering that the Fodor's project as stated in his article, "Special Sciences: Still Autonomous After All These Years" was to show that special sciences are autonomous [4[4]. Of course, just because A&G's conclusions differ from Fodor does not mean that their account of MR is incorrect, but claiming that they interpreted Fodor correctly should be taken with a grain of salt: especially considering that Fodor's main conclusion, the autonomy of special sciences, does not follow from their account. However, one could argue that a case that would satisfy S&P's MR criteria would probably secure autonomy in psychology in Fodor's sense. S&P otherwise argue for a modest identity theory, partly because no positive case (regarding mental kinds) that would pass their criteria has been presented so far. [10] What, according to them, their position implies for the autonomy of psychology is a different story, beyond the scope of this article.

Nevertheless, the purpose of the paper is not to dwell in exegetical debates. However, revisiting the problem behind the motivation for Fodor's project might be instructive. Fodor has two reason why special sciences are (probably) MR and autonomous. First, there are natural kinds that do not correspond to physical kinds, because we can make interesting generalizations about events that have distinct physical descriptions; moreover, the physical descriptions of these events, whether they are similar or not, are entirely irrelevant to the truth of the generalizations [3]. Second, the problem for reductionism is that physical laws are exceptionless, and laws of special sciences are not. If special sciences are reduced to physical sciences via bridge laws, and physical laws and bridge laws are exceptionless, how can the laws of special sciences have exceptions? "In short, given the reductionist model, we cannot consistently assume that the bridge laws and the basic laws are exceptionless while assuming that the special laws are not" [3].[1]

It seems that Fodor tries to solve the following problem: how can the laws of special sciences be reduced to physical laws, if the former are not exceptionless, whereas the latter are? Fodor

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[1] Fodor defines natural kinds in terms of laws, "roughly, the natural kind predicates of a science are the ones whose terms are the bound variables in its proper laws" [3].

offers two solutions, "we can give up the claim that the special laws have exceptions or we can give up the claim that the basic laws are exceptionless" [3]. Both options are undesirable: obviously, special laws have exceptions, and going down the path of physical laws having exceptions also seems like a very dangerous path. However, we believe that there is a third path: to deny that special sciences predicates pick out natural kinds (i.e. to deny that they are genuine laws).

4 THE GRANULARITY PROBLEM AND SPECIAL SCIENCES

Bechtel and Mundale [6] offered an explanation of why MR seems so intuitive in philosophy of mind. They claim that philosophers have used different grains when establishing MR, i.e. they used a coarse grain in identifying mental kinds and a very fine grain when identifying physical kinds. Whereas Bechtel and Mundale claimed that this is only characteristic of philosophers, we would like to expand the claim and argue that using coarser grains for higher order sciences is literally what enables us to make interesting and useful generalizations about the world. Let's illustrate this with corkscrews. Both camps (S&P and A&G) seem to be familiar with the granularity argument, yet their approaches do not seem to reflect that. Both use a very fine grain to identify physical kinds, but neither pays much attention in setting the conditions for identifying the same mental kinds.

Take the two different kinds of corkscrews (of which both S&P and A&G agree that they are MR). Are they functionally isomorphic, i.e. do they perform the *same* function in all contexts? Imagine we have to work in very low spaces, say you want to open a bottle of wine in a box that is only 5 cm taller than the bottle: the winged corkscrew will not do the job, whereas the waiter's corkscrew will. Even though the corkscrews perform a similar (or even the same) function in most situations and contexts, they differ in some. And if they differ in some, they cannot be functionally isomorphic. Similar for the aluminium and steel corkscrew: they differ regarding the temperature of the cork removal (e.g. at 800 ºC) The melting point of steel is 1370 ºC, whereas the melting point of aluminium is 660.3 ºC. Therefore, the two corkscrews will not be functionally isomorphic in all contexts, which, if they are natural kinds, should be the case. Yes, the differences are extremely small, one could say irrelevant, but they do exist. However, we ignore them (or we use a coarser grain) *because* they are so minute and rare that they are completely irrelevant compared to the extreme usefulness of the powerful generalizations that we acquire, if these differences are cast aside. They are similar enough, which enables us to use these generalizations with great proficiency.

This is not exclusive to corkscrews (or to special sciences). Even the most textbook example of MR is vulnerable to such granularity. Take a mechanical and an electronic computer, which are both realizing a Turing machine, i.e. they are functionally isomorphic. Note that we are again applying a very narrow context in which they are functionally isomorphic. If we add a massive magnet to both computers, the mechanical computer will still perform the function, whereas the electronic will not. Take two distinct electronic computers: one might have

a faster processor and will realize the program faster (this does not mean that we cannot imagine, or that there do not exist, any circumstances where two distinct computers can perform the same aspect of a program in the same way, but the totality of their functions in various contexts will not be isomorphic).

The same seems to hold for generalizations in special sciences: instead of listing countless similar but minutely different laws/kinds, psychologists ignore some details that are irrelevant and idealize others to develop powerful generalizations that are extremely useful. The very fact that they idealized and abstracted (or coarse grained) means that they are no longer describing natural kinds (as there are too many to describe), but they gain in simplification and generalization. This also explains why special science laws have exceptions: they do not always work precisely because they are abstracted and idealized laws of countless similar but not identical phenomena, and finding out which details are irrelevant and which important is an extremely difficult task.

5 CONCLUSION

Does this mean that special sciences do not accurately describe the world? Yes, and no. Yes, because, strictly speaking, they disregard details and idealize others to form powerful, informative, and useful generalizations. No, because the world is too complex to talk about it accurately. Are special sciences reducible to physical sciences, i.e. are type identical psychological states reducible to type identical neurological states? No, but not because they are multiply realized, but because there are no type identical psychological states: psychological states (and other special sciences predicates) are useful abstractions (as Davidson has shown, but for another reason [14]), that enable us to generalize about states that are minutely distinct, but, for all intents and purposes, identical.

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Odkrivanje znanja in podatkovna skladišča - SiKDD
Data Mining and Data Warehouses - SiKDD

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PREDGOVOR

Tehnologije, ki se ukvarjajo s podatki so v devetdesetih letih močno napredovale. Iz prve faze, kjer je šlo predvsem za shranjevanje podatkov in kako do njih učinkovito dostopati, se je razvila industrija za izdelavo orodij za delo s podatkovnimi bazami, prišlo je do standardizacije procesov, povpraševalnih jezikov itd. Ko shranjevanje podatkov ni bil več poseben problem, se je pojavila potreba po bolj urejenih podatkovnih bazah, ki bi služile ne le transakcijskem procesiranju ampak tudi analitskim vpogledom v podatke – pojavilo se je t.i. skladiščenje podatkov (data warehousing), ki je postalo standarden del informacijskih sistemov v podjetjih. Paradigma OLAP (On-Line-Analytical-Processing) zahteva od uporabnika, da še vedno sam postavlja sistemu vprašanja in dobiva nanje odgovore in na vizualen način preverja in išče izstopajoče situacije. Ker seveda to ni vedno mogoče, se je pojavila potreba po avtomatski analizi podatkov oz. z drugimi besedami to, da sistem sam pove, kaj bi utegnilo biti zanimivo za uporabnika – to prinašajo tehnike odkrivanja znanja v podatkih (data mining), ki iz obstoječih podatkov skušajo pridobiti novo znanje in tako uporabniku nudijo novo razumevanje dogajanj zajetih v podatkih. Slovenska KDD konferenca pokriva vsebine, ki se ukvarjajo z analizo podatkov in odkrivanjem znanja v podatkih: pristope, orodja, probleme in rešitve.

FOREWORD

Data driven technologies have significantly progressed after mid 90's. The first phases were mainly focused on storing and efficiently accessing the data, resulted in the development of industry tools for managing large databases, related standards, supporting querying languages, etc. After the initial period, when the data storage was not a primary problem anymore, the development progressed towards analytical functionalities on how to extract added value from the data; i.e., databases started supporting not only transactions but also analytical processing of the data. At this point, data warehousing with On-Line-Analytical-Processing entered as a usual part of a company's information system portfolio, requiring from the user to set well defined questions about the aggregated views to the data. Data Mining is a technology developed after year 2000, offering automatic data analysis trying to obtain new discoveries from the existing data and enabling a user new insights in the data. In this respect, the Slovenian KDD conference (SiKDD) covers a broad area including Statistical Data Analysis, Data, Text and Multimedia Mining, Semantic Technologies, Link Detection and Link Analysis, Social Network Analysis, Data Warehouses.

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A Dataset for Information Spreading over the News

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ABSTRACT

Analysing the spread of information related to a specific event in the news has many potential applications. Consequently, various systems have been developed to facilitate the analysis of information spreading, such as detection of disease propagation and identification of the spreading of fake news through social media. The paper proposes a method for tracking information spread over news articles. It works by comparing subsequent articles via cosine similarity and applying a threshold to classify into three classes: "Information-Propagated", "Unsure" and "Information-not-Propagated". There are several open challenges in the process of discerning information propagation, among them the lack of resources for training and evaluation. This paper describes the process of compiling corpus from the Event Registry global media monitoring system. We focus on information spreading in three domains: sports (i.e. the FIFA World Cup), natural disasters (i.e. earthquakes), and climate change (i.e. global warming). This corpus is a valuable addition to currently available dataset to examine the spreading of information about various kind of events.

KEYWORDS

Datasets, Information propagation, News articles

1 INTRODUCTION

Information spreading has received significant attention due to its various market applications such as advertisement. did the information about a specific product reach to the public of a specific region? This could be one of the significant research questions. Research in this area considers influential factors in the process of information spreading such as the economic condition of a specific area related to how textual or visual content is helping to advertise a product. Information spreading analytics can also be used in shaping policies, e.g., in media companies to understand if there is a need to improve the content before publishing it. Health organizations may be interested to know the patterns of spreading of a cure for a certain disease. Environmental scientists are perhaps attentive to see whether spread of news about climate changes inside the country is similar to what is being reported internationally.

Domain-specific gaps in information spreading are ubiquitous, and may exist due to economic conditions, political factors, or linguistic, geographical, time-zone, cultural and other barriers. These factors potentially contribute to obstructing the flow of local as well as international news. We believe that there is a lack of research studies which examine, identify and uncover the reasons for barriers in information spreading. Additionally, there is

Table 1: List of events

Selected events	Other events (ordered by popularity)
Football	Basketball, Baseball, Boxing, Tennis, Cycling
Earthquake	Floods, Tsunamis, Landslides, Hurricane, Volcanic eruptions
Global warming	CO_2 emissions, Chemical consumption

limited availability of datasets containing news text and metadata including time, place, source and other relevant information.

When a piece of information starts spreading, it implicitly raises questions such as:

(1) How far does the information in the form of news reach out to the public?
(2) Does the content of news remain the same or changes to a certain extent?
(3) Do the cultural values impact the information especially when the same news will get translated in other languages?

This paper presents a corpus that focuses on information spreading over news and that hopes to answer some of the above questions (This corpus is published as an online resource at). We present the use of a news repository to produce a corpus and then analyze information propagation. We present a novel methodology for automatically assembling the corpus for this problem and validate it in three different domains. We focused on a combination of rich- and low resource European languages, in particular English, Portuguese, German, Spanish, and Slovene. Three different types of events are targeted in the data collection procedure to potentially involve different information spreading behaviors in our society. These events are sports (FIFA World Cup, 2,695 articles), natural disasters (earthquakes, 3,194 articles), and climate change (global warming, 1,945 articles). The three types of events were chosen based on their popularity and diversity. A list of sub-events was observed from top websites related to the three events and we selected those which were the most popular in the countries with the selected national languages. For sports, a list of countries with their national sports was fetched and then filtered for national language[1], [2]. Based on popularity, we selected the FIFA world cup. Similarly, for natural disasters, lists of natural disasters were collected by country taking the national language into account, for instance, for Slovenia we looked for this country in the natural disaster category on Wikipedia[3]. Earthquakes[4] and global warming[5] were found to be the most prevalent, thus a dataset for each was collected. Table 1 shows the selected events and other related events ordered by prevalence.

The paper makes the following contributions to science:

(1) a novel methodology to collect a domain-specific corpus from news repository;
(2) semantic similarity between news articles;

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[1] http://www.quickgs.com/countries-and-their-national-sports/
[2] https://www.topendsports.com/
[3] https://en.wikipedia.org/wiki/Category:Natural_disasters_in_Slovenia
[4] https://en.wikipedia.org/wiki/List_of_earthquakes_in_2020
[5] https://www.theguardian.com/environment/2011/apr/21/countries-responsible-climate-change, [6]

(3) an annotated dataset encoding the level of information spreading from an article.

The rest of the paper is organized as follows: in Section 2 we discuss prior work about information spreading; in Section 3 we describe the data collection methodology; Section 4 describes semantic similarity and dataset annotation; and Section 5 gives the conclusions.

2 RELATED WORK

Information spreading is prevalent in our society. It plays a vital part in tasks that encompass the spreading of innovations [9], effects in marketing [6], and opinion spreading [4]. News spreading provides information to consumers that can be used for decision making and potentially contribute to shaping national and international policies. There are several types of media involved, such as print media, broadcast, and internet media. Internet is considered as a building block for connecting individuals worldwide, while news reflects current significant events for people [7]. Apart from news, online social media proved to be a remarkable alternative to support information spreading in an emergency [8, 5]. Social connection plays a vital role in news spreading. Especially the structure of network reflecting who is connected to whom, crucially increases the proportion of information spreading. Network structure analysis comes with a hypothesis related to the strength of the connections, namely that information will spread further in a situation where there exist many weak connections rather than clusters of strong [2].

While, in general, there are not many dataset that would help in modelling information spreading, there are some corpora for detecting the spreading of information about diseases [3] and fake news in social media [10]. There is currently no multilingual dataset of news articles for analysis of information propagation composed from a variety of event-centric information such as sports, natural disasters, and climate changes. This provides additional motivation for our work.

3 DATA COLLECTION METHODOLOGY

In order to collect news originating from different sources, in different languages, and targeting diverse events, we used Event Registry, a platform that identifies events by collecting related articles written in different languages from tens of thousands of news sources [9]. Using Event Registry APIs [7], we fetched a list of articles about each event in the following languages: English, Spanish, German, Portuguese, and Slovenian. Figure 1 shows the data collection process.

Each article was parsed from the JSON response and stored in CSV files. Each article was connected with the available list of relevant information such as the language of the article, event type, publisher, title, date, and time. Figure 2 shows the metadata of articles.

The number of collected articles in each domain varies considerably, and also varies across the languages within each domain. Table 2 shows statistics about each dataset.

4 SEMANTIC SIMILARITY BETWEEN NEWS ARTICLES

We have represented the cross-lingual news articles by monolingual (English) Wikipedia concepts using the Wikifier service[8].

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[7]https://github.com/EventRegistry/event-registry-python/blob/master/eventregistry/examples/QueryArticlesExamples.py
[8]http://wikifier.org/info.html

Figure 1: Data collection methodology

Figure 2: Articles with metadata

Table 2: Statistics about dataset

Dataset	Domain	Event type	Articles per Language					Total Articles
			Eng	Spa	Ger	Slv	Por	
1	Sports	FIFA World Cup	983	762	711	10	216	2682
2	Natural Disaster	Earthquake	941	999	937	19	251	3147
3	Climate Changes	Global Warming	996	298	545	8	97	1944

This service uses a page-rank based method to identify a coherent set of relevant concepts from Wikipedia [1]. We retrieved a list of Wikipedia concepts for each article. After representing each article with a list of Wikipedia concepts, the tf-idf score was computed using the popular machine learning library Scikit-Learn[9]. Using the same library, cosine similarity was calculated between tf-idf representation of news articles across all five languages. In the process of computing similarity between the articles, for each article we calculated its cosine similarity to all other articles and stored the results in a CSV file. The results were then sorted based on the publishing time of articles and we kept only the calculations of similarity to articles that are published later that the article in hands. Since we are interested in information propagation, we do not need to compare an article to those articles which have been published before it. As a result, we had a multiple similarity score for each article where each score show the similarity with other articles. Cosine similarity varies between zero and one, zero meaning no similarity and one meaning maximum similarity, i.e., a duplicate article.

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[9]https://scikit-learn.org/stable/
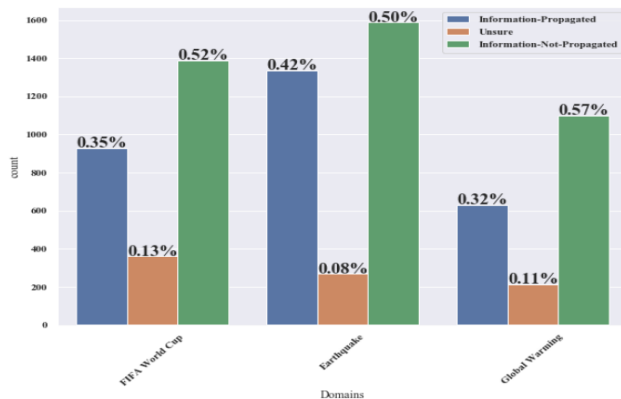
Figure 3: Class distribution for all domains

Table 3: Selected articles for evaluation

Domains	Percentage of correctly labelled pairs
Global Warming	100%
Earthquake	93%
FIFA World Cup	100 %

for Portuguese, German, Slovene and Spanish to translate them into English.

Evaluation results shown that the annotation was significantly related to information spreading. Articles in the "Information-Propagated" class show that most articles were an exact or paraphrased copy of each other, with some articles published within few hours after each other. Articles in the "Unsure" class were typically also relevant to the event but involved extra and different discussions. Lastly, in the third class "Information-Not-Propagated", articles involved only keywords related to event but discussion was about other topics. Moreover, here the gap in the publishing time was quite large.

4.1 Dataset annotations

The results of the semantic similarity calculation were in the form of a table where rows shown the list of articles and columns shown the corresponding similarity score in the range 0..1 with all the other articles. This similarity score was calculated using cosine between TF-IDF representation of news articles (See Section ??). First, we excluded those articles which had scored 1.0, as they were considered as a copy of the article. We then, for each article, chose an article which had the highest similarity score to it from the list of all articles. After performing this step, we had one similarity score for each article which shows either that the information spread to a certain extent (if >0) or not (if 0). To decide about the class label whether the information is spreading or not, we divided the scores into three intervals. The first is Similarity $\geq$ 0.7, the second is 0.7 > Similarity $\geq$ 0.4, and the third is Similarity < 0.4. Articles that have scores in the first interval were labeled as "Information-Propagated". The second interval was considered as unclear whether the information from the article propagated or not such articles were labeled as "Unsure". The lowest interval was considered as a signal for no propagation and labeled "Information-not-Propagated". For instance, low similarity can be of an article about a sports ground which mentions the population of the city and another article that discusses the population itself. We have manually examined concepts of articles in each class. Figure 3 shows the distribution of class labels in FIFA World Cup, Earthquake, and Global Warming dataset respectively.

4.2 Evaluation of dataset

Each article was annotated with a label based upon the similarity score threshold of each article with other articles (See Section 4.1). For evaluation of the dataset we have checked the content of the corresponding articles which were responsible for a specific class label. We performed the evaluation of labelling by manually inspecting a subset of pairs of articles. If a pair, for instance, were labelled as "Information-Propagated" then two articles should have text discussing more or less the same event, both in mono- and cross-lingual settings.

We have randomly chosen 10 articles with their corresponding articles considering all languages in each class and in each dataset. In this way, we have manually checked 180 articles. Table 3 shows these pairs of articles for evaluation in each dataset. We scanned each article manually for all languages, using Google Translator

5 CONCLUSIONS

This paper proposed a methodology and explained the process of data collection from a news repository to provide a corpus for event-centric information propagation between news articles. This corpus covers three domains and each dataset corresponds to one event type (FIFA World Cup, Earthquake, and Global Warming). The corpus is available to others for the evaluation of techniques for information spreading as it allows the analysis of cross-lingual news articles published by different publishers located geographically in different places.

In the future, we plan to add more attributes to each dataset. For instance, for now, we only know the publisher of a news article but in the future, we would like to include the publisher profile and the economic condition of a country from where the information is published. Also, we plan to apply and evaluate different techniques to analysis information propagation barriers.

6 ACKNOWLEDGEMENTS

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Learning to fill the slots from multiple perspectives

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ABSTRACT

We present an approach to train the slot-filling system in a fully automatic, semi-supervised setting on a limited domain of events from Wikipedia using the summaries in different languages. We use the multiple languages and the different topics of the events to provide several alternative views on the data. Our experiments show how such an approach can be used to train the multilingual slot-filling system and increase the performance of a monolingual system.

KEYWORDS

information extraction, slot filling, machine learning, probabilistic soft logic

1 INTRODUCTION

This paper is addressing the slot filling task that aims to extract the structured knowledge from a given set of documents using a model trained for a specific domain and the associated slots. For example, within a news article reporting on an earthquake, the task is to detect the earthquake's magnitude, the number of people injured, the location of the epicentre and other information. We refer to those as a set of *slot keys* or *slots*, to their exact values as a *slot values* and to the named entities from the documents corresponding to those values as *target entities*.

Slot filling is closely related to the task of relation extraction [1] and can be seen as a kind of unary relation extraction. Both tasks can be formulated as classification and are usually approached by first training a classifier with a sentence and tagged entities at the input and the prediction of relation or slot key as the output.

As there is a large number of relations between entities that we might be interested in detecting, there is also a large number of slot keys we seek the slot value for. In order to avoid the resource-intensive process of annotating a large number of examples for each possible slot/relation and to increase the flexibility of training procedures beyond the straight-forward supervised learning, many alternative approaches have been proposed, such as bootstrapping [4], distant supervision [6] and self supervision [5].

As stated both tasks can be performed for different types of documents. We limit our focus to news events on multiple topics (such as natural disasters and terrorist attacks), taking the articles reporting about events as the documents. Since the number of news topics is large, and consequently so is the number of slots, we would like to minimize the need for manual annotations.

Furthermore, since the set of topics is not fixed and could expand over time, such a slot filling system should be able to adapt quickly to fill new slots and ideally should not be limited to the English language.

We believe that annotation work can be greatly minimized if we rely on our limited domain to identify and annotate only informative examples and use the additional assumptions to propagate these labels. We also believe that simultaneous training of the system on multiple topics can be advantageous, as we can introduce additional supervision on the common slots and use distinct slots as a source of negative examples.

In this work we use Wikipedia and Wikidata [9] as the source of data. We treat the Wikidata entities that have the point-in-time property specified as events and summary sections of Wikipedia articles about the entity in different languages as news articles. Each entity belongs to a single topic and we adopt the subset of topic-specific properties as slot keys. An automatic exact matching of such values from Wikidata with named entities from Wikipedia articles is rarely successful. We use the successful and unambiguous matches as a set of labeled seed examples.

We formulate the task as a semi-supervised learning problem [8] where the set of base learners is trained iteratively, starting with a small seed set of labeled examples and a larger set of unlabeled examples. In each iteration, the most confident predictions on the examples from unlabeled set are used to increase the training set by assigning pseudo-labels. We introduce an additional component which combines the confidences of multiple base learners for each example.

To the best of our knowledge, we are the first to use the limited domain of news events, which allows the additional assumptions, such as the connection between slots of different topics and the redundancy of reporting in multiple languages, to first train and later boost the performance of a slot-filling system.

The contributions of this paper are the following:

- we combine the data from Wikidata and Wikipedia to setup a learning and evaluation scenario that mimics the learning on news events and articles,
- we demonstrate how simultaneous learning on multiple topics and languages can be used not only to train the multilingual slot-filling system, but to also improve the performance of a monolingual system,
- we show how an inference component can be used to combine predictions from multiple base learners to improve the pseudo-labeling step of the semi-supervised learning process.

2 METHODOLOGY

2.1 Problem Definition

Given a collection of topics $\mathcal{T}$ (such as earthquakes, terrorist attacks, etc.), where each topic t has its own set of slot keys $\mathcal{S}_t$, the goal is to automatically extract values from the relevant texts

to fill in the slots. For example, the members of $\mathcal{S}_{earthquakes}$ are *number of injured*, *magnitude* and *location*. For each topic t there is a set of events $\mathcal{E}_t$, each of which took place at some point in time and was reported by several documents in different languages.

The values of all or at least most slot keys (or slots) from $\mathcal{S}_d$ are represented in each of the documents as named entities, which we also refer to as *target entities*. We say most of the slots, since it is possible that an earthquake caused no casualties. It is also possible that some of the documents do not report about the number of casualties as it may be too early to know if there were any. In addition, the documents might contain different values for the same slot key, as for example, the reported number of people injured by an earthquake can increase over time. There may also be several different mentions of the same slot in a particular document, as for example one magnitude might refer to an actual earthquake that the event is about, while the other magnitude might refer to an earthquake that struck the same region years ago.

Our task is actually a two step process. In the first step, the goal is to train a system capable of identifying the target entities for a set of slot keys from the context, which in our case is limited to a single sentence. Such a system is not yet able to recognise the true value for a given slot if there are multiple different candidates, such as selecting the actual magnitude from several reported magnitude values. The goal of the second step is to assign a single correct value to each of the slot keys. We assume that inferring the correctness of a value is a document-level task, since it requires a broader context. Solving the first step is a kind of prerequisite for the second step, so we focus on it in this paper.

2.2 Overview of the proposed method

The system is trained iteratively and starts with a noisy seed set, which grows larger with pseudo-labeled positive and negative examples. Each of the base learners is trained on the set of labeled examples from the topic (or multiple topics) and language assigned to it. The prediction probabilities for each of the unlabeled examples are determined by combining the probabilities of all base learners. This is done either by averaging or by feeding the probabilities as approximations of the true labels into the component, which attempts to derive the true value for each example and the error rates for each learner [7]. The examples with probabilities above or below the specific thresholds are given a pseudo-label and added to the training set.

The seed set is constructed by matching the slot values obtained from Wikidata with named entities found in Wikipedia articles for each event. There are only a handful of unambiguous matches for each slot key, which are labeled as a positive examples, while the negative examples are all other named entities from the articles in which they appeared. Figure 1 shows a high-level overview of the proposed methodology. The entire workflow is repeated in each iteration until no new examples are selected for pseudo-labelling.

2.3 Representing the entities

Each named entity together with its context forms a single example. We annotate each article and extract the named entities with Spacy [1]. To capture the context, we compute the vector representation of each entity by replacing it with a mask token and feeding the entire sentence through a pre-trained version

of the XLM Roberta model [3] using the implementation from the Transformers [2] library. Note that the representation of each entity remains fixed throughout the learning process because we have found that the representation is expressive enough for our purposes and it speeds up the training between iterations. Also note that since the entity is masked, it is not directly captured in the representation.

2.4 Selecting the topics

Our assumption is that training the system to detect the slots on multiple topics simultaneously can provide additional benefits. For two topics t and t' there is potentially a set of common slots and a set of topic-specific slots.

For slot s' which appears in both topics the base learner trained on t' can be used to make predictions for examples from t. By combining predictions from learners trained on t and t', we could get a better estimate of the true labels of the examples.

For the slot s, which is specific to the topic t, all examples from the topic t' can be used as negative examples. Selecting reliable negative examples from the same topic is not easy, as we may inadvertently mislabel some of the positive examples.

2.5 Using multiple languages

Articles from different languages offer in some ways different views on the same event. The slot values we are trying to detect should appear in all the articles, as they are highly relevant to the event.

The values for slots such as location and time should be consistent across all articles, whereas this does not necessarily apply to other slots such as the number of injured or the number of casualties. Matching such values across the articles is therefore not a trivial task, and although a variant of soft matching can be performed, we leave it for the future work and limit our focus only on the values that can be matched unambiguously.

We can combine the predictions of several language-specific base learners into a single pseudo-label for entities that can be matched across the articles.

2.6 Assigning pseudo labels

Each iteration starts with a set of labeled examples X_l, a set of unlabeled examples X_u and a set of base learners trained on X_l. Base learners are simple logistic regression classifiers that use vector representations of entities as features and classify each example x as a target entity for the slot key s or not.

Each base learner $\bar{f}_{t,l}^s$ is a binary classifier trained on the labeled data for the slot key s from the topic t and the language l. Such base learners are *topic-specific* as they are trained on a single topic t. Base learners $\bar{f}_l^s$ are trained on the labeled data for the slot key s from the language l and all the topics with the slot key s. Such base learners are *shared* across topics, as they consider the examples from all the topics as a single training set. We use the classification probability of the positive class instead of hard labels, $\bar{f}_{t,l}^s(x), \bar{f}_l^s(x) \in [0,1]$.

For each entity x from a news article with the language l reporting on the event e from the topic t we obtain the following predictions:

- $\bar{f}_{t',l}^s(x)$ for each $s \in \mathcal{S}_t$ and all such t' that $s \in \mathcal{S}_{t'}$, that is the probability that x is a target entity for the slot key

---

[1] https://spacy.io/

[2] https://huggingface.co/transformers/
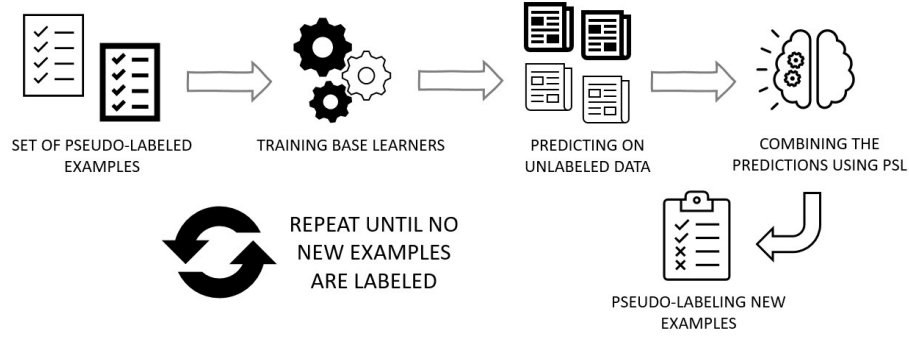
Figure 1: High-level overview of the proposed methodology.

s, where s is a slot key from the topic t, using the *topic-specific* base learner trained on examples from the same language on the topic t' that also has the slot key s,

- $\bar{f}^s_{t,l'}(x)$ which equals $\bar{f}^s_{t,l'}(y)$ for each $s \in \mathcal{S}_t$ and for each language l' such that there is an article reporting about the same event e in that language and contains an entity y which is matched to x,
- $\bar{f}^s_l(x)$ for each $s \in \mathcal{S}_t$, using the *shared* base learner, which is on examples from all topics t' that have the slot key s.

Predictions from multiple base learners for each x and s are combined as a weighted average to obtain a single prediction $f^s(x)$. The weight of each base learner $\bar{f}$ is determined by its error rate $e(\bar{f})$ which is estimated using an approach from [7] using both unlabeled and labeled examples. This is done by introducing the following logical rules (referred to as *ensemble rules* in [7]) for each of the base learners $\bar{f}^s$ predicting for x:

$$\bar{f}^s(x) \wedge \neg e(\bar{f}^s) \to f^s(x), \; and, \; \bar{f}^s(x) \wedge e(\bar{f}^s) \to \neg f^s(x),$$

$$\neg \bar{f}^s(x) \wedge \neg e(\bar{f}^s) \to \neg f^s(x), \; and, \; \neg \bar{f}^s(x) \wedge e(\bar{f}^s) \to f^s(x).$$

The truth values are not limited to Boolean values, but instead represent the probability that the corresponding ground predicate or rule is true. For a detailed explanation of the method we refer the reader to [7]. We introduce a prior belief that the predictions of base learners are correct via the following two rules:

$$\bar{f}^s(x) \to f^s(x), \; and, \; \neg \bar{f}^s(x) \to \neg f^s(x).$$

Since each x can be target entity for at most one slot key, we introduce a *mutual exclusion* rule:

$$\bar{f}^s(x) \wedge f^{s'}(x) \to e(\bar{f}^s).$$

The rules are written in the syntax of a Probabilistic soft logic [2] program, where each rule is assigned a weight. We assign a weight of 1 to all *ensemble rules*, a weight of 0.1 to all *prior belief* rules and a weight of 1 to all *mutual exclusion* rules. The inference is performed using the PSL framework [3]. As we obtain the approximations for all $x \in X_u$, we extend the set of positive examples for each slot s with all x such that $f^s(x) >= T_p$ and the set of negative examples with all x such that $f^s(x) <= T_n$, for predefined thresholds T_p and T_n.

3 EXPERIMENTS

3.1 Dataset

To evaluate the proposed methodology, we have conducted experiments on two topics: *earthquakes* and *terrorist attacks*.

We have collected the Wikipedia articles and Wikidata information of 913 earthquakes from 2000 to 2020 in 6 different languages, namely English, Spanish, German, French, Italian and Dutch. We have manually annotated the entities of 85 English articles using the slot keys *number of deaths*, (*number of injured* and *magnitude*, which serve as a labeled test set and are not included in the training process. In addition, we have collected the data of 315 terrorist attacks from 2000 to 2020 with the articles from the same 6 languages.

3.2 Evaluation Settings

The evaluation for each approach is performed on the labeled English dataset, where 76 entities are labeled as number of deaths, 45 as number of injured and 125 as magnitude. The threshold values for the pseudo-labeling are set to $T_p = 0.6$ and $T_n = 0.05$. The approaches differ by the subset of base learners used to form the combined prediction and by the weighting of the predictions.

Single or multiple languages. In single language setting, only English articles are used to extract the entities and train the base learners. In the multi-language setting, all available articles are used and the entities are matched across the articles from the same event.

Single or multiple topics. In the single topic setting only the examples from the *earthquake* topic are used. In the multi-topic setting, the examples from *terrorist attacks* are used as negative examples for the slot key *magnitude*, the base learners for the slot keys *number of deaths* and *number of injured* are combined as described in the section 2.6.

Uniform or estimated weights. In the uniform setting all predictions of the base learners contribute equally, while in the estimated setting the weights of the base learners are estimated using the approach described in the section 2.6.

3.3 Results and discussion

The results of all experiments are summarized in the table 1. Since the test set is limited to the topic *earthquake* and English, only a subset of base learners was used to make the final predictions. We report the average value of precision, recall and F1 across all slot keys. The threshold of 0.5 was used to round the classification probabilities.

Single iteration. Approaches in which base learners are trained on the initial seed set for a single iteration achieve higher precision with the cost of a lower recall. We observe that they distinguish almost perfectly between the slots from the seed set and

Table 1: Results of all experiments. The column *Single iteration* reports the results of approaches where base learners were trained on the seed set only. Results where base learners were trained in the semi-supervised setting with different weightings of the predictions are reported in the columns *Uniform weights* and *Estimated weights*. The values of precision, recall and F1 are averaged over all slot keys.

Model	Single iteration			Uniform weights			Estimated weights		
	P	R	F1	P	R	F1	P	R	F1
Single language, single topic	0.94	0.64	0.76	0.83	0.75	0.77	0.84	0.76	0.79
Multiple languages, single topic	0.94	0.64	0.76	0.82	0.74	0.76	0.83	0.75	0.77
Single language, multiple topics	0.91	0.76	0.83	0.83	0.83	0.83	0.86	0.83	0.84
Multiple languages, multiple topics	0.93	0.76	0.83	0.82	0.83	0.82	0.84	0.84	0.84

produce almost no false positives. Using one or more languages has almost no effect on the averaged scores when the number of topics is fixed. When using multiple topics, a higher recall is achieved without a significant decrease in precision. All incorrect classifications of the slot *number on injured* are actually examples of the *number of missing* slot that is not included in our set and likewise almost all incorrect classifications for the slot *magnitude* are examples of the slot *intensity on the Mercalli scale*. This could easily be solved by expanding the set of slot keys and shows how important it is to learn to classify multiple slots simultaneously.

Semi-supervised. Approaches in which base learners are trained iteratively trade precision in order to significantly improve recall. Most of the loss of precision is due to misclassification between slots *number of deaths* and *number of injured*, similar as the example *"370 people were killed by the earthquake and related building collapses, including 228 in Mexico City, and more than 6,000 were injured."* where 228 was incorrectly classified as number of injured and not the number of deaths. The use of multiple topics reduces misclassification between these slots and further improves the recall as new contexts are discovered by the base learners trained on *terrorist attacks*.

Uniform and estimated weights. Using the estimated error rates as weights for the predictions of base learners shows a slight improvement in performance. It may be advantageous to estimate multiple error rates for *topic-specific* base learners, as they tend to be more reliable in predicting examples from the same topic. We believe that more data and experimentation is needed to properly evaluate this component. A major advantage is its flexibility, since we can easily incorporate prior knowledge of the slots or additional constraints on the predictions in the form of logical rules.

4 CONCLUSION AND FUTURE WORK

We presented an approach for training the slot-filling system which can benefit from large amounts of data from Wikipedia. The experiments were performed on a relatively small dataset and show that the proposed direction seems promising. However, the right test of our approach would be to apply it to a much larger number of topics and events, which will be done in the immediate next step. Furthermore, the current approach needs to be evaluated in more detail.

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Knowledge graph aware text classification

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ABSTRACT

Knowledge graphs are becoming ubiquitous in many scientific and industrial domains, ranging from biology, industrial engineering to natural language processing. In this work we explore how one of the largest currently available knowledge graphs, the Microsoft Concept Graph, can be used to construct interpretable features that are of potential use for the task of text classification. By exploiting graph-theoretic feature ranking, introduced as part of the existing tax2vec algorithm, we show that massive, real-life knowledge graphs can be used for the construction of features, derived from the relational structure of the knowledge graph itself. To our knowledge, this is one of the first approaches that explores how interpretable features can be constructed from the Microsoft Concept graph with more than five million concepts and more than 80 million IsA relations for the task of text classification. The proposed solution was evaluated on eight real-life text classification data sets.

KEYWORDS

knowledge graphs, text classification, feature construction, semantic enrichment

1 INTRODUCTION

Text classification is the process of assigning labels to text according to its content. It is one of the fundamental tasks in Natural Language Processing (NLP) with various applications such as spam detection, topic labeling, sentiment analysis, news categorization and many more [1]. In recent years, *knowledge graphs*—real-life graph-structured sources of knowledge—are becoming an interesting source of background knowledge, potentially useful in contemporary machine learning [2]. Knowledge graphs, such as DBPedia[1] or the Microsoft Concept Graph[2] span tens of millions of triplets of the form subject-predicate-object, and include many potentially interesting relations, from which a given machine learning algorithm can potentially benefit.

In this work we propose an approach to scalable *feature construction* from one of the largest freely available knowledge graphs, and demonstrate its utility on multiple real life data sets. The main contributions of this work are as follows:

(1) We propose an extension to the tax2vec [3] algorithm for semantic feature construction, adapting it to operate with real-life knowledge graphs comprised of tens of millions of triplets.

(2) The proposed method is extensively empirically evaluated, indicating that the proposed semantic feature construction aids the classification performance on many real-life datasets.

(3) The implemented method is freely available[3] with a simple-to-use, scikit-learn API.

The paper is structured as follows. Section 2 presents the background and related work. Section 3 presents the proposed approach to semantic feature construction using the information from a given knowledge graph. Section 4 describes the experimental setting and the results, followed by a summary and further work in Section 5.

2 BACKGROUND AND RELATED WORK

In text classification tasks, characterized by short documents or small amounts of documents, deep learning methods are frequently outperformed by more standard approaches, including SVMs [4]. In such settings, it was shown that approaches capable of using semantic context may outperform the naïve learning approaches, the examples are among other based on Latent Dirichlet Allocation [5], Latent Semantic Analysis [6] or word embeddings [7], which is referred to as first-level context.

Second-level context can be introduced by adding *background knowledge* into a learning process, which may help to increase performance and improve interpretability. Usage of knowledge graphs also helped in classification with extending neural network based lexical word embedding objective function [8]. Elhadad et al. [9] present an ontology-based web document, while Kaur et al. [10] propose a clustering-based algorithm for document classification that also benefits from knowledge stored in the underlying ontologies. Use of hypernym-based features was performed already in e.g., the Ripper rule learning algorithm [11]. Wang and Domeniconi [12] used the derived background knowledge from Wikipedia for text enriching. In short document classification, it was shown that the tax2vec algorithm (described below) can help those classifiers gain better results by adding *extra semantic knowledge* to the feature vectors.

The tax2vec [3] is an algorithm for *semantic feature construction* that can be used to enrich the feature vectors constructed by the established text processing methods such as the tf-idf. It takes as input a labeled or unlabeled corpus of documents and a word taxonomy, i.e. a directed graph to which parts of a given document map to. It outputs a matrix of *semantic feature vectors* where each row represents a semantics-based vector representation of one input document. It makes it by mapping the words from the document to a given taxonomy, WordNet or in this work Microsoft Concept Graph, by which it creates the collection of terms for each document and from it, a *corpus taxonomy*—a relational structure specific to the considered document space. The terms presented in the corpus taxonomy represent the potential features.

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[1]https://wiki.dbpedia.org/
[2]https://concept.research.microsoft.com/Home/Introduction

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[3]https://github.com/SkBlaz/tax2vec

3 KNOWLEDGE GRAPH-BASED SEMANTIC FEATURE CONSTRUCTION

Semantic features are constructed as follows. With the help of spaCy library [13], we first find *nouns* in each document in the corpus and for every noun we find all *hypernyms* in the associated knowledge graph. Next, we add the most frequent n such hypernyms to the document-based taxonomy (the number in the third column in Table 1). We identified this step as critical, as the crawl-based knowledge graphs are commonly noisy, and prunning out *uncertain relations* is of high relevance. After performing this for all documents in the corpus, document-based taxonomies are concatenated into corpus-based taxonomy. Next, we perform feature selection, discussed next.

3.1 Feature selection

During feature selection we choose a predefined number of features within the set of features with the goal to *select* the most useful or important features. Hence, from the set of hypernyms which we constructed from the knowledge graph, we choose only top d features (= dimension of the space) based on one of the heuristics described below. **Closeness centrality** of a node is a measure of centrality in a network, calculated as $C(x) = \frac{1}{\sum_y d(y,x)}$, where $d(y, x)$ is the distance (path length) between vertices x and y. The bigger the closeness centrality value a given node has, the closer it is to all other nodes. The **rarest terms** are the most document-specific and are more likely to provide more information than the ones frequently occurring. Hence this heuristic simply takes overall counts of all the hypernyms, sorts them in ascending order by their frequency of occurrence and takes the top d. The **mutual information** between two random discrete variables represented as vectors X_i (the i-th hypernym feature) and Y (the target binary class) is defined as follows:

$$MI(X_i, Y) = \sum_{x,y \in \{0,1\}} p(X_i = x, Y = y) \log_2 \frac{p(X_i = x, Y = y)}{p(X_i = x)p(Y = y)}$$

where $p(X_i = x)$ and $p(Y = y)$ correspond to marginal distributions of the joint probability distribution of X_i and Y. Tax2vec computes the mutual information (MI) between all hypernym features and a given class. So for each target class a vector of mutual information scores is obtained, corresponding to MI between individual hypernym features and a given target class. Then the MI scores for each target class are summed up and the final vector is obtained. The features are sorted by MI scores in descending order and the first d features are chosen as the final semantic space. The **personalized PageRank** algorithm takes as an input a network and a set of starting nodes in the network and returns a vector assigning a score to each node. The scores are calculated as the stationary distribution of the positions of a random walker that starts its walk on one of the starting nodes and, in each step, either randomly jumps from a node to one of its neighbors (with probability p) or jumps back to one of the starting nodes (with probability 1-p). In our experiments probability p was set to 0.85. The tax2vec exploits the idea initially introduced in [14], where personalized PageRank scores are computed w.r.t. the terms, present throughout the document space. This way, a graph-based, completely unsupervised ranking is obtained, and is used in similar manner to other feature selection heuristics discussed in the previous paragraphs. In this section we introduce how the knowledge graph is used for semantic

Table 1: Part of the Microsoft Concept Graph. The row is in form of hypernym - hyponym - frequency of relation

social network	facebook	4987
symptom	fever	4966
sport	tennis	4964
fruit	strawberry	4824
activity	fishing	4789

feature construction, how the text is being processed prior to that and how are semantic features used after that.

3.2 Microsoft Concept Graph

We are using Microsoft Concept Graph[4] [15] [16] for obtaining the extra semantic information. This large relational graph consists of more than 5.4 million concepts that are a part of more than **80 million triplets**. It was created by harnessing billions of web pages, so it is very general and various, offering a lot knowledge to add to our text we want to classify. It contains mostly IsA relations, which was the part we use to obtain hypernyms for nouns in the input text and enrich the feature vectors by some of them. A part of the downloaded knowledge graph is shown in Table 1. The number in the third column is the count of times this relation was found when creating the knowledge graph, so a frequency of the relation's occurrence. We removed relations that had frequency of one, which immediately reduced the graph approximately to half the size and removed mostly noisy relations. Later we used the NetworkX library [17] to transform the Microsoft Knowledge Graph from bare text to a directed graph. This step makes the subsequent exploitation of the knowledge graph easier.

3.3 Proposed approach extending tax2vec

Firstly, we tokenize each document and assign part-of-speech tags to the tokens with the help of the spaCy library [13]. Then for each noun in the text, we find its hypernyms in the knowledge graph. The number of hypernyms for each noun is a parameter chosen by the user, we choose those hypernyms based on the highest frequencies of relation between the current noun and the hypernyms. As shown later in the paper, bigger number of hypernyms does not help a lot, but increases execution time significantly, so it is more sensible to choose a smaller number. Then we create a document-based taxonomy, which is a directed graph where edges are created as hypernym-noun for each hypernym and each noun. We merge the document-based taxonomies into one corpus-based taxonomy (maintaining unique nodes, mergeGraph method in the pseudocode) and on it we perform one of the above mentioned heuristics to choose the best d hypernyms. Those steps are outlined in Algorithm 1.

4 EXPERIMENTS AND RESULTS

This section presents the setting of the experiments and the data sets on which the experiments were conducted. We also describe the metrics used to estimate classification performance.

4.1 Data sets

We conducted the experiments on eight different data sets, which are described below. They were chosen intentionally from different domains and the basic information about them can be seen in Table 2.

---

[4]https://concept.research.microsoft.com/

Data: corpus, knowledgeGraph, maxHypernyms
corpusTaxonomy = [ ];
foreach *doc* ∈ *corpus* **do**
   documentTaxonomy = [ ];
   tokens = tokenize(*doc*);
   foreach *token* ∈ *tokens* **do**
      if *token is noun* **then**
         edges = knowledgeGraph.edgesFrom(*token*);
         foreach *edge* ∈ *edges* **do**
            if *len*(*documentTaxonomy*) >=
            maxHypernyms **then**
               break;
            documentTaxonomy.add(*edge* ∈ *edges*)
   corpusTaxonomy.mergeGraph(documentTaxonomy)
featureSelection(corpusTaxonomy)

Result: Selected semantic features
   Algorithm 1: Semantic feature construction.

Table 2: Data sets used for evaluation of knowledge graph's extra features impact on learning.

Data set	Classes	Words	Unique w.	Documents
PAN 2017 Gender	2	5169966	607474	3600
PAN 2017 Age	5	992742	185713	402
SMSSpam	2	86910	15691	5571
CNN-news	7	1685642	159463	2107
MedicalRelation	18	1136326	66235	22176
Articles	20	5524333	178443	19990
SemEval2019	2	295354	39319	13240
Yelp	5	1298353	88539	10000

PAN 2017 (Gender) Given a set of tweets per user, the task is to predict the user's gender [18].

PAN 2017 (Age) Given a set of tweets per user, the task is to predict the user's age group [19].

CNN News Given a news article (composed of a number of paragraphs), the task is to assign to it a topic from a list of topic categories. [20].

SMS Spam Given a SMS message, the task is to predict whether it is a spam or not. [21].

Medical Relations Given an article with biomedical topic, the task is to predict the relationship between the medical terms annotated. [22].

SemEval 2019 Given a tweet, the task is to predict whether it contains offensive content [23].

Articles Given an web article, the goal is to assign to it a topic. [24].

Yelp Given an review of a restaurant, the goal is to predict the ranking from one to five stars.

Settings. In all the datasets the stop words were removed. Stop words are for example "the", "is", "are" etc. There is no universal list of stop words in NLP research, however we used NLTK (Natural Language Toolkit) [25] for filtering stop words. The documents were tokenized with the help of spaCy's NLP tool. The data sets were divided into 90% training data and 10% test data by using random splits. Number of hypernyms for each noun was 10. We used linear SVM classifier for classification and F_1 measure for performance.

4.2 Results

Figure 1 shows that on some datasets (namely Yelp, PAN 2017 Age, PAN 2017 Gender and on SemEval 2019 and Articles) the extra semantic features constructed from the knowledge graph help in

some cases. We compare those results to the classification without any semantic features which is plotted as a grey horizontal line. On the other hand, on the datasets CNN News, Medical Relation and SMS Spam we didn't see any improvement with the addition of semantic features. Figure 2 shows the relation between feature space size and the execution times.
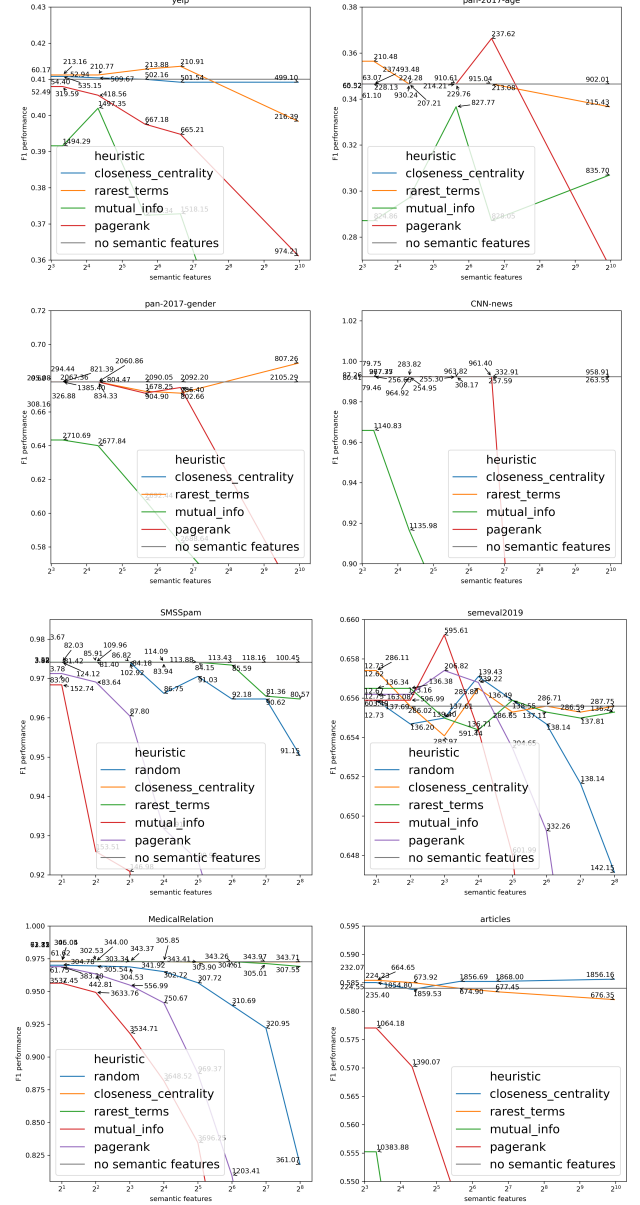
Figure 1: Results of text classification on data sets Yelp, pan-2017-age, pan-2017-gender, CNN News, SMSSpam, SemEval 2019, Medical Relation and Articles with execution times as the numbers in the plot.

5 CONCLUSION

We showed that information from a large, real-life knowledge graph can improve text classification. Our approach aims at short texts like tweets, shorter articles, messages and similar. We firstly process the document with spaCy, find nouns with their corresponding hypernyms, from which we create a taxonomy and from that we later choose the most helpful features with one
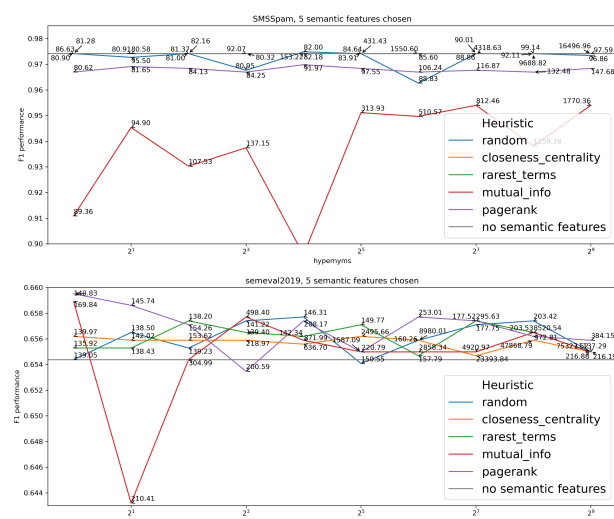
Figure 2: Results of text classification on data sets SMSS-pam and SemEval 2019 with execution times as the numbers in the plot.

of the heuristics. The result remains *interpretable*, which is an advantage of this approach. This approach could be potentially improved by performing some type of word sense disambiguation and by finding objects in texts, which consists of more than one word. Further, other knowledge graphs can be used for the hypernym search. Also, because the hypernym search in each document is independent, the documents can be processed in parallel; however, such processing can be memory-intensive, which is to be addressed.

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EveOut: Reproducible Event Dataset for Studying and Analyzing the Complex Event-Outlet Relationship

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ABSTRACT

We present a dataset consisting of 77, 545 news events collected between January 2019 and May 2020. We selected the top five news outlets based on Alexa Global Rankings and retrieved all the events reported in English by these outlets using the *Event Registry API*. Our dataset can be used as a resource to analyze and learn the relationship between events and their selection by the outlets. It is primarily intended to be used by researchers studying bias in event selection. However, it may also be used to study the geographical, temporal, categorical and several other aspects of the events. We demonstrate the value of the resource in developing novel applications in the digital humanities with motivating use cases. Website with additional details is available at *http://cleopatra.ijs.si/EveOut/*.

KEYWORDS

Dataset, News Event Analysis, Event selection bias, News coverage

1 INTRODUCTION

News outlets are constantly faced with the task of selecting events they will report on, dependent on the perceived interest of the event to their readership. This can be driven by various factors, such as the geographical origin of the event, involvement of well-known persons, etc. Such selection requires monitoring of current affairs to determine their news value for the outlet.

Machine learning tools may help outlets to deal with the large numbers of events, help them explore strategies for selecting publishable events, and build dedicated decision support systems for this task. The effectiveness of these systems depends on the availability of news event collections complemented by relevant event details such as date, category, country of occurrence, brief description, etc.

In this paper we introduce EveOut, the first large publicly available data set of 77, 545 English news events with a variety of features collected between January 2019 and May 2020. It includes events in eight different categories of news, i.e. business, politics, technology, environment, health, science, sports, and arts-and-entertainment. We hope that EveOut will encourage publishers and others involved in the news production process to develop tools to enhance digital journalism. The data set would also allow researchers from digital humanities to study and analyze the

relationship and impact of different features on the selection of events by the outlets.

1.1 Contributions

The paper makes the following three contributions to science:

- The dataset generation scripts, which provide a structured reproducible approach to building a publicly available dataset of news events with varied features. This will not only speed up the development of future versions of EveOut, but will also help to create custom datasets with the desired outlets and features.
- The compilation of EveOut, a novel dataset with a rich range of event features and spanning multiple news categories.
- Identification of possible use cases intended to facilitate the creation of tools to improve digital journalism and to help researchers study the complex relationship between events and news outlets.

2 DATASET

Several news outlets may cover a single world event as a story in a variety of different ways. A collection of one or more stories, all of which describe the same world event, is referred to as an *'event'* in the entire paper. In the following subsections, we define our data generation process and provide statistics on the resulting dataset.

2.1 Data Source

We use **Event Registry**[1][4] as the data source which monitors, collects, and provides news articles from news outlets around the world in over 30 languages. It also identifies the major incidents reported in the articles and aggregates them into clusters known as events. For example, *"missiles launched by Iran at US forces in Iraq"* is an event reported across the globe in over 3,200 news articles.

To construct an event, Event Registry follows a series of steps. News aggregation is the first step in which RSS feeds are constantly monitored for new articles. The next major step is the semantic event information extraction, which retrieves information from the articles in a structured way to be used in subsequent steps. Clustering algorithms are then used to group articles that describe the same event. In the last step, the article clusters are marked as events and are annotated with rich metadata such as a unique id to track the event coverage, categories to which it may belong, geographical location, sentiment, etc. As a result, its extensive temporal coverage can be used effectively to study the complex correlation between events and news outlets.

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[1]https://eventregistry.org
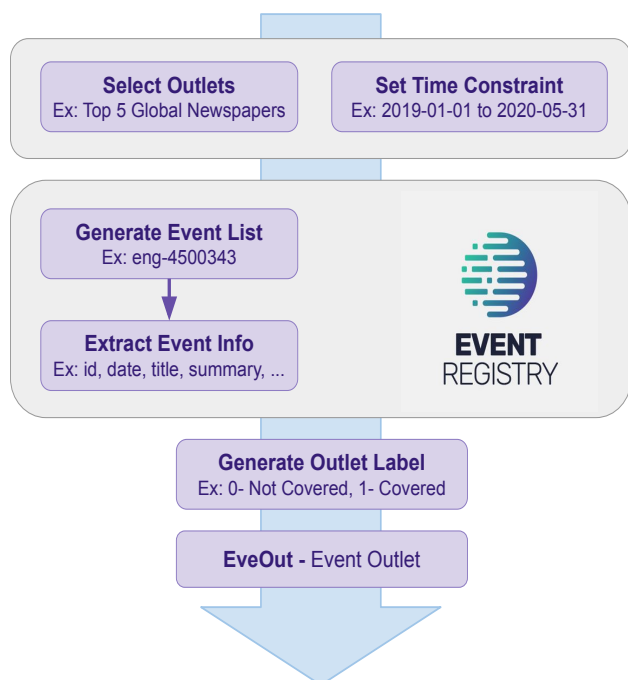
Figure 1: EveOut dataset generation process.

Table 1: Description of the dataset attributes.

Attribute	Description
uri	a unique event identifier
title	title of the event in English
event_date	date in yyyy-mm-dd format
sentiment	event sentiment
categories	event categories
loc_country	country where the event occurred
loc_continent	continent where the event occurred
total_article_count	total number of articles published
article_count	total number of articles published in English
summary	summary of the event
outlet_list	list of outlets that reported the event

2.2 Data Generation Process

To generate the dataset we adopted an automated approach which is depicted in Figure 1. We use Event Registry API to collect event related information mentioned in Table 1. The script is designed to simplify the release of future versions and to be able to replicate the process of generating custom datasets. The outlined process is the result of the resource's core requirement to best address the potential use-cases referred to in Section 4.

For data generation, we first selected the top five news outlets based on Alexa Global Rankings [2]. We then used an explicit temporal query (Q_t) to retrieve all events in all news categories from the Event Registry API. Q_t = {Q_{text}, Q_{time}} consists of the text component Q_{text} and the time component

Q_{time}. Next, we set the time limit Q_{time} = [Q_{sd}, Q_{ed}] for extracting events that occurred within the specified time where, Q_{sd} = '2019-01-01' and Q_{ed} = '2020-05-31' signify the event's start date and end date. Since the outlet's event selection policy may change over time, we selected this time frame as recent data tends to be more reliable in predicting event coverage patterns. We then set Q_{text} = {Q_{out}, Q_{lang}, Q_{cat}} where, Q_{out} = {'nytimes', 'indiatimes', 'washingtonpost', 'usatoday', 'chinadaily'}, Q_{lang} = {'eng'}, and Q_{cat} = {'politics', 'business', 'sports', 'arts and entertainment', 'science', 'technology', 'health', 'environment'} represent the outlets, languages and news categories respectively.

From the extracted event list, we first excluded events that were not covered by any of the selected outlets. We then extracted individual outlets from the event's outlet list and created a column in the dataset to represent each of them. We use a binary scalar value to indicate whether the outlets covered the event or not. The event coverage by the outlets is not uniform, which can be visualized in Figure 2.
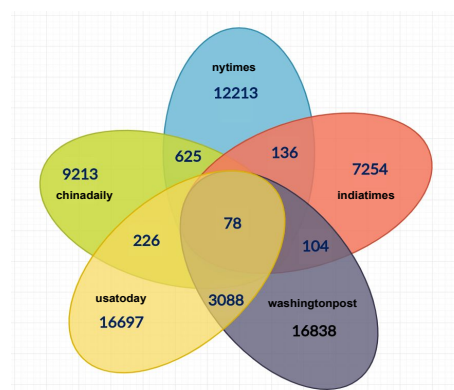
Figure 2: Distribution of event coverage by the outlets.

3 AVAILABILITY

The GitHub repository containing the scripts is available at *https://github.com/Swati17293/EveOut*. To facilitate discoverability and preservation, the full data set is archived as an online resource at *https://doi.org/10.5281/zenodo.3953878*. EveOut is available in three common formats (JSON, XML, and CSV) for direct download and use. The documentation meets the requirements of the *FAIR Data principles*[3] with all necessary metadata defined. Under the *Creative Commons Attribution 4.0 International license*, it is freely available to make it reusable for almost any purpose. A separate web page with detailed statistics and illustrations can be found at *http://cleopatra.ijs.si/EveOut/* for in-depth analysis.

3.1 Reusability

The resource is currently being used for individual projects and as a contribution to the project's deliverables of the Marie Skłodowska-Curie CLEOPATRA Innovative Training Network[4]. A major part of this project aims to provide a temporal, cross-lingual analysis of concepts around different events, exploring how language impacts the mediatic narratives built by the media. It also aims to analyse news reporting bias and multiple media
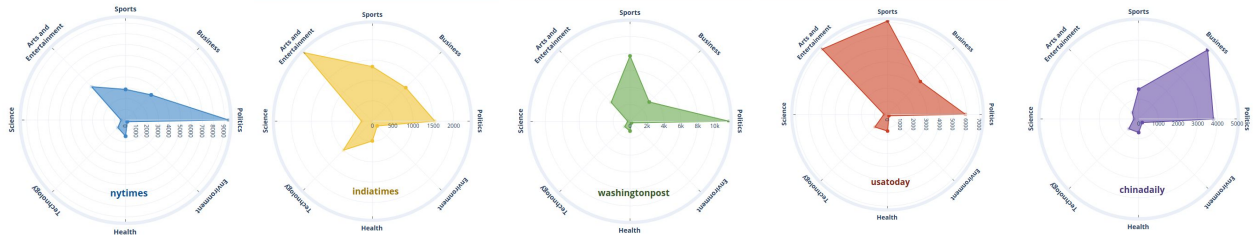
Figure 3: Overview of the category-wise event coverage by the outlets.

narratives which would enable to filter out appropriate information which then will be used to build information representation tools. Since EveOut serves as the basis for the study and analysis of events and their attributes, it is ideally suited to the project needs.

4   POTENTIAL USE CASES

4.1   Examine Event-Selection Bias

It is important for a journalist to know which event is worthy enough to be published. Even readers would be interested to know the factors that affect this selection. An automated solution can be devised using EveOut to provide an overview of the event and to visualize differences in coverage.

4.2   Outlet Prediction

EveOut is designed to predict the likelihood of an event being covered by the outlet. It would enable the publishers of the outlets to assess the significance of the event. In addition, it may also be used by independent editors who prefer to report on events covered by mainstream outlets.

5   STATISTICS AND ANALYSIS

In this section we provide further information about the data contained in EveOut, focusing explicitly on the distribution of events between the outlets.

With regard to the distribution of event categories covered by the outlets, as shown in Figure 3, *'politics'* is the most common category, while *'environment'* is the least common category. It is also worth noting that each outlet focuses on the different categories of events aside from *'politics'*. For instance, *'india-times'* focuses more on events related to *'arts and entertainment'*, whereas *'chinadaily'* tends to cover more *'business'* related events.

As far as the coverage of the event over time is concerned, it is also inconsistent as depicted in Figure 6. Furthermore, the event-coverage of *'usatoday'* and *'washingtonpost'* is slightly inconsistent. It is also interesting to note the sharp decline in coverage by *'usatoday'* in *'Aug* 2019' and by *'washingtonpost'* in *'May* 2020'.

The drop in the graph for washingtonpost in *'May* 2020 is due to its event preference. It is evident from washingtonpost's radial graph in Figure 3 that its coverage is biased towards politics and sports. These two categories alone represent around 50% of events in the dataset. However, this percentage dropped to 40% in *'May* 2020 and, as a result, the coverage of washingtonpost dropped significantly. Increase of event coverage in *'Mar* 2019 is also attributed to the fact that about 56% of events were from these two categories. In nutshell, if the outlet favors a certain category of events and, in a specific time frame, and events of

that category are high/low than usual, it will be reflected in the outlet's coverage pattern.

Figure 4 reveals that instead of favoring events with neutral sentiment, outlets tend to favor events with positive sentiment. In addition, event coverage by *'usatoday'* and *'washingtonpost'* is quite diverse with respect to sentiments.
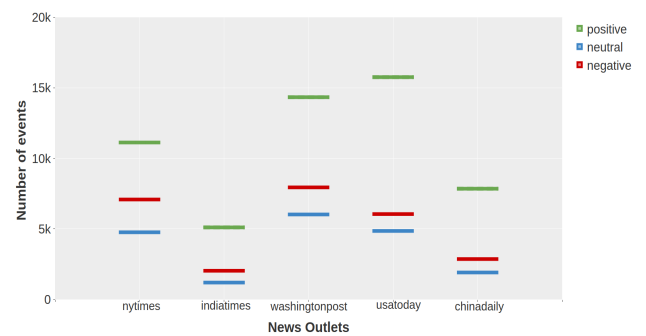
Figure 4: Distribution of event coverage by the outlets with respect to sentiments.

In terms of the sentiments used in each category as plotted in Figure 5, it is worth noting that *'technology'* and *'sports'* events are mostly positive.
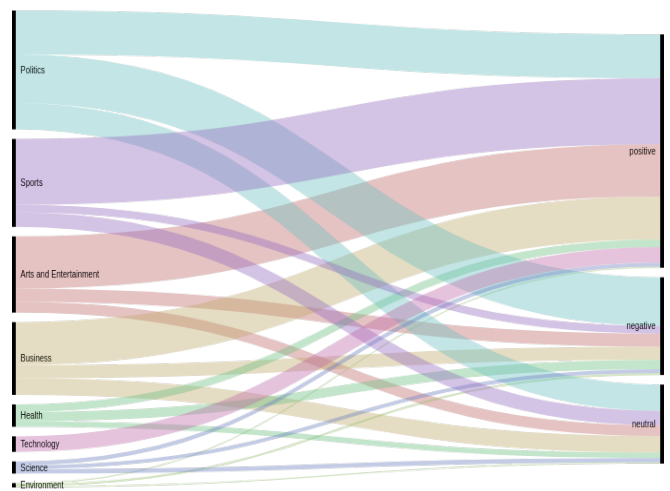
Figure 5: Distribution of category over sentiments.
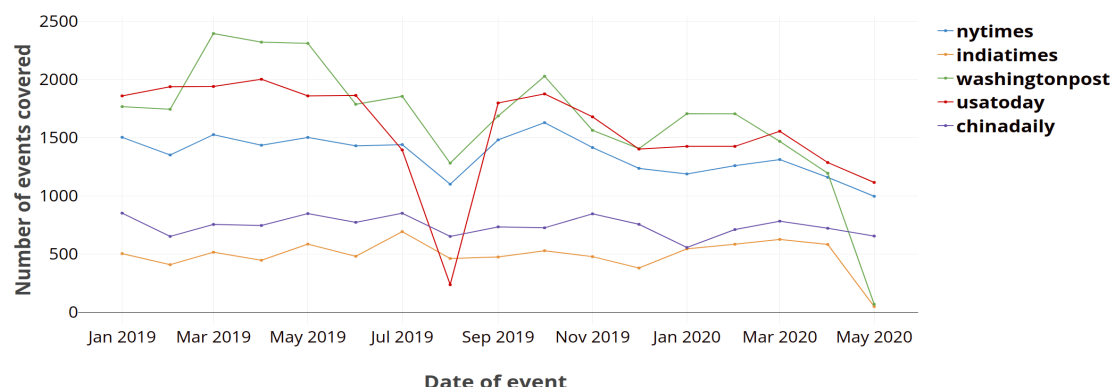
Figure 6: Distribution of the event coverage by the outlets over time.

6 RELATED WORK

There are a number of datasets that focus on news articles [7]. As far as the availability of event-centric datasets is concerned, there is a scarcity of publicly available datasets. There are few related research on the event data [3, 1], but the extracted/generated datasets for the experiments is also not publicly accessible.

GDELT [5] is the most popular, very large and publicly available event-oriented news dataset. It contains data in multiple languages from a wide range of online publications. It's collection of world events is centered on location, network and temporal attributes. There is no attribute defining the outlet list for the event in the dataset. As a result, there is a lack of knowledge essential to the analysis of the event-outlet relationship that is the foundation of our dataset.

In addition, the existing event datasets [6, 2] are category-dependent (*politics/healthcare/disaster etc.*) which renders them useful for specific research purposes only. Therefore, by providing a generalized event-centric news dataset, EveOut addresses the stated dataset bottleneck.

7 CONCLUSIONS AND FUTURE WORK

In this paper, we introduced the EveOut dataset, which covers events reported by the top five global news outlets for over 17 months. We have ensured that the dataset complies with the *FAIR principles*. In conjunction with the data set, we provide the source code for reproducing the dataset with varied features. For instance, it is possible to generate a reduced version of Eve-Out, focused on just one category, say *'politics'*. Specific outlets, dates, and languages can also be specified in accordance with the requirements. We illustrate potential use cases to show how the dataset could be used to study the pattern of event coverage of an individual outlet and to predict whether or not the outlet will cover a specific event. Researchers from digital humanities can also use it for an in-depth analysis of complex event-outlet relationships. In the future , we intend to extend the dataset to include events described in different languages.

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Ontology alignment using Named-Entity Recognition methods in the domain of food

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Abstract

In recent years, a great amount of research has been done in predictive modeling in the domain of healthcare. Such research is facilitated by the existence of various biomedical vocabularies and standards which play a crucial role in understanding healthcare information. In addition, the Unified Medical Language System (UMLS) links together biomedical vocabularies to enable interoperability. However, in the food domain such resources are scarce. To address this issue, this paper explores a methodology for ontology alignment in the domain of food by leveraging Named-Entity-Recognition (NER) methods based on different semantic resources. It is based on a recently published rule-based NER method named FoodIE, whose semantic annotations are based on the Hansard corpus, as well as a NER tool called Wikifier, from which DBpedia URIs are extracted. To perform the alignment we use the FoodBase corpus, which consists of recipes annotated with food entities and includes a ground truth version which is additionally used for evaluation.

1 Introduction

Information Extraction (IE) is the task of automatically extracting information from unstructured data and, in most cases, is concerned with the processing of human language text by means of natural language processing (NLP) [Aggarwal and Zhai, 2012]. The main idea behind IE is to provide a structure to the information extracted from the unstructured data.

One of the core IE tasks is named-entity recognition (NER), which addresses the problem of identification and classification of predefined concepts [Nadeau and Sekine, 2007]. It aims to determine and identify words or phrases in text into predefined labels (classes) that describe concepts of interest in a given domain. Various NER methods exist: *terminology-driven*, *rule-based*, *corpus-based*, *methods based on active learning (AL)*, and *methods based on deep neural networks (DNNs)*.

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Terminology-driven NER methods, also called dictionary-based NER methods [Zhou *et al.*, 2006], match text phrases against concept synonyms that exist in the terminological resources (dictionaries). The main disadvantage of these methods is that only the entity mentions that exist in the resources will be recognized, but the benefit of using them is related to the frequent updates of the terminological resources with new concepts and synonyms.

Rule-based NER methods [Hanisch *et al.*, 2005] use regular expressions that combine information from terminological resources and characteristics of the entities of interest. The main disadvantage of these methods is the manual construction of the rules, which is a time-consuming task and depends on the domain.

Corpus-based NER methods [Alnazzawi *et al.*, 2015; Leaman *et al.*, 2015] are based on an annotated corpus provided by subject-matter experts as well as the use of ML techniques to predict the entities' labels. These methods are less affected by terminological resources and manually created rules. However, their limitation is their dependence on an existence of an annotated corpus for the domain of interest. The construction of the annotated corpus for a new domain is a time consuming task and requires effort by the subject-matter experts to produce it.

To exploit unlabelled data in constructing NER methods, *AL* can be used [Settles, 2010; Tran *et al.*, 2017]. This represents semi-supervised learning in which an algorithm is able to interactively query the user to obtain the desired labels/outputs at new data points. Which examples are sent to the user for labelling is chosen by the algorithm and their number is often much lower than the number of examples required for supervised learning. It usually consists of three components: (1) the annotation interface, (2) the corpus-based NER, and (3) component for querying samples.

2 Related work

2.1 Hansard corpus

The Hansard corpus is a collection of text and concepts created as a part of the SAMUELS project [Alexander and Anderson, 2012; Rayson *et al.*, 2004]. It contains 37 higher level semantic groups, one of which is our topic of interest — *Food and Drink*.

2.2 FoodIE

FoodIE is a rule-based food Named-Entity Recognition method [Popovski *et al.*, 2019a]. As it is rule-based, it consists of a rule-engine in which the rules are based on computational linguistics and semantic information that describe the food entities.

2.3 Wikifier

Wikifier is a tool that uses an efficient approach for annotating documents with relevant concepts from Wikipedia [Brank *et al.*, 2017]. It is based on a pagerank method to identify a set of relevant concepts. As it provides the location in the document where the annotation occurs, it is effectively a Named-Entity Recognition method. It provides Wikipedia concepts as annotations, additionally assigning DBpedia concepts if they exist.

3 Data

A recent publication provides one of the first annotated corpora, named FoodBase [Popovski *et al.*, 2019b], containing food entities. It consists of two version, a ground truth set referred to as "curated" (containing 1,000 annotated recipes), as well an "un-curated" version, consisting of around 22,000 recipes. The recipe categories that are included are: *Appetizers and snacks*, *Breakfast and Lunch*, *Dessert*, *Dinner*, and *Drinks*. In this paper, we use the *curated* version to perform the ontology alignment as well as evaluate the methodology. This version was manually checked by subject-matter experts, so the false positive food entities were removed, while the false negative entities were manually added in the corpus. An example of a recipe can be found on Figure 1.

4 Ontology alignment

Using FoodIE and the Wikifier tool, we obtain annotations for all 1,000 recipes from the FoodBase.

FoodIE extracts and annotates each recipe with semantic tags from the Hansard corpus. Each annotation contains the location of the extracted entity, i.e. where in the raw text the surface form representing the concept occurs, and its corresponding semantic tags from the Hansard corpus.

The Wikifier tool is used to annotate the recipes with DBpedia URIs. As these are general DBpedia concepts, additional information to filter out food concepts from non-food concepts is required. Webscraping the pages for the URIs provides useful information that can be used to distinguish food from non-food concepts, such as the broader concept/class to which the concept of interest belongs. The post-processing of the DBpedia URIs checks the entity type of the concept and checks if it is one of: "FOOD", "FOODS", "DISH", "INGREDIENT", "FOOD AND DRINK", "BEVERAGE", "PLANT", "ANIMAL", or "FUNGUS". If it does not belong to one of the above entity types, the page is checked for mentions of other URIs which are semantically related to food: "FOOD", "PLANT", "ANIMAL", or "FUNGUS". These URI mentions can occur anywhere in the page and if one of these matches is satisfied, the entity is assumed to be a food entity.

A post-processed example of such an annotation can be found on Figure 2.

Having annotated the recipes with both methods, we can perform the ontology alignment by using the location information for each annotation in each recipe. Each unique concept from both methods (semantic resources) is assigned its unique ID, and then a table is constructed for each concept mapping containing the IDs.

5 Evaluation and experimental setup

5.1 Match types

- True Positives (TP) — these are matches where the whole food concept is correctly annotated;
- False Positives (FP) — these are matches where a non-food concept is annotated as a food concept;
- False Negatives (FN) — these are matches where a food entity is not properly annotated;
- Partial match — these are matches where only some tokens from a food concepts are properly annotated.

5.2 Evaluation metrics

Using the concept of True Positives, False Positives and False Negatives, we compute the widely used evaluation metrics: Precision (P), Recall (R) and F1 Score (F1). They are defined as:

- $P = \frac{TP}{TP+FP}$
- $R = \frac{TP}{TP+FN}$
- $F1 = 2\frac{P \cdot R}{P+R}$

6 Results and discussion

After running the evaluation, we obtain the following results. The matches for both methods are presented in Table 1, while the evaluation metrics are presented in Table 2.

Table 1: Match types.

	FoodIE	Wikifier
TPs	11461	6380
FNs	684	4121
FPs	258	5861
Partial	359	3297

Table 2: Evaluation metrics.

	FoodIE	Wikifier
F_1 Score	0.9605	0.5611
Precision	0.9780	0.5212
Recall	0.9437	0.6076

From the results in the tables it is evident that FoodIE provides more promising results. However, this was expected as this NER method was specifically constructed to only cater to the domain of food. Of especial interest are the matches of type *partial*, since they represent a match where only a subset of the tokens in a food entity are correctly recognized. For example, looking at Figure 1, the first extracted food entity

```
<document>
    <id>0recipe1090</id>
    <infon key="category">Appetizers and snacks</infon>
    <infon key="full_text">
    Mix the dry ranch salad dressing mix, mayonnaise, and milk in a bowl.
    Beat in the cream cheese with an electric mixer until smooth. Mix in Cheddar cheese.
    Cover bowl with plastic wrap, and freeze 30 minutes. Divide mixture in half, and shape into balls.
    Roll each ball in almonds to coat. Cover and refrigerate balls until ready to serve.
    </infon>
    <annotation id="1">
        <location offset="3" length="28"/>
        <text>dry ranch salad dressing mix</text>
        <infon key="semantic_tags"> AG.01.h.02 [Vegetables];AG.01.m [Substances for food preparation];
            AG.01.n.09 [Prepared vegetables and dishes];</infon>
    </annotation>
    <annotation id="2">
        <location offset="9" length="10"/>
        <text>mayonnaise</text>
        <infon key="semantic_tags"> AG.01.l.04 [Sauce/dressing];
            AG.01.n.01 [Food by way of preparation];</infon>
    </annotation>
    <annotation id="3">
        <location offset="12" length="4"/>
        <text>milk</text>
        <infon key="semantic_tags"> AG.01.e [Dairy produce];</infon>
    </annotation>
    <annotation id="4">
        <location offset="20" length="12"/>
        <text>cream cheese</text>
        <infon key="semantic_tags"> AG.01.e [Dairy produce];AG.01.e.02 [Cheese];
            AG.01.n [Dishes and prepared food];AG.01.n.18 [Preserve];</infon>
    </annotation>
    <annotation id="5">
        <location offset="31" length="14"/>
        <text>Cheddar cheese</text>
        <infon key="semantic_tags"> AG.01.e.02 [Cheese];AG.01.n.18 [Preserve];</infon>
    </annotation>
    <annotation id="6">
        <location offset="59" length="7"/>
        <text>almonds</text>
        <infon key="semantic_tags"> AG.01.h.01.f [Nut];</infon>
    </annotation>
</document>
```

Figure 1: Example recipe from the "curated" part of FoodBase.

	urls	text	from	to	matchType
0	http://dbpedia.org/resource/Salad	salad	19	23	PREF
1	http://dbpedia.org/resource/Mayonnaise	mayonnaise	39	48	PREF
2	http://dbpedia.org/resource/Milk	milk	55	58	PREF
3	http://dbpedia.org/resource/Bowl	bowl	65	68	PREF
4	http://dbpedia.org/resource/Cream	cream	83	87	PREF
5	http://dbpedia.org/resource/Cream_cheese	cream cheese	83	94	PREF
6	http://dbpedia.org/resource/Cheese	cheese	89	94	PREF
7	http://dbpedia.org/resource/Cheddar_cheese	Cheddar	140	146	PREF
8	http://dbpedia.org/resource/Plastic_wrap	plastic wrap	172	183	PREF
9	http://dbpedia.org/resource/Mixture	mixture	216	222	PREF
10	http://dbpedia.org/resource/Virus	shape	237	241	PREF
11	http://dbpedia.org/resource/Almond	almonds	273	279	PREF
12	http://dbpedia.org/resource/Refrigeration	refrigerate	300	310	PREF

Figure 2: Wikifier annotation example on a single recipe

should be "dry ranch salad dressing", which is correctly extracted by FoodIE. Looking at Figure 2, the same food entity is only extracted as "salad". Such match types do not factor in the calculation of the evaluation metrics, as it is debatable whether to count them as TPs or FNs. Nevertheless, they are interesting to compare, since even partial matches convey at least some semantic meaning regarding the food entity. Moreover, FP annotations on the same figure are "bowl" and "shape" which are not food entities. Additionally, a recent comparison of existing food NER methods can be found in [Popovski *et al.*, 2020], where the authors compare the performance of FoodIE with NER methods using other food ontologies available in the BioPortal.

Regarding the mapping of the concepts, a total of 348 explicit concept mappings were discovered by the methodology. An example mapping for the concept "garlic" would be:

- A000016: 'garlic', AG.01.h.02.e [Onion/leek/garlic].
- E000029: 'garlic', http://dbpedia.org/resource/Garlic

7 Conclusion and future work

In this work we propose a methodology for ontology alignment by using Named-Entity Recognition methods in the domain of food. It utilizes the newly proposed FoodIE NER method and the Wikifier text annotation tool. Our experimental results show that FoodIE provides more promising results than Wikifier, achieving an $F1$ score of 0.9605, compared to 0.5611. This is expected since FoodIE is specifically designed for the food domain, while Wikifier uses general vocabulary and annotates text with Wikipedia concepts.

For future work, recursive webscraping can be performed to more accurately distinguish between food and non-food annotated concepts from the Wikifier tool. Specifically, this would mean repeating the steps to check if the entity is a food entity or not on the parent nodes in DBpedia. Additionally, more food semantic resources can be included to provide mapping between multiple ontologies. Doing this is dependent on the existence of a NER method that works with concepts from the desired food semantic resource.

Acknowledgements

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Extracting structured metadata from multilingual textual descriptions in the domain of silk heritage

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ABSTRACT

In this paper, we present a methodology for extracting structured metadata from museum artifacts in the field of silk heritage. The main challenge was to train on a relatively small and noisy data corpus with highly imbalanced class distribution by utilizing a variety of machine learning techniques. We have evaluated the proposed approach on real-world data from five museums, two English, two Spanish, and one French. The experimental results show that in our setting using traditional machine learning algorithms such as Support Vector Machines gives comparable and in some cases better results than multilingual deep learning algorithms. The study presents an effective approach for categorization of text described artifacts in a niche domain with scarce data resources.

KEYWORDS

Information extraction, Text classification, Silk heritage, Transformers, Support Vector Machines.

1 INTRODUCTION

When looking to improve the understanding of silk heritage we find that the data available in the museums often lack semantic information on the artifacts or have them to some extent included in textual descriptions. To facilitate automatic analysis of silk heritage data and support digital modeling of the weaving techniques, we propose multilingual metadata extraction from textual descriptions provided by the museums.

We propose the usage of machine learning techniques to model the target variables, referred here as slots to align with the terminology of information extraction. Using machine learning methods we build a model for each of the target variables in order to annotate the text. This enabled us to add metadata to the silk heritage artifacts of the museums. The domain experts collaborating on Silknow project [9] have identified four kinds of metadata information that would be useful and are contained in texts of at least some of the targeted museums. We treat these as four slots for information extraction, where the list of possible slot values for each of the four was defined by the domain experts. Based on that we formed a multi-class dataset for each slot.

The corpora of text included were in three different languages (English, Spanish, and French) from five different museums, with a total of 500 museum records used in the study. After the data

processing and annotation, we generated 24 binary datasets and 19 multi-class datasets (four for English, two for Spanish, and one for French). Using machine learning techniques we trained classifiers on the labeled data examples to predict the labels (slot values) based on the textual descriptions. Despite relatively small and unbalanced data corpora, using sampling techniques and weighted loss function helped mitigate the issue. In an experimental evaluation, we observed that on our data using traditional methods might be as good as using deep learning models when the data is scarce. However, using deep learning allows for building multilingual models that scale across different languages.

The main contribution of this paper is in proposing an approach to adding metadata to historical artifacts based on applying machine learning on multilingual textual descriptions of the artifacts. Moreover, we have defined the learning problem in collaboration with domain experts and performed evaluations on real-world data in English, Spanish, and French. The rest of this paper is structured as follows. Section 2 provides a description of the data, Section 3 describes the proposed methodology, Section 4 gives the results of the evaluation and Section 5 concludes the paper summarizing the approach and the findings.

2 DESCRIPTION OF DATA

We used the SilkNow knowledge graph [8] as our source of data. The source consists of records of different museums in different languages as shown in Table 1. The largest are MET with 8364 artifacts in English, VAM with 7231 artifacts in English, and Imatex with 6799 artifacts in Spanish. We have used a subset of the data that contain artifacts with provided metadata and textual descriptions in related fields that were pointed out as relevant by the domain experts. Each record consists of the basic information about the object, such as the title and the museum it belongs to, along with two other sets of attributes, textual attributes, and categorical attributes. Textual attributes hold a textual description of the object in several fields, such as physical description and a technical description. The categorical description holds metadata information, such as technique or materials used. However, the data quality varies across the museums and records. Some museums are rich in both textual and categorical attributes, like the VAM museum, and others have short/low-quality textual attributes like Imatex. Also, some records have a text description in their categorical attributes instead of a single category value.

The metadata fields that we have considered are weaving technique, weave, motifs, and style. The list of labels or slot values for each of the metadata field (i.e. slot for information extraction) were compiled by the domain experts. These values describe the silk artifacts' nature and structure. Each of those slot values is represented by a term and a list of alternatives, up to four alternatives per term. Examples of slot values are satin, twill, and tabby, representing possible values of the weave slot.

Museum	Language	Count
CER	Spanish	1296
Garin	Spanish	3101
Imatex	Spanish	6799
Joconde	French	376
MAD	French	763
MET	English	8364
MFA	English	3297
MTMAD	French	663
RISD	English	3338
VAM	English	7231

Table 1: Museums from the Silknow knowledge graph showing the language of the artifacts and the number of artifacts included in the knowledge graph.

3 METHODOLOGY

3.1 Annotating datasets with slot values

Based on the data and target variables, two types of datasets were formed for two types of text classification tasks. The first type is binary classification dataset, in which the target class is one of the slot values. The other is multi-class classification dataset, in which a dataset is formed for each of the four slots in each museum, where the target classes are the slot values that fall under the selected slot in addition to extra "other" class indicating that the example doesn't fall under any of them.

For forming the binary classification dataset we used a simple string matching approach. For each target class in each museum, examples were formed out of textual attributes of the museum records that contain a mention of either one of the possible value terms or its alternatives. Categorical attributes of the same record were used to determine the label of the example. The task is to classify whether the example has the slot value against the other slot values of the same slot. Each item is classified as True if the categorical attributes contain only the target value or one of its alternatives but not any of the other slot values' terms or their alternatives. If there is no mention of the slot value term or alternatives, then it's classified as false. If it contains this slot value' term along with other slot values' terms then it's considered as indeterminate and the example is removed.

To form the multi-class datasets, we merged the datasets of the same museum with target classes representing slot values that fall under the same slot. The true items of each slot value dataset formed the set of the examples with that slot value as the labels. The items that are false in each slot value dataset formed the "Other" class in the multi-class dataset.

3.2 Binary Classification Tasks

For binary classification, we used TFIDF word-vector representation for generating the feature vectors and trained a Linear Support Vector Machines (SVM) as the classifier using scikit-learn library [5]. All dataset were split into train and test using 80-20 stratified split. We performed a grid search with 5-fold cross validation on the training part using the following options:

- stemming, lemmatisation, or none
- max document frequency: [0.95.1.0]
- min document frequency: [0,0.05]
- SVM tolerance: [1e-4,1e-5]

The features were generated from sequences of words, referred to as n-grams, of length 1, 2, and 3. The remaining parameters were left unchanged from their default values. We used nltk [1] library for tokenization, SpaCy [4] for lemmatization, and Snow Ball Stemmer [6] for stemming.

Due to the methodology of data labeling, we sometimes ended up with a highly imbalanced datasets having a lot more negatives than positives. Therefore, in the binary dataset, we took a random subset from the negative examples to match the positive count. In addition, some examples were generated from the same records, by having more than one textual record with mentions of the same class's term/alternatives, therefore, corrections have been applied to the dataset by putting all examples of the same record in either train or test but not in both. This process was done to ensure no leakage occurs by potentially having highly similar textual text in train and text.

3.3 Multi-class Classification Tasks

For multi-class classification, we used a deep learning approach. The architecture consists of a pre-trained transformer, an LSTM layer, a dropout layer, a dense (linear) layer, and finally a soft-max activation layer. For the transformer we used BERT [3], multi-lingual BERT, and XLM-ROBERTA [2]. The loss function used was a cross-entropy loss with Adam as the optimizer. We used PyTorch framework [7] and hugging-face transformers library [10].

Considering that some of the datasets have a large class imbalance, which can be a couple of thousand examples of the majority class and only a few examples of the minority classes, we experimented with several class-weighting schemas. First, we tried assigning weights to the classes in the loss function is inversely proportional to the number of examples of each class. In addition, when we used weighted sampling with return for loading the examples into batches. This had the effect of over-sampling the minority classes and under-sampling the majority classes to achieve as balanced batch representation as possible. Finally, we tried a derivable version of F1 Macro as a loss function where the prediction matrix is taken as a probability rather than a binary value.

4 RESULTS

4.1 Experimental Datasets

The dataset collection methodology was applied to 10 museums and 4 categories holding more than 150 class values overall. However, most of the datasets have no positive items. In this research, we have selected datasets with at least 10 positive examples for binary classification tasks and at least 10 non-other in multi-class tasks. This final list consists of 24 binary datasets and 19 multi-class datasets. These datasets are used for training machine learning classifiers.

4.2 Binary Classification Tasks

For binary Classification, we applied the described methodology on all the datasets with at least 10 positive examples. The results of binary classification are consolidated in Table 2.

The graph in figure 1 displaying the correlation between the number of examples and the F1 score reveals a weak correlation of 0.19. We can see that when having more than 600 examples, we achieve F1 over 0.8. Upon closer inspection on the museum level, we found that the best results are achieved in the MFA museum on motifs and weaving technique and Joconde museums on weave.

Museum	Slot value	Slot	Language	#Exs	Accuracy	Precision	Recall	F1
cer	bordado	weaving technique	Spanish	278	0.89	0.87	0.93	0.9
cer	motivo vegetal	motifs	Spanish	146	0.57	0.56	0.6	0.58
cer	tafetÃ¡n	weave	Spanish	581	0.77	0.9	0.6	0.72
cer	terciopelo	weaving technique	Spanish	118	0.67	0.67	0.67	0.67
garin	brocatel	weaving technique	Spanish	932	0.88	0.85	0.92	0.89
garin	damasco	weaving technique	Spanish	1748	0.9	0.92	0.87	0.89
garin	espolÃn	weaving technique	Spanish	972	0.88	0.89	0.88	0.88
joconde	Satin	weave	French	159	0.91	0.9	0.95	**0.93**
joconde	Taffetas	weave	French	110	0.95	0.92	1	**0.96**
mfa	Lace	motifs	English	190	0.92	0.9	0.95	**0.92**
mfa	plain	weaving technique	English	130	1.00	1.00	1.00	**1.00**
vam	brocade	weaving technique	English	634	0.87	0.87	0.87	0.87
vam	damask	weaving technique	English	480	0.84	0.85	0.83	0.84
vam	Ear	motifs	English	262	0.83	0.84	0.81	0.82
vam	Edge	motifs	English	178	0.81	0.87	0.72	0.79
vam	embroidery	weaving technique	English	1614	0.85	0.86	0.83	0.84

Table 2: Results for the binary classification task.

Overall the best results are achieved by MFA and Joconde with an average F1 of .96 and .95 respectively followed by Garin, VAM, and CER with the average F1 of .89, .81, and .72 respectively.
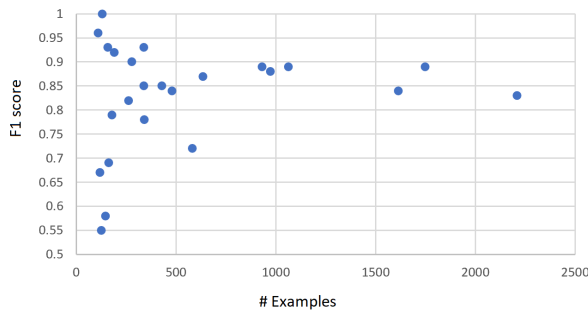
Figure 1: F1 score vs #Examples showing good performance on the largest datasets, when the number of examples is at least 600.

4.3 Multi Class Classification Class

4.3.1 Use Case: Detecting Weave Slot from VAM museum. We selected the VAM Weave slot as a use case dataset to perform hyperparameter tuning and select the best configurations for weighting. The dataset contains 2760 items with a baseline of 52.9% distributed across 4 classes: Satin, Tabby, Twill, and Other. The dataset was split into train, test, and validation in the form of 60-20-20 split. The results in Table 3 show that using class weighting in both loss function and sampling provides the best results w.r.t both classification accuracy and F1. Using F1 as a loss function sometimes provided good results but was discarded as it was not stable across different datasets. In addition, decreasing the learning rate improved results and stabilized the training curve. Finally, using the XLM-ROBERTA transformer showed an improvement in accuracy. The number of epochs was determined based on the accuracy performance of the validation dataset. The training would stop when the accuracy did not improve for the last 15 epochs. The accuracy (F1 micro) was chosen over F1 macro

because of the large fluctuation in F1 macro value across training epochs caused by having minority classes with few examples.

Model configuration	Accuracy	F1
Base model	84.6	43.1
Weighted loss	82.1	47.2
Weighted sampling	82.6	52.2
F1 loss function	77.5	59.1
weighted sampling and f1 loss	52	22.8
Weighted loss and weighted sampling	84.8	54.7
+ Learning rate 1e-4 $\rightarrow$ $5e-6$	86.1	57.9
Multi-Lingual BERT	85.3	55.2
XLM-ROBERTA	87.5	53.6

Table 3: Comparison between different model configuration on the Weave Slot detection in VAM Dataset

Comparing the learning curves of BERT and multi-lingual BERT in figure 2 reveals that despite the comparable results, the multi-lingual BERT took double the number of epochs to stabilize and finish training compared to its BERT counterpart. This can be due to the fact that Multi-lingual BERT is trained in many languages and it needs more fine-tuning to adapt to any certain language, whereas the BERT transformer was trained in English-only documents.

4.3.2 Generalizing towards all datasets. After we experimented with different parameter settings, we decided to use the following parameters on all the datasets: Weighted Loss function and Weighted Sampling for batches; learning rate of $5 * 10^{-6}$; batch size of 16 for BERT and 12 for multi-lingual BERT and XLM-ROBERTA, due to memory limits; 1024 Units for LSTM Layer; dropout layer of 0.5.

Moreover, the datasets were tested against three types of transformer: Language-Specific BERT, Multilingual BERT, and XLM-ROBERTA, as well as the SVM classifier. The accuracy results in Table 4 show that on most of the datasets SVM performs better or comparable to the deep learning models.

Museum	Lang	Slot	Baseline	# Cls	# Exs	SVM	BERT	Multi BERT	XLM-ROBERTA
VAM	English	Weave	52.9	4	2760	82.8	86	85.3	**87.5**
VAM	English	Weaving Technique	35.9	14	3525	77.6	**80.1**	78	78
VAM	English	Motifs	84.8	9	5500	**91**	**90.6**	87.4	87
CER	Spanish	Weave	59.3	5	945	**75.1**	**75.1**	64	72
CER	Spanish	Weaving Technique	61.1	11	720	**74.3**	74.1	71.5	66
Joconde	French	Weave	55.6	4	180	66.7	30.6	86.1	**91.7**
Joconde	French	Weaving Technique	60	5	150	**97.2**	70	76.7	63.3

Table 4: Results for the multi-class classification task.
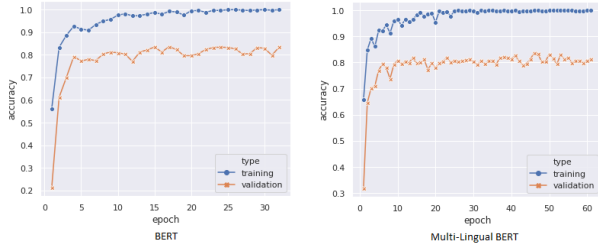
Figure 2: Comparison of a learning curve between BERT and Multi-Lingual BERT as a transformer in the deep learning model trained on the VAM museum Weave Slot dataset.

5 CONCLUSION AND FUTURE WORK

We propose an approach to extracting metadata from a multilingual text description of silk heritage domain museum artifacts. The datasets had several specifics that made the model development a non-trivial task. First, the size of the dataset sometimes was too small to train a model. Second, some class values have considerably more examples than others, which caused the datasets to be imbalanced. Finally, in the preparation phase, the datasets were labeled to accommodate the described issues, which in itself is an approximation and carries an inherent error rate. We have improved the performance of the model by oversampling minority classes, under-sampling majority classes, and using a class-weighted loss function. In addition, by performing cross-validation in the binary classification case or adding a dropout layer and validating based on a validation dataset, we managed to mitigate some of the over-fitting behavior caused by having a little amount of data. We believe that the over-fitting could be mitigated further by using regularization on the LSTM layer, as well as using weight-decaying in the optimizer.

The experimental results show that with low data quality and having not enough data, traditional methods such as SVM in some cases outperform deep neural network models. We expect that the results could be improved by having an assembly of those models instead of using one of them only, which is a part of the future work. Furthermore, one can fine-tune each model independently to achieve better performance.

In future work, we plan to test cross-museum learning by training on one museum and predicting other museums both in the same language and in different languages using multi-lingual transformers. This has practical value for labeling the data in the museums that do not contain metadata information but do have suitable textual descriptions of the artifacts.

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Hierarchical classification of educational resources

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ABSTRACT

This paper describes an approach to automate the process of labelling hierarchically structured data. We propose a top-down level-based approach with SVMs to classify the data with scientific domain labels. The model was trained on labeled open education lectures and returns high accuracy predictions for lectures in the English language. We found that our model performs better with the traditional text extraction method TF-IDF than with pre-trained language model XLM-RoBERTa.

KEYWORDS

hierarchical classification, support vector machine, multi-class classification, machine learning, open educational resources

1 INTRODUCTION

Manually labeling data can be tedious work; one must have sufficient background knowledge about the data and have clear instructions in the labeling process. This becomes even more difficult when the data needs to be annotated with hierarchically structured labels.

In this paper we present a top-down level-based approach using support vector machines (SVMs) for labeling open education resources (OERs). The labels are in a hierarchical structure and represent different scientific domains. We compare different lecture representations using TF-IDF and XLM-RoBERTa and find that the TF-IDF representations yield better results. Even though the paper focuses on OERs the method can be generalized to any textual data set.

The remainder of the paper is structured as follows. Section 2 describes the related work done on the topic of hierarchical classification. Next, we present the data used in the evaluation in Section 3. The methodology is described in Section 4. The evaluation setting and its results are described in Section 5 followed by a discussion in Section 6. We present the future work in Section 7 and conclude the paper in Section 8.

2 RELATED WORK

There are two approaches to hierarchically classify the data: (1) the Big-bang, and (2) the Top-down level-based approach [4, 8, 9].

The big-bang approach works by training (complex) global classifiers which consider the entire class hierarchy as a whole. Each global classifier is binary and decides if the material fits the entire hierarchy (entire hierarchy is for example "Computer Science/Machine Learning/Support Vector Machine"). The advantage of this approach is that it avoids class-prediction inconsistencies across multiple levels. The major drawback of this approach is the high complexity due to the enforcing the model to correctly predict the whole hierarchy branch, which can be difficult to achieve.

The top-down level-based approach works by training local classifiers at each level to distinguish between its child nodes. An example will first, at the root level, be classified into a second-level category. It will then be further classified at the lower level category until it reaches one or more final categories where it can not be classified any further. The main advantage of this model is its simplicity. The disadvantage is the difficulty to detect an error in the parent category which could lead to false classification.

The most common implementation of a local classifier [3] is the support vector machine [7, 11]. In the later papers they propose to train separate SVMs for every level of a branch in the hierarchy.

3 DATA SET

The data set used in the experiment consists of 28,769 OER lectures available at Videolectures.NET [10], an award winning video OER repository. For each lecture we collected the following metadata: title, description, labels, language, authors, date published and the length of the lecture. The description is present in 58% of the lectures. The data set contains 24532 lectures in English, 3930 in Slovene and 307 lectures in other 16 languages.

Preprocessing. For our methodology we used only the lecture's title, description, language and categories. Each lecture is labeled with one or more scientific (sub-)domains most relevant for the lecture (e.g. "Computer Science", "Computer Science/Crowd Sourcing"). Figure 1 shows the distribution of lectures per number of labels.

Almost half of the lectures have more than one label. Lectures with no labels are placed under the "No Labels" category. These lectures are mostly introductory speakers' presentations in conferences. We focus on predicting a single label with high accuracy. We prescribed to only have one label per lecture. We achieve this by duplicating a lecture n times, where n is the number of labels of the lecture and assign a distinct label to each duplicate. Although the duplicates may reduce the performance of the models we do not reduce the already small number of lectures used during the
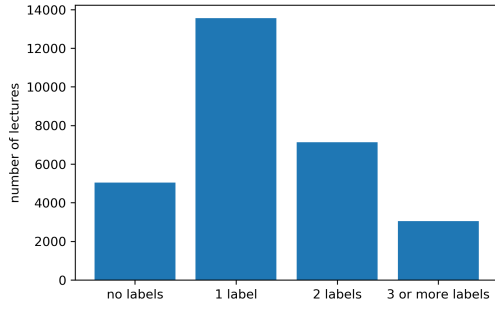
Figure 1: Distribution of lectures per number of corresponding labels. Most of the lectures have only one label.

training process. Figure 2 shows the top scientific domain labels in the data set.
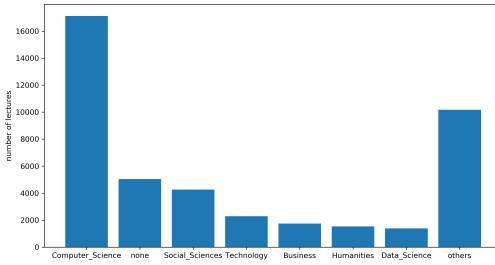
Figure 2: Top scientific domain labels in the data set. The most frequent label is Computer_Science.

The most frequent label is "Computer Science". In addition, a large number of lectures are not labeled; this is because a lot of lectures are presentations that do not correspond to any of the scientific domains. The data set is unbalanced on both domain and sub-domain levels.

4 METHODOLOGIES

In this section we describe the methods used to perform the feature extraction of the text, the implementation of multi class classifier model and the lectures' weights.

The input to the classifier is a raw string created by concatenating the title and the description if the description is available. It is then converted to a vector. In this paper we experimented with two approaches: TF-IDF and XLM-RoBERTa.

4.1 Feature Extraction

TF-IDF. Each lecture is represented with a vector of its TF-IDF values [6]. TF measures how frequently a term occurs in a lecture's text. The IDF is a measure of how much information the word provides. If it is common across all lectures its value is close to 0. The terms with the highest TF-IDF scores are usually the ones that characterize the topic of the lecture best.

The size of the lecture's vector representation is exactly the same as the total number of unique words. Since most of the features are zero the lecture vectors are sparse.

XLM-RoBERTa. The model is based on the RoBERTa model released in 2019. It is a large language model trained on 2.5 TB of CommonCrawl data [2]. The model achieves state-of-the-art performance on cross-lingual classification, sequence labeling and question answering. The most useful feature of the model is that it does not require the sentence language as an input. In theory, it extracts the same vectors for similar words in 100 languages.

The length of the vector that the model outputs is 768. To extract the features a CUDA-enabled GPU is required and the model training is very slow.

4.2 Multi-class SVM Classifier

We chose the top-down level-based approach for our classifier. The raw text input is firstly vectorized following one of the two feature extraction approaches described in Section 4.1. The vector is then input to the main SVM which determines the first category. Then the input is handled by the second SVM, trained specifically for sub-labels of first classified category. If a sub-label tops the threshold of 0, this step is repeated, otherwise the model outputs the lowest level parent category.

For example "Computer Science" is the first determined category. Then the input is handled by the SVM trained on sub-labels of "Computer Science", which determines that the input does not match with any of the sub-labels. The model puts the lecture in the "Computer Science" category. This is visually explained in figure 3.
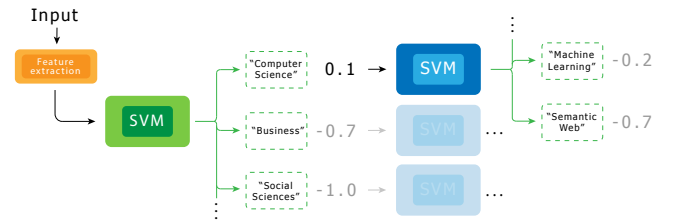
Figure 3: Visual representation of hierarchical SVM classifier. The example shows a lecture classified as belonging to the "Computer Science" category

Each SVM is an implementation of a multi-class classifier using the one-vs-rest approach. Predicted class should always be dominant otherwise the recommendation is not relevant.

4.3 Lecture Weights

Each lecture is assigned a weight of $\frac{1}{n^x}$, $x = 4$, where n is the number of total labels in the original lecture and x is a parameter. If $x < 4$ the accuracy is greatly reduced, if $x > 4$ the accuracy is increased by a small margin. It converges when $x \rightarrow \infty$. When increasing the parameter x the weight comes closer to 0 which means that the model accounts for data less during training. This means that the 4$^{\text{th}}$ power is a sufficient balance between excluding some data and reducing the accuracy.

The other approach could be to ignore multi-label lectures during testing phase ($\frac{1}{n^\infty}$).

Because some labels are so scarce, we limit ourselves to labels with at least 20 lectures. This reduces the total number of labels in the data set from 502 to 244.

5 EVALUATION

5.1 Parameters and Specifications

SVM. The SVM implementation used in the evaluation is the LinearSVC [1] with the default parameters.

XLM-RoBERTa. The model used for representation generation is the hugging face's pretrained model [5] which was trained on default parameters found in the paper [2]. The training was executed on the Google Colab (online hosted Jupyter notebook) free tier machine (12GB RAM, dual core CPU, NVIDIA K80).

5.2 Results

Table 1 shows the performance of the different models with linear kernel. We have also evaluated other kernels (polynomial, RBF, sigmoid), but the performance was worse than using linear kernel. That is why we omitted them from the performance table.

TF-IDF with linear kernel SVM. Using the TF-IDF method for feature extraction we found that the SVMs performed the best with linear kernel. One explanation for such results is that the dimension of the features is large (more than 60k), which means that other more advance kernels might lead to over-fitting.

XLM-RoBERTa with linear kernel SVM. The model's performance was worse than using TF-IDF. The accuracy of the main classifier was 19% compared to 70% when using TF-IDF. The other SVM kernels (polynomial, RBF, sigmoid) performed worse compared to linear kernel. Table 1 shows the performance of the model.

SVM. The problem with current SVM implementation is that it can only put the lecture in one category. One way to solve the issue of only one label would be to firstly predict one label. Then, if the user (editor) wants another prediction, the model can output the prediction with second highest certainty.

TF-IDF vs XLM-RoBERTa. The advantage of choosing XLM-RoBERTa over of TF-IDF is that it works with 100 languages. The vector outputs are similar [2] for all languages. This was proven by translating the same text input into multiple languages (using Google Translate) and the predicted category did not change. When using TF-IDF you have to split the original data set into subsets containing a single language and train the model from scratch. That would be possible with enough data. For some languages (German, French) the the data set contains less than 30 lectures, which means that you can not train an SVM sufficiently.

6 DISCUSSION

Unbalanced Data Set. We found the SVM trained on an oversampled data set to be working better than the SVM trained on the raw data set. Due to the unbalanced data if the data set is not resampled the bias towards the strongest category (*Computer Science*) is strongly presented. For example neutral words such as " ", "the" etc. are classified as belonging in *Computer Science* category.

Comparing Word Embedding Techniques. The TF-IDF approach performs much better than XLM-RoBERTa which is surprising. Pre-trained models usually perform better than legacy feature extractors. The reason could be that the hyper parameters of the model were not set correctly, but we did not find the right balance for the model to perform any better. The production versions could include both models. For languages with a lot of data in the data set,

the model would opt for SVMs trained on features extracted using TF-IDF, because of the better performance. All other languages would be handled by SVMs trained by XLM-RoBERTa, because the classifier performs much better than random.

The TD-IDF method could also be used to classify lectures that are in the non-english languages by firstly translating the text to English before using them during training. With this approach the model could work in all languages and retain the simplicity of TF-IDF. Note that that this approach would be strongly dependant on the quality of the translations.

Weighting the errors during the training process. We did not use the hierarchy structure for calculating the error between the predicted and the actual labels hence all the errors types during training were the same. This is not ideal because the error should be more significant when the classifier incorrectly predicts the main branch versus when it incorrectly predicts a lower level label. For example, if we take a lecture that is labeled as "Computer Science/Machine Learning" then the error should be bigger if our classifier predicts the "Biology" label rather than the "Computer Science/Semantic Web" label.

7 FUTURE WORK

We intend to improve the performance of the XLM-RoBERTa and to experiment with other language models and try to achieve better performance.

One additional direction for future work might be training a multiclass classifier to predict more than one label to a given lecture. We tried implementing the multi label output classifier using the MultiOutputClassifier wrapper on SVM but the precision of the model was noticeably lower.

The model is ready to be used in production in Videolectures.NET as a recommender engine to help the editors. The service could either be wrapped in a *Flask* microservice or directly into Videolectures.NET's backend.

8 CONCLUSION

In this paper we explore a top-down level-based approach for classifying OER lectures with scientific domain labels. We used oversampling to handle label unbalance and experimented with two text representation approaches, TF-IDF and XLM-RoBERTa. We found that the model using the TF-IDF representations gives better results.

ACKNOWLEDGMENTS

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parent category	TF-IDF				XLM-RoBERTa				materials
	acc.	recc.	F	prec.	acc.	recc.	F	prec.	
Root	70%	69%	72%	75%	19%	11%	19%	68%	27009
Computer Science	59%	59%	60%	61%	9%	4%	8%	50%	12935
Machine Learning	60%	55%	59%	64%	11%	5%	9%	26%	3260
Semantic Web	75%	71%	75%	79%	23%	20%	31%	68%	454
Computer Vision	82%	79%	81%	83%	57%	55%	59%	63%	140
Social Sciences	73%	72%	73%	74%	35%	24%	34%	60%	2928
Society	74%	72%	72%	72%	36%	28%	38%	60%	890
Politics	76%	66%	75%	86%	59%	43%	54%	73%	83
Law	96%	96%	96%	96%	57%	41%	51%	67%	112
Journalism	100%	100%	100%	100%	91%	88%	90%	92%	53
Technology	84%	82%	82%	82%	50%	43%	50%	60%	970
Nanotechnology	69%	59%	69%	83%	46%	37%	46%	62%	78
Business	74%	72%	73%	74%	43%	36%	43%	54%	1009
Transportation	63%	53%	61%	71%	33%	22%	32%	56%	267
Humanities	85%	83%	84%	85%	55%	48%	55%	65%	873
Biology	71%	66%	67%	68%	23%	17%	22%	31%	430
Science	78%	77%	78%	79%	53%	51%	52%	53%	656
Medicine	89%	88%	89%	90%	39%	34%	48%	83%	326
Computers	83%	83%	83%	83%	55%	48%	53%	59%	731
Mathematics	89%	87%	89%	91%	41%	36%	38%	40%	421
Physics	86%	81%	85%	89%	36%	32%	38%	46%	227
Arts	88%	87%	85%	83%	45%	40%	49%	63%	338
Visual Arts	100%	100%	100%	100%	62%	56%	70%	92%	159
Design	52%	46%	55%	68%	23%	9%	14%	30%	104
Chemistry	100%	100%	100%	100%	85%	83%	91%	100%	161
Environment	94%	94%	93%	92%	71%	66%	73%	81%	161
Earth Sciences	73%	67%	74%	82%	50%	51%	50%	49%	27

Table 1: Comparison of model performance using the linear kernel. The performance of the TF-IDF approach is better than that of XLM-RoBERTa.

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Are You Following the Right News-Outlet? A Machine Learning based approach to outlet prediction

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ABSTRACT

In this work, we propose a benchmark task of outlet prediction and present a dataset of English news events tailored to the proposed task. Addressing this problem would not only allow readers to choose and respond to relevant and broader facets of events but also enable the outlets to examine and report on their work. We also propose a neural network based approach to recommend a list of probable outlets covering an event of interest. Evaluation results reveal that even in its simplest form, our model is capable of predicting the outlet significantly better than the existing rule based approaches. The proposed model will also serve as a baseline for evaluating approaches intended to address the task. Implementation scripts can be found at *https://github.com/Swati17293/outlet-prediction*.

KEYWORDS

News bias, Event Selection bias, News coverage, News Event Analysis, Recommendation System

1 INTRODUCTION

The advancement in the field of Natural Language Processing [9, 10, 5, 4] over the last decade, has made solutions to complex machine learning problems more convenient. The problems such as machine translation, text summarization, and segmentation are being solved much more efficiently than ever before. Consequently, it offered the researchers the opportunity to use these advanced techniques to solve problems in a variety of contexts such as news bias analysis. This analysis task is poised as the identification of the inherent bias present in the news production and its coverage process. It occurs when a news outlet publishes a news story selectively or incorrectly.

If the news is biased, then it can bias the thought process and decision making of the person listening, watching, and/or reading it [12]. It can have several direct or indirect implications whether political or social. For example, if the news shows only the positive or negative side of a political party; it has been observed to influence the public vote [2]. Not only politics but also the news about the disaster or spread of viral disease affects the belief system of the general public.

There are numerous events that happen continuously, and any form of bias can arise in numerous possible ways. It is not possible for any single outlet to capture every event. Thus, an outlet is forced to select a set of reporting events. Several factors, such as the geographical origin of the event, the involvement of an elite person or country, etc. influences such selection. Also the procedure requires rigorous monitoring of current affairs to determine the news value, and may result in event selection bias also known as gatekeeping bias.

However, no well-established automated method reveals to users the outlets that will cover the event of their interest. This drives the motivation of this study. The aim is to predict a list of outlets reporting on a given event. Addressing this problem would not only allow readers to choose and respond to relevant and broader facets of events but also enable the outlets to examine and report on their work. For instance, some outlets tend to publish events covered by well-established outlets. Instead of waiting for the news to be published, the proposed system will help them to get an insight into the degree of predictability of event selection by the major outlets.

1.1 contributions

We make the following contributions in this context:

- We propose a benchmark task of outlet prediction and present a dataset of English news events tailored to the proposed task.
- We provide a neural network model that can serve as a baseline for evaluating approaches intended to address the task.

The GitHub repository containing our code is available at ***https://github.com/Swati17293/outlet-prediction***.

1.2 Problem Statement

The problem is addressed as an outlet prediction task in which the bias is examined by comparing the learning ability of a classifier trained to predict the probability of event coverage by an outlet.

2 LITERATURE REVIEW

During the different stages of news production, various forms of news bias arise as described by Baker et al. [1]. The first stage begins with the selection of events also called gatekeeping, where an outlet selects or rejects an event for reporting. The selection process is driven by a number of factors, such as the geographical origin of the event, the involvement of an elite person or country, etc., and requires rigorous monitoring of current affairs to determine the news value. To our knowledge, only a few methods have been suggested that explicitly attempt to examine this bias.

Saez-Trumper et al. [11] attempted to identify bias in online news sources and social media groups surrounding them. They studied the disparity in the selection of events based on the quantity and exclusivity of stories published by 80 mainstream news

outlets across the globe over a span of two weeks. From the review, it is found that there is a weak correlation between the quantity and exclusivity of news articles published by the outlets. It is also discovered that both the news and social media follow the same pattern of selection of events in similar geographical areas. However, media in the same region often choose the same events and publish similar-length posts.

Bourgeois et al. [3] used a matrix factorization method to extract latent factors that determine the selection of the event by an outlet. They combined the method with a BPR optimization scheme developed by Rendle et al.[8]. They used the events derived from the GDELT dataset and arranged the outlets in rows and their reported events in columns to form a matrix. Each cell value of the resulting matrix describes the selection/rejection of the event by the outlet.

For the bias analysis, they chose affiliation, ownership, and geographic proximity of the different outlets as the major factors. They suggest that each outlet follows its own latent preferences structure which facilitates the outlet to rank events. They also suggested that events should be selected such that the selected list should be diverse and should include a wide range of actively reported events. They thus adopted the method of Maximum Marginal Relevance which facilitates ranking based on the relevance and diversity of the events. It is discovered that event selection favors the most discussed topics rather than the unique ones.

F. Hamborg et al. [6] uses a matrix similar to the one created by Bourgeois et al.[3] Each cell in the matrix represent the most representative topic of the article reported by one country about the other. By spanning the matrix through outlets and topics in a region, the bias can be examined. They used a collection of 1.6 million articles from more than 100 countries over a two-month span from the Europe Media Monitor (EMM)[1] as their dataset.

Authors in [6] aggregates the related articles and then outsource the task of bias identification to the users, forcing them to determine the bias on their own. While the rest of the existing work analyzes the selection bias, it certainly does not present an automated approach suited to the outlet prediction task, unlike our work.

3 DATA DESCRIPTION

3.1 Raw Data Source

Event Registry[2] [7] monitors, collects, and provides news articles from news outlets around the world. It also aggregates them into clusters that are referred to as events. Each event is then annotated with several metadata such as unique id to track the event coverage, categories to which it may belong, geographical location, sentiment, etc. As a result, its large-scale temporal coverage can be used effectively to study the event selection process of news outlets.

3.2 Dataset

For our experiments, we first selected the top three news outlets based on Alexa Global Rankings [3]. We then used the Event Registry API to collect all news events reported in English between January 2019 and May 2020. We excluded events that were not covered by any of the selected outlets. We ended up with 51,409 events for which we extracted basic information such as event id, title, summary, and source. Since the event coverage by these outlets is not uniform, which can be visualized in Figure 1, we used a stratified split to mimic this imbalance across the generated train-valid-test sets.
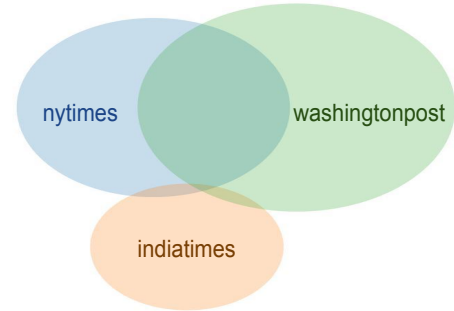
Figure 1: Distribution of event coverage by the outlets.

4 MATERIALS AND METHODS

4.1 Problem Modeling

For an event E and its associated pair (T, S), the task is to generate a list of outlets O expected to cover E. Here T is the event title and S is a short summary of the event as provided by the Event Registry. Mathematically, the task can be formulated as,

$$O = f(T, S, \alpha) \tag{1}$$

where, f is the outlet prediction function and α denotes the model parameters. O can have a well-thought-out variable length response generated from the list unique outlets O^l. For this work, $|O^l| = 3$.

4.2 Methodology

We extract feature vectors from T and S. We fuse them together to create a fused vector which is then passed through several layers to finally generate O. Figure 2 illustrates the entire prediction process. We further outline these tasks with more details in the following subsections.

4.2.1 Feature Extraction and Fusion. We used Google's *Universal Sentence Encoder* [4] *(USE)* to extract 128-dimensional feature vectors T' and S'. For feature fusion, we concatenated T' and S' and applied *tanh* activation to generate F. We then used batch-normalization to increase the stability of the network and for regularization.

$$F = BN(tanh(T' \oplus S')) \tag{2}$$

In Eq 2, *BN* and $\oplus$ represents batch-normalization and concatenation respectively.

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[1]https://ec.europa.eu/knowledge4policy/
[2]https://eventregistry.org

[3]https://www.alexa.com/topsites/category/Top/News/Newspapers
[4]https://tfhub.dev/google/universal-sentence-encoder/
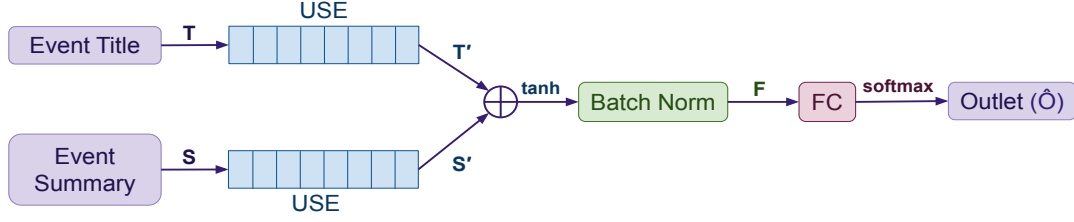
Figure 2: Outlet prediction process.

4.2.2 Outlet Prediction. We solve the problem using a multi-label classification model for which we create a separate outlet-index dictionary for outlets $D = \{o_1 : 1, \; o_2 : 2 \ldots \; o_n : n\}$, where n is the total number of unique outlets in O^l. To predict the list of outlets we pass F to the fully-connected layer (FC) having *softmax* activation with n output neurons. Since an event can be covered by more than one outlet, we formulate the recursive prediction procedure as,

$$\hat{o} = \mathcal{P}(o_i | F, \hat{o}_{i-1}, b) = softmax(F w_i + b_i) \tag{3}$$

$$= \frac{e^{F w_i + b_i}}{\sum_{j=1}^{n} e^{F w_j + b_j}} \tag{4}$$

where, $\hat{o}$ is the probability of selecting the ith outlet (o_i) given F, bias (b), and the set of probabilities of previously predicted outlets ($\hat{o}_{i-1}$), and w is the weight. We use categorical cross entropy as the loss function as follows:

$$\mathcal{L}(o, \hat{o}) = - \sum_{j=1}^{n} \sum_{i=1}^{x} (o_{ij} * \log(\hat{o}_{ij})) \tag{5}$$

In Eq (5), for i^{th} outlet in the output sequence of length x, o_{ij} and $\hat{o}_{ij}$ denotes the actual and predicted probability of selecting the jth outlet from D.

4.2.3 Hyper-parameters. We used Categorical accuracy[5] as the metrics to calculate the mean accuracy rate for multilabel classification problems across all the predictions. We consider a batch of size 128 and number of epocs as 100 for training. To optimize the weights during training we use Adam optimizer.

5 EXPERIMENTAL EVALUATION

5.1 Baselines

We use the following well-known and simplified methods as our baseline models.

- **Uniform:** Generate predictions randomly using a uniform distribution.
- **Stratified:** Generates predictions by respecting the class distribution of the training set.

5.2 Evaluation Metric

We aim to predict the list of outlets in this work. However, it is not necessary to predict the sequence in which outlets appear on this list. This is explained with an example given in Table 1. In other cases, a combination of correct and incorrect outlets may be predicted by the model.

We used the following metrics to evaluate the effectiveness of our model where, $\hat{o}$ is the predicted outlet, o is the true outlet, and N is the total number of instances.

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[5]https://github.com/keras-team/keras/blob/master/keras/metrics.py

Table 1: Multiple correct predictions.

indiatimes nytimes washingtonpost
indiatimes washingtonpost nytimes

- **Subset Accuracy (a):** It measures the percentage of instances in which all of the outlets are correctly classified.

$$\text{Subset Accuracy } (a) = \frac{1}{N} \sum_{i=1}^{N} (\hat{o}_i - o_i) \tag{6}$$

- **Hamming Loss (ℓ):** It measures the fraction of the incorrectly predicted outlet to the total number of outlets. Since it is a loss function, its ideal value is 0.

$$\text{Hamming Loss } (\ell) = \frac{1}{N} \sum_{i=1}^{N} \left| \frac{\hat{o}_i \cap o_i}{\hat{o}_i \cup o_i} \right| \tag{7}$$

5.3 Results and Analysis

Table 2 shows the comparison of our model with the baseline models in terms of subset accuracy and hamming loss.

Table 2: Comparison between the baseline models and our proposed model.

	Subset Accuracy	Hamming Loss
Uniform	0.140	0.526
Stratified	0.286	0.422
Ours	**0.546**	**0.275**

Quantitative analysis of the experimental results shows that, our model outperforms the Uniform and Stratified models by a margin of 0.41 and 0.26 points for subset accuracy and by 0.25 and 0.15 points for hamming loss respectively. The performance difference is clearly visible in Figure 3.

The intersection that we find among the different outlet pairs differs considerably as evident in Figure 1. This can be best seen by assessing the conditional probability of an event covered by an outlet given that it is covered by another outlet as listed in Table 3. For example, we can note that the $P(washington|nytimes) = 0.492$ which is quite high and indicates that *washingtonpost* tends to cover most of the events covered by *nytimes*. It is also interesting to note that *indiatimes* do not follow *washingtonpost* or *nytimes*, and vice versa.

6 CONCLUSIONS AND FUTURE WORK

It is important for a journalist to know which event is worthy enough to be published. Even readers would be interested to know

Table 3: Conditional probability of an event to be covered by an outlet, provided it is covered by another outlet.

P(x|y)	nytimes	indiatimes	washingtonpost
nytimes	1.000	0.067	0.364
indiatimes	0.034	1.000	0.023
washingtonpost	0.492	0.063	1.000
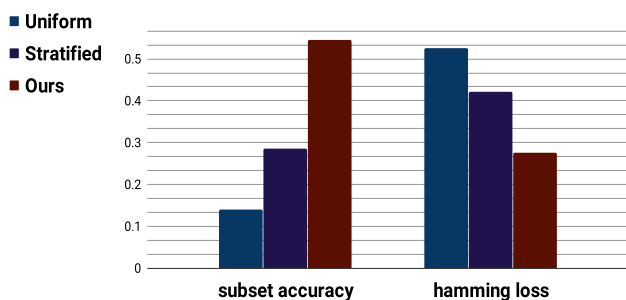
Figure 3: Comparison between the baseline models and our proposed model.

the outlets that are going to cover the event of their interest. Yet it is certainly not an automated approach, therefore in this work, we propose an approach to address the outlet prediction task given the event title and description. We also find that even in its simplest form, our model is capable of predicting the outlet. In the future, we intend to enhance our proposed model to better predict the outlets and to work in a cross-lingual setting. We plan to include a few more metadata provided by Event Registry (refer Section 3.1) along with Wikipedia concepts. We also plan to analyze the speed of reporting, time-span, and importance given to the events by the outlets. In addition, we will also be looking into how the outlets change their coverage style over time.

ACKNOWLEDGMENTS

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MultiCOMET – Multilingual Commonsense Description

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ABSTRACT

This paper presents an approach to generating multilingual commonsense descriptions of sentences provided in natural language. We have expanded on an existing approach to automatic knowledge base construction in English to work on different languages. The proposed approach has been utilized to develop MultiCOMET, a publicly available online service for generating multilingual commonsense descriptions. Our experimental results show that the proposed approach is suitable for generating commonsense description for natural languages with Latin script. Comparing performance on Slovenian sentences to the English original, we have achieved precision as high as 0.7 for certain types of descriptors.

CCS CONCEPTS

•CCS Information systems Information retrieval Document representation Content analysis and feature selection

KEYWORDS

deep learning, commonsense reasoning, multilingual natural language processing

1 Introduction

As artificial intelligence systems are becoming better at performing highly specialized tasks, sometimes outperforming humans, they are unable to understand a simple children's fairy tale due to their inability to make commonsense inferences from simple events. With recent breakthroughs in the area of deep learning and overall increases in computing power, it has enabled us to model commonsense inferences with deep learning models. In our research, we expand on the approach to automatic generation of commonsense descriptors proposed in COMET [1] by applying their deep learning models to languages other than English.

The approach presented in COMET tackles automatic commonsense completion with the development of generative models of commonsense knowledge, and commonsense transformers that learn to generate diverse commonsense descriptions in natural language [1].

Our research hypothesis is that the approach proposed by COMET [1] can be expanded to Latin script languages other than English. To test this claim, we have trained our own deep learning model on the original training data, and another model on the data translated into another natural language.

The main contributions of this paper are (1) a new multilingual approach to annotating natural language sentences with commonsense descriptors, (2) implementation of the proposed approach that is made publicly available as an online service MultiCOMET http://multicomet.ijs.si/ (illustrated in Figure 4), (3) evaluation of the proposed approach on the Slovenian language. An additional contribution is the publicly available source code [3] allowing users to train their own models for other natural languages.

The rest of this paper is organized as follows: Section 2 provides a data description. Section 3 describes the problem and the algorithm used. Section 4 exhibits our experimental results. The paper concludes with discussion and directions for the future work in Section 5.

2 Data Description

One might say the only way for AI to learn to perform commonsense reasoning, is to learn from humans. Following the approach proposed by COMET [1], we used data from the ATOMIC [2] dataset. The ATOMIC dataset consists of over 24,000 sentences containing common phrases manually labelled by workers on Amazon Turk. For each sentence the workers were asked to assign open-text values to nine descriptors which capture nine if-then relation types to distinguish causes vs. effects, agents vs. themes, voluntary vs. involuntary events and actions vs. mental states [2] as described in ATOMIC.

The following are the nine descriptors and their explanations:

xIntent – Because PersonX **wanted…**

xNeed – Before, PersonX **needed…**

xAttr – PersonX is **seen as…**

xReact – As a result, PersonX **feels…**

xWant – As a result, PersonX **wants…**

xEffect – PersonX **then…**

oReact – As a result, others **feel…**

oWant – As a result, others **want…**

oEffect – Others **then…**

The dataset contains almost 300,000 unique descriptor values for the listed nine descriptors. An example of a labeled sentence is shown in Figure 3.

In order to test the proposed approach, we implemented it for the Slovene language. We have translated the sentences from the ATOMIC dataset to Slovene, keeping the descriptor values in English. The translation was done using Google Cloud's Translation API [4].

3   Problem Description and Algorithm

The problem we are solving is predicting the most likely values for each tag in the ATOMIC [1] dataset, given an input sentence in a Latin script language. Following the proposal in COMET, we are addressing the following problem:

Given a training knowledge base of natural tuples in the $\{s, r, d\}$ format, where s is the sentence, r is the relation type and d represents the relation values. The task is to generate d given s and r as inputs.

Figure 1 depicts our approach to solving this problem. The system takes labelled sentences as input, translates them to the targeted Latin language and trains a deep learning model capable of labelling previously unseen sentences with values for nine descriptors capturing the nine predefined relation types as described in Section 2.
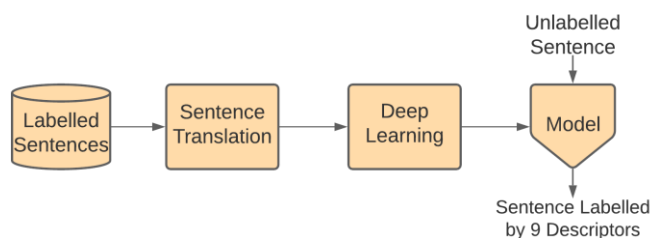
Figure 1: Architecture of the proposed approach

4   Experimental Results

Prior to training the model, we split the ATOMIC dataset into train, test and development sets identical to those used in COMET [1]. In our evaluation we used 100 sentences from the test set.

Our deep learning models are trained on the ATOMIC [2] dataset. We have trained one model on the original dataset in English, and another model on an automatically translated dataset to Slovene. Both models were trained under the same parameter settings: batch size=6, iterations=50000, maximum number of input features = 50.

To evaluate the performance of the proposed approach, we compared the predictions of the model trained on Slovene sentences with the predictions of the English model. As the performance metrics, we took the top 5 predicted values for each descriptor and checked their overlap. By taking the English predictions as the ground truth, we are measuring the precision of our model by the number of identical descriptor values. Note that

we were strict in our comparisons, for instance "to stay away from people" and "to get away from others" do not count in overlap.

Experimental results show there is considerable difference in performance between the nine descriptors. The best performing descriptor was xReact, where precision@5 was 0.716, followed by oReact and oWant with precisions@5 of 0.706 and 0.468 respectively. The worst performing descriptor was xWant, with a precision@5 of 0.21 (see Table 1).

Descriptor	Precision
xIntent	0.324
xNeed	0.352
xAttr	0.438
xReact	0.716
xWant	0.210
xEffect	0.456
oReact	0.706
oWant	0.468
oEffect	0.310
Average	0.442

Table 1: Experimental results on the nine descriptors, showing precision of the top 5 predictions.

The best performing descriptor was xReact (representing the relation: As a result, PersonX feels). This was likely due to the fact that most predicted values were only one word long for both models, making it considerably easier for their predictions to overlap.

The worst performing descriptor was xWant (representing the relation: As a result, PersonX wants), this could be attributed to the fact that the most predicted values were at least 3-4 words in length, greatly decreasing the likelihood of overlap. Another reason for such low precision could be our strict overlap comparisons.

	Original	Translated/Predicted
Sentence	PersonX looks PersonY ___ in the face	PersonX izgleda PersonY ___ v obraz
xReact Values	nervous	**satisfied**
	happy	**happy**
	satisfied	attractive
	powerful	proud
	confident	angry

Table 2: One of the worst performing test sentences for xReact

Table 2 shows the predicted values of one of the worst performing sentences for the xReact descriptor. Note the sentence "PersonX looks PersonY ___ in the face" can refer to "Bob looks Mary slowly in the face" or "Adrian looks Anna kindly in the face" or something

else. The columns in Table 2 and Table 3 labelled "Original" show the original English sentence and its predicted descriptor values. The columns labelled "Translated/Predicted" show the sentence translated into Slovene and its predicted descriptor values.

Table 3 shows the predicted values of one of the worst performing sentences for the xWant descriptor. We can see that there are no common predictions between the two models. Note the sentence "PersonX avoids every ___" can refer to "Marko avoids every car on the road" or "Dunja avoids every boring event" or something else.

	Original	Translated/Predicted
Sentence	PersonX avoids every ___	PersonX se izogiba vsakemu ___
xWant Values	to stay away from people	to get away from others
	to avoid trouble	to make sure they are ok
	to stay away	to get away from the situation
	to not get caught	to be alone
	to not be noticed	to make a decision

Table 3: One of the worst performing test sentences for xWant

While Tables 2 and 3 show the model's outputs for a single descriptor, Figure 3 shows the full output of the model, given an example sentence "Mojca je pojedla odličen sendvič" (Mary ate an excellent sandwich). Figure 2 shows a close-up of the output of Figure 3. The images in Figures 2 and 3 were taken directly from the interface of our online service MultiCOMET [5].
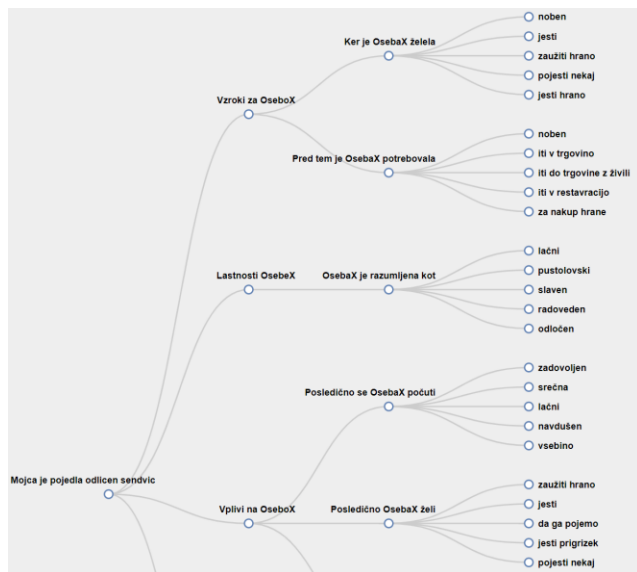
Figure 2: Close-up of predicted descriptor values generated for an example Slovene sentence
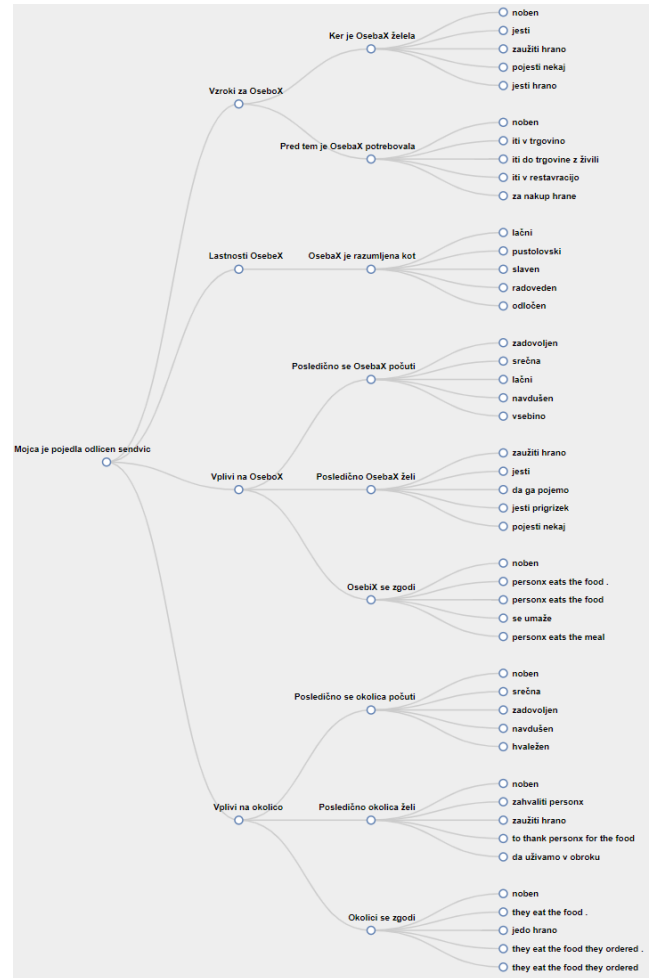
Figure 3: Full tree of predicted descriptor values generated for an example Slovene sentence

For the sentence "Mojca je pojedla odličen sendvič" (Mary ate an excellent sandwich) depicted in Figures 2 and 3, here is a potential English interpretation of the Slovenian output of the model:

Mary was hungry (xAttr) and wanted to eat food (xIntent). To do that, she needed to go to the restaurant (xNeed). At the restaurant, other people were also eating food (oEffect). As a consequence of eating the sandwich, Mary's clothes got dirty (xEffect). Mary feels impressed (xReact) and wants to eat something else (xWant). The restaurant is grateful (oReact) for Mary's visit and wants to thank Mary (oWant).

The MultiCOMET online service is a publicly available implementation of our proposed approach, shown in Figure 4. At the time of writing, MultiCOMET only supports English and Slovene.
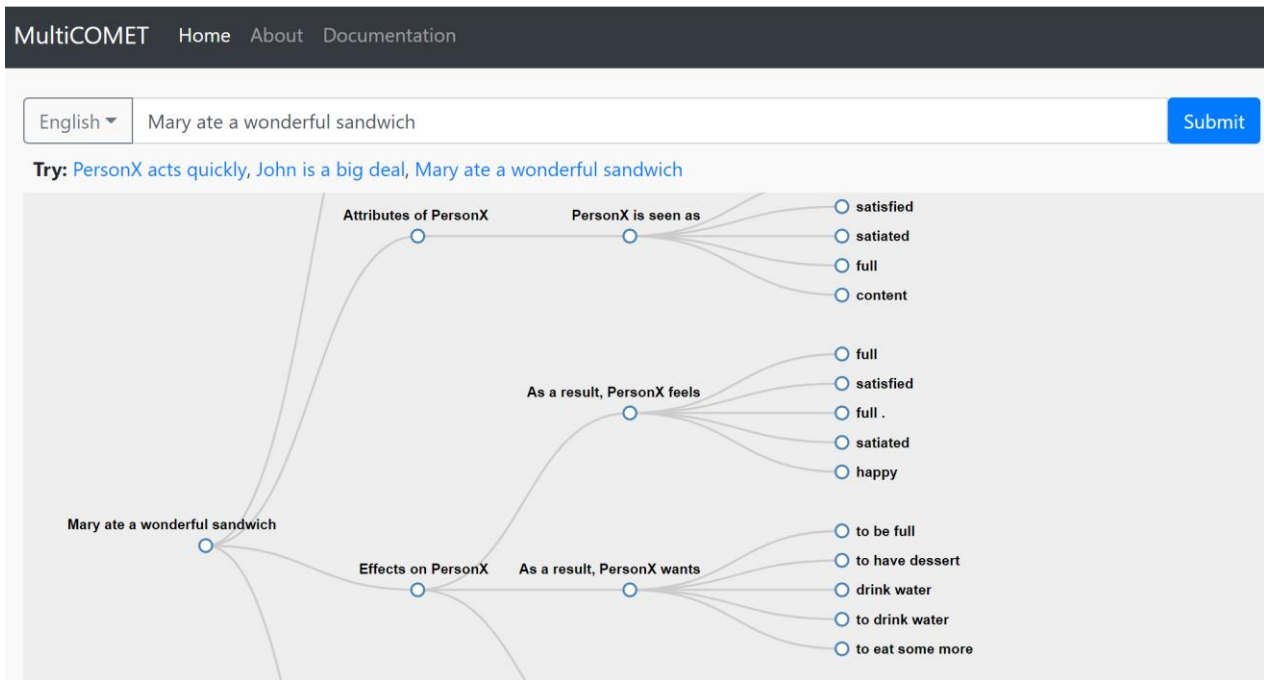
Figure 4: Illustrative example of MultiCOMET after submitting a query "Mary ate a wonderful sandwich."

5 Discussion

In our research we expanded on an existing monolingual approach and proposed a new approach to generating multilingual commonsense descriptions from natural language. In order to implement our approach, we built on an existing library, implementing the approach proposed by COMET [1]. Our experimental results show that we are getting meaningful values for the descriptors. Experimental comparison of the predicted descriptor values of the Slovene and English models show an average precision of 0.44, given our strict comparison methodology. We noted the precision values ranged from 0.716 to 0.210 across different descriptors.

Based on our literature review (September 2020), none of the articles citing the original COMET [1] paper expanded their approach to include other languages. The most similar work we found in the literature combining commonsense and multilinguality was [6] where the authors were extending the SemEval Task 4 solution using machine translation.

The possible direction for future work includes improving the quality of the translated sentences from ATOMIC by manual translation to improve the precision of the models. Another possible direction would be to evaluate the performance of our models on a larger number of sentences to increase the reliability of the results.

After testing the proposed multilingual approach on the Slovene language, we intend to expand our coverage to other Latin script languages including Croatian, Italian and French.

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A Slovenian Retweet Network 2018-2020

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ABSTRACT

As the popularity of social media has been growing steadily since the beginning of their era, the use of data from these platforms to analyze social phenomena is becoming more and more reliable. In this paper, we use tweets posted over a period of two years (2018-2020) to analyze the socio-political environment in Slovenia. We use network analysis by applying community detection and influence identification on the retweet network, as well as content analysis of tweets by using hashtags and URLs. Our study shows that Slovenian Twitter users are mainly grouped in three major socio-political communities: Left, Center and Right. Although the Left community is the most numerous, the most influential users belong to the Right and Center communities. Finally, we show that different communities prefer different online media to inform themselves, and that they also prioritize topics differently.

Keywords

Complex networks, Twitter, community detection, influencers

1. INTRODUCTION

Since the rise of the social networks, their data has been extensively used in social analysis. As the popularity of these platforms continues to grow daily, using them as a proxy to analyze specific phenomena is becoming more and more reliable. Their popularity, accessibility and availability made them the go-to way to share one's opinion, support another and even get in conflict with an opposing one. Recently, with the targeted advertising advancements, social media became the most important cultural and political battlefront.

In this paper, the country of interest is Slovenia and the proxy is Twitter data. By following the methodology developed in [3, 2, 4, 8], we address the following questions:

- Are there groups of densely connected Twitter users in the Slovenian retweet network 2018-2020?
- Who are the leading influencers in these groups?
- What is the content of the tweets in these groups and how much does it overlap?

This paper is organised as follows. In Section 2, the data acquisition process and the collected Twitter data are presented. Section 3 discusses the communities in the retweet network and their properties. Section 4 covers the notion of influencers and identifies the main influencers in the Slovenian retweet network. Section 5 investigates the content of the tweets in terms of hashtags and URLs. We draw conclusions in Section 6.

2. DATA

We acquired 5,147,970 tweets in the period from January 2018 to January 2020 with the TweetCat tool [6], built specifically for collecting Twitter data written in "smaller" languages. The tool identifies users tweeting in the focus language by searching for most common words in that language through the Twitter Search API, and collects these users' tweets through the whole data collection period. On average, the dataset containis around 8,000 tweets per day, with the three highest volume peaks on March 13, 2018 (11,556 tweets, the resignation of Slovenia's PM, Miro Cerar), June 1, 2018 (13,506 tweets, the last day of the 2018 Slovenian parliamentary elections campaign), and May 9, 2019 (12,381 tweets, Eurovision semi-final in which Slovenia had a successful run). The variation of the daily volume of tweets is affected by many phenomena, but the more evident are: a weekly seasonality with high volumes on working days and low volumes on weekends, extraordinary periods for the country (e.g. the 2018 Slovenian parliamentary elections campaign, boosting average daily tweets by around 2,000), and holidays (e.g. 2018 and 2019 Easters as local minima with 5,174 and 4,887 tweets, respectively).

3. COMMUNITY DETECTION

We used the collected tweets to construct a retweet network for the purpose of community detection. A retweet network is a directed weighted graph, where nodes represent Twitter users and edges represent the retweet relations. An edge from node (user) A to node B exists if B retweeted A at least once, indicating the information spread from A to B, or A influenced B. Note that retweeting a retweet is actually retweeting the original tweet (source), thus ignoring all intermediate retweets. The weight of an edge is the number of times user B retweeted user A. We removed all self-retweets, since they did not provide us additional information for community and influence detection. Consequently, we formed a network with 10,876 users (94% of all users) and 1,576,792 retweets (92% of all retweets).

This network can be simplified if the direction of the edges is ignored, meaning that two users are linked if one retweets the other while the source and destination are irrelevant. It turns out that such undirected retweet graphs between Twitter users are useful to detect communities of like-minded users who typically share common views on specific topics.
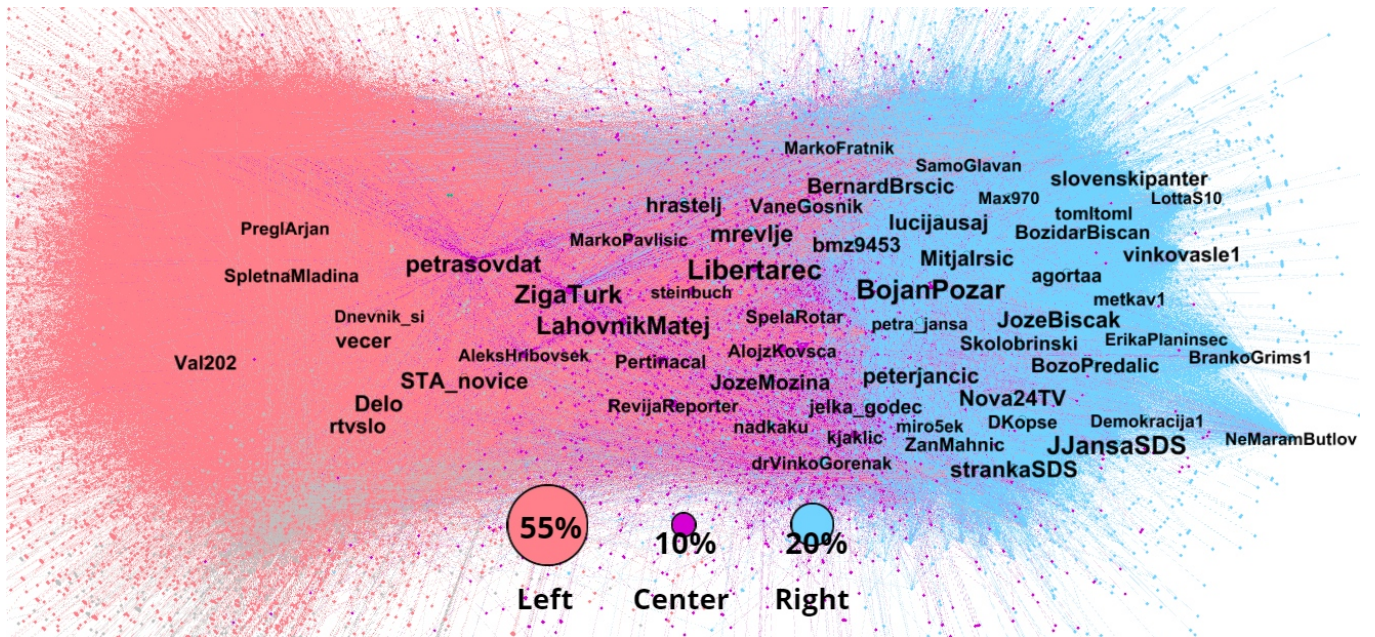
Figure 1: The Slovenian retweet network (2018-2020) colored according to the detected communities, with shares of the total number of users. The label size of a node corresponds to the number of unique users that retweeted it. Only nodes with at least 700 unique retweeters are included.

In complex networks, a community is defined as a subset of nodes that are more closely connected to each other than to other nodes. For the purpose of this paper, we apply a standard algorithm for community detection, the Louvain method [1]. The method partitions the nodes into communities by maximizing modularity (which measures the difference between the actual fraction of edges within the community and such fraction expected in a randomized graph with the same degree sequence) [7]. Modularity values range from -0.5 to 1.0, where a value of 0.0 indicates that the edges are randomly distributed, and larger values indicate a higher community density.

We ran the Louvain method (resolution $= 1.05$) on our undirected retweet network resulting in 183 communities with a modularity value of 0.382, which indicates a strong connectedness within communities. Only the three largest communities each have more than 5% of all users, while combined they contain 85% of all users. The three main detected communities are presented in Fig. 1. We observe the following:

- The three largest communities are labeled as Left, Center and Right with 55%, 20% and 10% as their respective shares of all users. The labeling of the communities does not necessarily represent their political orientation.

- The Left community, even though the largest, contains the smallest number of users with more than 700 unique retweeters.

- The Left community is well separated from the Center and the Right communities, which are more tightly interlinked.

We performed an exploratory data analysis and calculated the community properties presented in Table 1, to compare the communities. Most of the properties are normalized by the user to ease the comparison between communities.

- Nodes – unique users count

- Central user – user with most retweets

- Central user retweets – times the central user is retweeted

- Central user retweeters – unique users retweeting the central user

- HHI ($n = 50$) – Herfindahl–Hirschman index [9] measures the distribution of influence of the top n influential users. Higher value reflects the community influence concentrated only in few influential users, while lower value indicates more dispersed and balanced influence distribution.

- Edges in/node – edges remaining in the community per user (source and destination in the same community)

- Edges out/node – edges going out of the community per user (destination in a different community)

- Weighted edges in/node – weighted edges remaining in the community per user

- Weighted edges out/node – weighted edges going out of the community per user

- Out/In ratio – "Edges out" divided by "Edges in"

- Weighted out/in ratio – "Weighted edges out" divided by "Weighted edges in"

4. INFLUENCERS

We use two simple, but powerful metrics to detect influencers in the retweet network: the weighted out-degree and the Hirsch index (h-index) [5]. Both metrics are calculated from the number of retweets, thus known as retweet influence metrics, indicating the ability of a user to post content of interest to others.
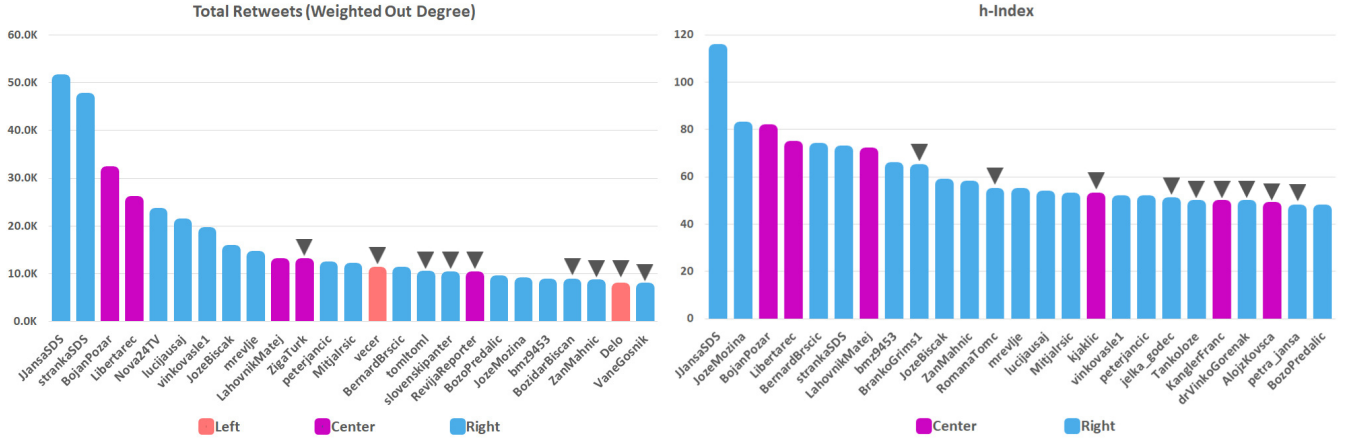
Figure 2: Weighted out-degree (total retweets) and h-index comparison. Both charts include the top 25 most influential Slovenian Twitter users according to their respective metric. Bar colors represent the community of a user. Triangles point to users exclusive to one of the charts.

Table 1: Community properties

	Left	Center	Right
Nodes	7,030	1,223	2,519
Central user	vecer	BojanPozar	JJansaSDS
Central user retweets	10,398	31,432	50,688
Central user retweeters	973	1,325	1,242
HHI ($n = 50$)	0.031	0.066	0.042
Edges in/node	19.32	14.53	69.30
Edges out/node	4.47	37.11	13.19
Weighted edges in/node	52.91	83.68	308.33
Weighted edges out/node	6.95	119.42	36.14
Out/In ratio	0.23	2.55	0.19
Weighted Out/In ratio	0.13	1.43	0.12

Weighted out-degree is simply the total number of retweets of a particular user, while the h-index is an author-level bibliometric indicator that measures the scientific output of a scholar by quantifying both the number of publications (i.e., productivity) and the number of citations per publication (i.e., citation impact). Adapted to a Twitter network, it would be described as: a user with an index of h has posted h tweets and each of them was retweeted at least h times.

Let RT be the function indicating the number of retweets for each original tweet. The values of RT are ordered in decreasing order, from the largest to the lowest, while i indicates the ranking position in the ordered list. The h-index is then defined as follows:

$$h\text{-}index(RT) = \max_i \min(RT(i), i)$$

The top 25 most influential users by weighted out-degree and h-index are shown in Fig. 2. The two metrics provide fairly similar results (they differ only in 9 users). Both results confirm the already visible phenomena from the previous observations: The Right community has the most influential users, while the Left community, even though the biggest, does not have nearly as popular users as the ones from the other two communities.

5. CONTENT ANALYSIS

We refer to content analysis in terms of getting knowledge from the text of the tweets. In this paper, we perform two kinds of content analysis: domain URLs and hashtags.

For domain URLs, we filtered the 2,297,008 tweets which contain a URL. Then, we extracted the domain part of the URLs and removed the domains with no specific meaning for Slovenia's content analysis (e.g. social networks: twitter.com, facebook.com, instagram.com, etc., and URL shorteners: ift.tt, bit.ly, ow.ly, etc.). This results in 512,308 tweets (approximately 22% of all the tweets with links). The most frequently occurring domains are owned by Slovenian media with nova24tv.si, rtvslo.si and delo.si as the top three URL domains with 23,879, 20,210 and 17,360 occurrences respectively. If instead of the total number of occurrences we count only the unique number of users which posted a domain URL, the top three domains are rtvslo.si, siol.net and delo.si with 2,802, 2,193 and 2,186 unique users respectively.

For the hashtag analysis, we filtered only tweets which contain a hashtag, ending up with 701,266 tweets. The top three hashtags are the following: #volitve2018 (the 2018 Slovenian parliamentary elections), #plts (the Slovenian First Football League) and #sdszate (Slovenian Democratic Party hashtag, meaning: SDS for you) with 9,845, 9,318 and 7,308 occurrences respectively. If we count only the unique number of users using a particular hashtag, the results for the top three Slovenian hashtags are as follows: #volitve2018 with 2,473, #slovenija with 1,611 and #fakenews with 1,343 users.

To see these results in the context of communities, we look at the tweets authored by members of the three largest communities, resulting in 84% of the tweets with relevant domain URLs and 83% of the tweets with relevant hashtags. We summed the domain URL counts, while grouping them by the community in which their user belongs. We applied the same procedure to the hashtags. Finally, we filtered the top eight domain URLs and hashtags for each community and put them on a single Sankey diagram in Fig. 3. Even though overlaps exist, the most popular hashtags and media very much differ from community to community, meaning that all three main communities prioritize topics differently and they inform themselves via different media.
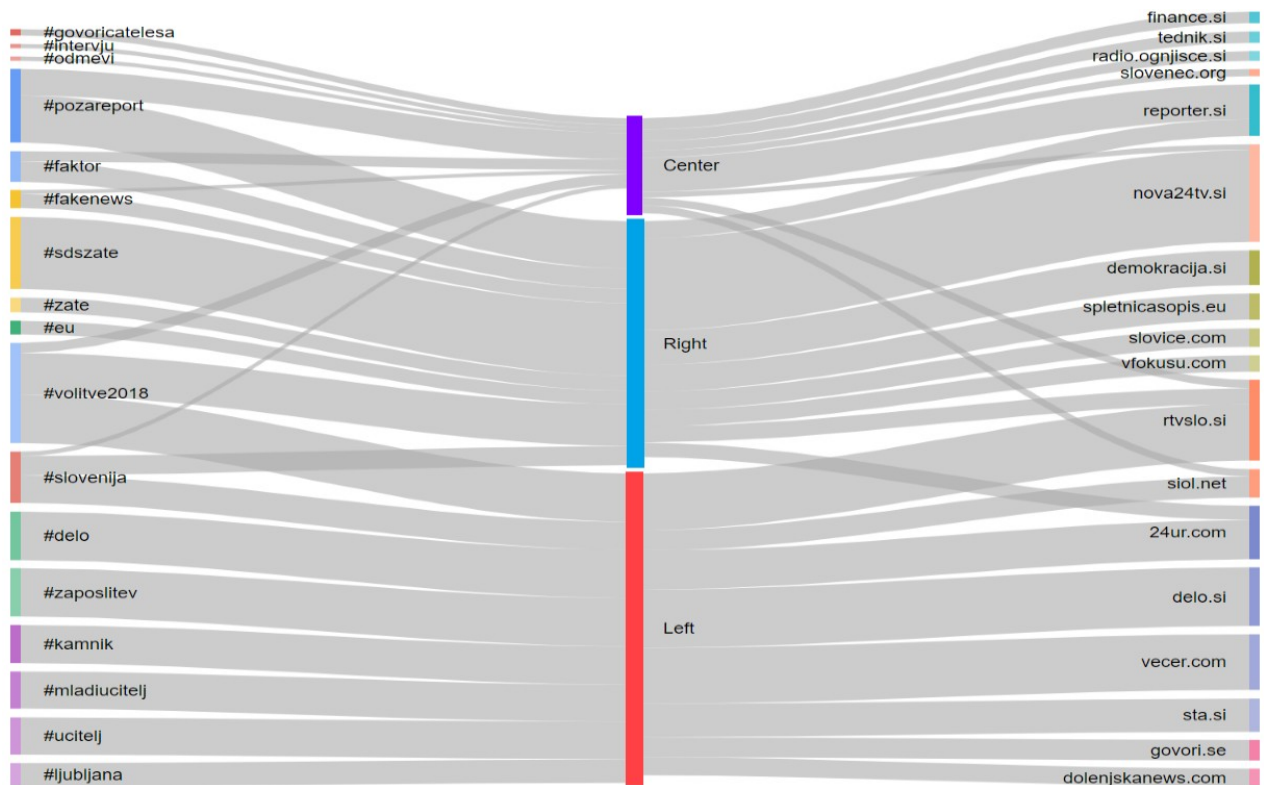
Figure 3: A Sankey diagram depicts the use of the eight most common hashtags (left-hand side) and URLs (right-hand side) by the three largest detected communities.

6. CONCLUSIONS

In this paper we explored the Slovenian twitter network from January 2018 until January 2020. We applied community detection, identifying three main communities: Left, Center and Right. We identified the most influential and the central users of each community by calculating the weighted out-degree and the h-index of the nodes. We used the Herfind-ahl–Hirschman index to estimate the distribution of influence within the top communities in the network. Finally, by analysis of hashtags and URL domains in tweets, we discovered the most popular topics for Slovenians as well as the most referred Slovenian media on Twitter. We showed that users from different communities prioritize different topics and use different media to inform themselves.

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Toward improved
semantic annotation of food and nutrition data

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ABSTRACT

This paper aims to provide a critical overview of the state-of-the-art vocabularies used for semantic annotation of databases and datasets in the domain of food and nutrition. These vocabularies are commonly used as a backbone for creating metadata that is usually used in search. Furthermore, the paper aims to provide a summary of ICT technologies used for storing food and nutrition datasets and searching digital repositories of such datasets. Finally, the results of the paper will provide a roadmap for moving towards FAIR (findable, accessible, interoperable, and reusable) food and nutrition datasets, which can then be used in various AI tasks.

KEYWORDS

ontologies, semantic technologies, data mining, food and nutrition

1 INTRODUCTION

Today more than ever before in history, we live in an age of information-driven science. Vast amounts of information are being produced daily as a result of new types of high-throughput technology in all walks of life. Consequently, the quantity of available scientific information is becoming overwhelming and without its proper organization, we would not be able to maximize the knowledge we harvest from it. Namely, research groups carry out their research in different ways, with specific and possibly incompatible terminologies, formats, and computer technologies. To tackle these issues, researchers have developed high-level knowledge organization systems (KOS), such as ontologies, which constitute the core of the semantic web stack. Throughout the years, an abundance of ontologies has been developed and released, slowly expanding from the biomedical sciences to the fields of information science, machine learning, as well as the domain of food and nutrition science.

There is an old, yet simple saying which goes: "You are what you eat". As the world becomes more globalized and food production grows massively, it is becoming increasingly difficult to track the farm-to-fork food path. In the last few decades, digital technology has been profoundly affecting many health and economic aspects of food production, distribution, and consumption. Issues regarding food safety, security, authenticity as well as conflicts arising from biocultural trademark protection are issues that were further enhanced by the lack of a centralized food data

repository without which there is a great difficulty in achieving cross-cultural and expert consensus. [1]

In this paper, we will briefly go through the fundamental components of the Semantic Web technologies, as well as the standards for the development of high-level KOS (Section 2). Next, we provide a critical overview of the most significant semantic resources in the domain of food and nutrition (Section 3). Finally, we present a proposal for the design and implementation of a broad ontology that would allow us to harmonize and integrate reference vocabularies and ontologies from different sub-areas of food and nutrition (Section 4).

2 BACKGROUND

The goal of the Semantic Web is to make Internet data machine-readable by enhancing web pages with semantic annotations. Linked data is built upon standard web technologies, also including semantic web technologies in its technology stack [11]. **Resource Description Framework (RDF)** allows the representation of relationships between entities using a simple subject-predicate-object format known as a triple. The triples form an RDF database — called a triplestore — which can be populated with RDF facts about some domain of interest. **RDF Schema (RDFS)** was developed immediately after the appearance of RDF as a set of mechanisms for describing groups of related resources and the relationships between them. **Simple Protocol and RDF Query Language (SPARQL)** is the query language for querying RDF triples stored in RDF triplestores.

The Web Ontology Language (OWL) is based on Description Logics, a family of logics that are expressively weaker than First Order Logic, but enjoy certain computational properties advantageous for purposes such as ontology-based reasoning and data validation. Most of the ontologies used today are represented in the OWL format.

All the semantic technologies operate on top of various KOS. A KOS is intended to encompass all types of schemes for organizing information and promoting knowledge management [7]. One example of a KOS is a thesaurus as a structured, normalized, and dynamic vocabulary designed to cover the terminology of a field of specific knowledge. It is most commonly used for indexing and retrieving information in a natural language in a system of controlled terms. When looking at the expressiveness of a KOS, a thesaurus is on the lower side of the scale. On the other side, ontologies enjoy greater expressiveness than thesauri due to the inclusion of description logics. Arp, Smith, and Spear define the term ontology as "A representation artifact, comprising a taxonomy as proper part, whose representations are intended to designate some combination of universals, defined classes, and certain relations between them" [1].

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[1]https://www.nature.com/scitable/knowledge/library/food-safety-and-food-security-68168348/, accessed 22/04/2020

The Open Biomedical Ontologies (OBO) Foundry applies the key principles that ontologies should be open, orthogonal, instantiated in a well-specified syntax, and designed to share a common space of identifiers. Open means that the ontologies should be available for use without any constraint or license and also receptive to modifications proposed by the community. Orthogonal means that they ensure the additivity of annotations and compliance with modular development. The proper and well-specified syntax is expected to support algorithmic processing and the common system of identifiers enables backward compatibility with legacy annotations as the ontologies evolve [17].

The FAIR guiding principles for scientific data management and stewardship were conceived to serve as guidelines for those who wish to enhance the reusability and invaluableness of their data holdings [19]. The power of these principles lies in the fact that they are simple and minimalistic in design and as such can be adapted to various application scenarios. *Findability* ensures that a globally unique and persistent identifier is assigned to the data and the metadata which describes the data. *Accessibility* ensures that the data and the metadata can be retrieved by their identifier using a standardized communications protocol. *Interoperability* ensures that data, as well as metadata, use a formal, accessible, and shared language for knowledge representation. *Reusability* ensures that data and metadata are accurately described, released with a clear and accessible license, have detailed provenance, and meet domain-relevant community standards.

3 CRITICAL OVERVIEW OF FOOD AND NUTRITION SEMANTIC RESOURCES

In this section, we provide a critical overview of the most relevant KOS in the field of food and nutrition. We start by describing LanguaL [8], a thesaurus that serves as a foundation for most of the ontologies in this domain. We are more focused on analyzing ontologies which belong to different sub-spheres of the food and nutrition domain. Namely, FoodOn [4], as a more general food description ontology, ONS [18], relevant in the field of nutritional studies and ISO-Food [6], relevant in the field of annotating isotopic data acquired from food samples.

LanguaL [8] is a thesaurus used for describing, capturing, and retrieving data about food. Since 1996, it has been used to index numerous European Union (EU) and US agency databases, among which, the US Department of Agriculture (USDA) Nutrient Database for Standard Reference and 30 European Food Information Resource (EuroFIR) databases. Food ingredients are represented with indexing terms, preferably in the form of a noun or a phrase. The thesaurus also includes precombined terms which are food product names to which facet terms have been assigned. There are 4 main facets in LanguaL: A (Product Type), B (Food Source), C (Part of Plant or Animal), and E (Physical State, Shape, or Form). Other food product description facets include chemical additive, preservation or cooking process, packaging, and standard national and international upper-level product type schemes.

The LanguaL thesaurus complies with the FAIR guidelines. The completeness of LanguaL's indexing is to a large extent assured by the Langual Food Product Indexing (FPI) software, which verifies that all facets have been indexed for each food in the list [8]. It is available online[2] and can be queried using a food descriptor or synonym. Its interoperability and reusability are eminent as it represents a cornerstone in the development

of more sophisticated ontologies, such as FoodOn. Even though the OBO Foundry principles apply only to ontologies, we can use the more general ones as evaluation criteria for the LanguaL thesaurus. For instance, as previously mentioned, the thesaurus is open, made available in an accepted concrete syntax, versioning is ensured, textual definitions are available for all the terms and a sufficient amount of documentation is provided.

FoodOn [4] is an open-source, comprehensive ontology composed of term hierarchy facets that cover basic raw food source ingredients, process terms for packaging, cooking, and preservation, and different product type schemes under which food products can be categorized. FoodOn is applicable in several use-cases, such as personalized foods and health, foodborne pathogen surveillance and investigations, food traceability and food webs, and sustainability. FoodOn echoes most of LanguaL's plant and animal part descriptors —– both anatomical (arm, organ, meat, seed) and fluid (blood, milk) —– but reuses existing Uberon [12] and Plant Ontology [10] term identifiers for them. Multiple component foods are more challenging because LanguaL provides no facility for giving identifiers to such products.

Building on top of this, FoodOn allows food product terms like lasagna noodle to be defined directly in the ontology, and allows them to reference component products through various relations which do not exist in LanguaL, such as: "has ingredient", "has part", "composed primarily of". As a suggestion, these relations can all be represented with a single relation "has ingredient" and the quantity can be expressed explicitly when annotating the objects. All of the ontology terms have unique identifiers and the ontology is accessible and can be searched via The European Bioinformatics Institute (EMBL-EBI) and its Ontology Lookup Service (OLS).[3] The ontology itself is open-source and is a member of the OBO Foundry. It also includes the upper-level Basic Formal Ontology (BFO) [1]. The adherence to BFO proves useful in the case of aligning ontologies covering different domains because they share the same top-level.

ONS [18] is the first systematic effort to provide a solid and extensible ontology framework for nutritional studies. ONS was built to fill the gap between the description of nutrition-based prevention of disease and the understanding of the complex impact nutrition has on health. Its structure consists of 3334 terms imported from already existing ontologies and 100 newly defined terms. The usability of ONS was tested in two scenarios: an observational study, which aims at developing novel and affordable nutritious foods to optimize the diet and reduce the risk of diet-related diseases among groups at risk of poverty, and an intervention study represented by the impact of increasing doses of flavonoid-rich and flavonoid-poor fruit and vegetables on cardiovascular risk factors in an "at risk" group study.

The development of ONS followed FAIR principles and as a result, it has been published in the FAIR-sharing database.[4] Before defining new terms, the developers of ONS have ensured that they are not yet defined, with the use of the ONTOBEE web service. Terms that were already defined were imported using the ontology reuse service — ONTOFOX [20]. In compliance with the OBO Foundry principles, the ONS has been developed to be interoperable with other ontologies, as it has been formalized

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using the latest OWL 2 Web Ontology Language and RDF speci-fications and edited using Protégé [13] and the Hermit reasoner for consistency checking. It is also accessible, under the Creative Commons license (CC BY 4.0), published on GitHub and at NCBO BioPortal. Moreover, this ensured the adoption of a well-defined and widely adopted structure for the top and mid-level classes and principally the adherence to BFO as upper-level ontology.

ISO-Food is an ontology that was conceived to aid with the or-ganization, harmonization, and knowledge extraction of datasets containing information about isotopes, that represent variants of a particular chemical element which differ in neutron number. To develop this ontology a mixed approach was used, a combination of both expert knowledge-driven (bottom-up) and data-driven (top-down) methods. Its main classes include Isotope, Sample, Location, Measurement, Article. The main class Isotope is con-nected to the rest of the classes with respective relations. The Food and Nutrient classes are linked to the RICHFIELDS ontology [5]. The ontology was further applied in a study for describing isotopic data, to annotate a data sample that consists of isotopic measurements of milk and potato samples.

The ISO-Food ontology can be accessed online via the Bio-Portal repository of biomedical ontologies.[5] It reuses terms from several ontologies, such as the concept Unit from the Units of Measurements Ontology (UO), the classes Food and Component from the RICHFIELDS ontology [5], the class Document from the Bibliographic Ontology (BIBO) [3].

4 PROPOSAL

Ontologies for data mining. To provide a suitable formalized representation of the outcomes of the research in the food and nutrition domain, as well as to suggest new ways to extract knowl-edge from the ever-abundant data produced in this field, we turn to ontologies that are used to formally represent the data analysis process. More specifically, we focus on the **OntoDM** ontology, which provides a unified framework for representing data mining entities. It consists of three modular ontologies: **OntoDM-core** [15] which represents core data mining entities, such as datasets, data mining tasks, algorithms, models and patterns, **OntoDT** [16] — a generic ontology of datatypes, and **OntoDM-KDD** [14] which describes the process of knowledge discovery.

The ontology defines top-level concepts in data mining and machine learning, such as data mining task, algorithm, and their generalizations, which denote the outputs of applying an imple-mentation of an algorithm on a particular dataset. Starting with these general concepts, OntoDM also defines the components of the algorithms, such as distance and kernel functions, and other features they may contain. From the input and output data per-spective, in this ontology, there is a hierarchical representation of data, from general concepts such as dataset to more specific concepts regarding its structure, such as the number of features, their role in a given task, concluding with the datatype of each attribute. These properties of OntoDM provide a complete formal representation of the data mining process from beginning to end.

Combining orthogonal domain ontologies. Our goal is to align the selected ontologies in the domain of food and nutrition with the OntoDM ontology of data mining to improve the se-mantic annotation of the food and nutrition domain datasets, as well as to formally represent data analysis tasks performed in the
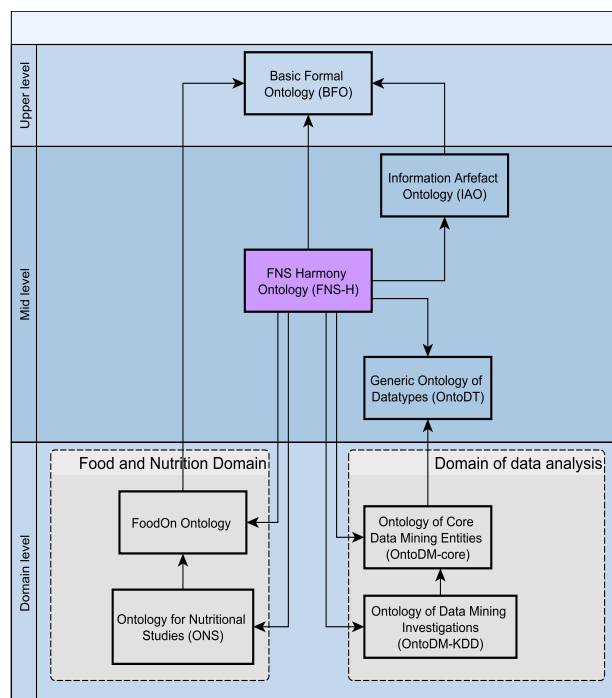
Figure 1: Diagram representing the alignment of the pro-posed ontology with the identified relevant upper-level and domain ontologies.

domain of food and nutrition (see Figure 1). In this way, we can also use the benefits of cross-domain reasoning. Since FoodOn, ONS, and OntoDM all use BFO as a main top-level ontology, they speak the same general language and are consequently, easier to align.

Towards the FNS Harmony ontology. In the context of the H2020 project FNS Cloud[6] (food, nutrition, security) the goal is to develop an infrastructure and services to exploit food, nutrition and security data (data, knowledge, tools – resources) for a range of purposes. To support the different functionalities required by the cloud platform, we started with the development of the FNS-Harmony (FNS-H). The application ontology would allow us to harmonize and integrate the different reference vocabularies and ontologies from different sub-areas of food and nutrition, as well as ontologies representing the domain of data analysis.

Initial ontology development. The development of FNS-H, which is intended to bridge the gap between the field of data analysis and food and nutrition will be guided by common best practice principles for ontology development. The aim is to max-imize the reuse of available ontology resources and simultane-ously follow the Minimum Information to Reference an External Ontology Term (MIREOT) principles [2]. In the first phase, we will integrate the FoodOn ontology and the ONS ontology with the OntoDM suite of ontologies. With this integration, we will be able to (1) define domain-specific data types for the domain of food and nutrition by extending OntoDT generic data types; (2) define food and nutrition analysis pipelines for the domain of food and nutrition by extending OntoDM-core, and (3) define

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[5]http://bioportal.bioontology.org/ontologies/ISO-FOOD, accessed 22/04/2020

[6]https://www.fns-cloud.eu/

food and nutrition knowledge discovery scenarios by extending OntoDM-KDD ontology.

The development of the ontology already started in a top-down fashion, it is expressed in OWL2 and being developed using the Protégé ontology development tool. Aspiring to maximize accessibility, the ontology will be available for access on a GitHub repository, [7] as well as via BioPortal. In the current stage of development, an initial set of higher-level domain terms, data types, data formats, data provenance metadata, lists of external ontologies and vocabularies were extracted from the literature and FNS-Cloud project documents.

In the next steps, we will first align the extracted terms with the BFO ontology and then integrate them with domain terms from the domain ontologies based on BFO, such asFoodOn, and ONS, at the first instance, as well as with the OntoDM set of ontologies. Other potentially relevant ontologies include the Ontology for Biomedical Investigations (OBI), Ontology of Biological and Clinical Statistics (OBSC), Ontology of Chemical Entities of Biological Interest (ChEBI), Ontology of Statistical Methods (STATO), and others. To achieve integration of different ontological resources, we will use the ROBOT tool [9] that supports the automation of a large number of ontology development tasks and helps developers to efficiently produce high-quality ontologies.

5 CONCLUSION

In this paper, we provided an overview of the most relevant knowledge organization systems in the domain of food and nutrition. We started with the LanguaL food thesaurus that served as a foundation for the development of the more sophisticated ontologies — FoodOn, used for a multi-faceted description of various foods; ONS, used for observational and interventional nutrition studies; ISO-Food for the studies of isotopic data in foods. Next, we assessed the selected vocabularies with respect to the FAIR principles and OBO Foundry guidelines for scientific data management. All of the selected vocabularies showed compliance with these accomplishment criteria, with only minor suggestions for improvement provided from our side. Finally, in our proposal, we lay down the foundations of a new ontology which would connect data mining concepts in the domain of food and nutrition using domain ontologies (FoodOn, ONS) with ontologies for datatypes, data mining, and knowledge discovery in databases (OntoDT, OntoDM-core, OntoDM-KDD). By doing so, we can provide richer semantic annotation and discover new scenarios of harvesting knowledge from the food and nutrition data.

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[7]https://github.com/panovp/FNS-Harmony

Absenteeism prediction from timesheet data: A case study

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ABSTRACT

Absenteeism, or employee absence from work, is a perpetual problem for all businesses, given the necessity to replace an absent worker to avoid a loss of revenue. In this paper, we focus on the task of predicting worker's absence based on historical timesheet data. The data are obtained from MojeUre, a system for tracking and recording working hours, which includes timesheet profiles of employees from different companies in Slovenia. More specifically, based on historical data for one year, we want to predict, under (which) certain conditions, if an employee will be absent from work and for how long (e.g., a week, a month). In this respect, we compare the performance of different predictive modeling methods by defining the prediction task as a binary classification task and as a regression task. Furthermore, in the case of one week ahead prediction, we test if we can improve the predictions by using additional aggregate descriptive attributes, together with the timesheet profiles.

KEYWORDS

Absenteeism at work, absence prediction, predictive modeling, timesheet data, human resource management

1 INTRODUCTION

Companies strive to have better predictive accuracy in their day to day operations, with the main goal of improving the productivity of the human resources (HR) department and hence obtaining higher profits and lower HR expenditures. They obtain information and insight from the large collections of human resource management (HRM) data that each employer owns, to support day to day operations and decision making, as well as, to comply to the national and international legislation.

The new era of HR executives is moving from settling on receptive choices exclusively taking into account reports and dashboards towards connecting business information and human asset information to foresee future results which will bring changes. Having such data enables them to detect patterns and trends, anticipate events and spot anomalies, forecast using what-if simulations and learn of changes in employee behaviour so that employee can take actions that lead to desired business outcomes. The purpose of HRM is measuring employee performance and engagement, studying workforce collaboration patterns, analyzing employee churn and turnover and modelling employee lifetime value [1].

In this paper, we address the task of absenteeism prediction from time sheets data. More specifically, based on data that we get from MojeUre time attendance register system, we want to build a predictive model to predict if or for how many days an employee would be absent. In this case, we are considering one-week-ahead prediction from workers profiles and one year historical time sheets data. To predict if an employee will be absent in a given week, we employee the task of binary classification, which can be addressed by using a large number of binary classification methods. On the other hand, to predict the number of days an employee would be absent in a given week, we employee regression, which can be addressed by using regression methods. Furthermore, we observe and discuss how adding of aggregate attributes influences the prediction power if used together with the timesheet profiles.

2 DATA

In this section, we present the MojeUre system and then describe the structure of the raw data, as well as the process of data cleaning. Then we present the structure of the dataset, used for learning the predictive and the aggregate attributes, we constructed in order to test if they would improve the predictive power of the predictive models.

2.1 MojeUre system

The MojeUre system (https://mojeure.si) was developed to support the process of planning workers schedules, as well as for recording work attendance and absenteeism. In addition to the easy recording of the working hours of employees by a company, the system also provides access to each employee's own working hours, vacation control, sick leave, travel orders, etc. The system can be accessed using the web or by using a mobile application.

The entry of working hours is done either through a web application or a mobile application. In the case the company also wants to invests into a working time registrar, this can be done through the registrar where the employee has a personalized card for clock-in or clock-out (for example usage of break, such as a lunch break, a private break, etc.). The system allows different types of registered hours to be entered in the system in a single day.

All data used in the paper was obtained from the electronic system for recording working hours. There are currently more than 150 different companies that use the system for registering workers attendance. The basic function of the system is to record the arrivals and departures of an employee at work and to record the various types of employee absence, such as sick leave and vacation leave. In addition, the system covers other absences such as paternity leave, maternity leave, part-time leave, study leave, student leave, etc.

In this paper, we use data from the MojeUre system for the year 2019 and we have timesheet attendance data for all 52 weeks. The data instances are composed of three types of attributes: (1) attributes describing workers profiles (See Table 1), (2) attributes describing timesheets absence profiles of each worker (See Table 2), and (3) attributes that are aggregates from timesheets profiles constructed using domain knowledge (more details about the attributes is provided in Section 2.2). The timesheets attributes composing the absence profile of each worker are calculated based on the logged presence and absence logging data aggregated on the week level.. The entire dataset for the whole year consists of 232 different attributes and 2363 employees which are defined as each row.

Table 1: Workers profile attributes

Attribute name	Type	Description
EmployeeID	numeric	Unique employee identifier.
WorkHour	numeric	Data indicating how many hours per day an employee is employed by contract.
CompanyType	nominal	Company type by specific categories.
EmploymentYears	numeric	Describes how many years the person has been employed by the current company.
JobType	nominal	Describes type of job (e.g. permanent, part-time).
Region	nominal	The region in which the employee's company is located.

Table 2: Timesheet absence profile attributes

Attribute name	Type	Description
WeekWNYTotal	numeric	The number of all absences in a given week, including the sum of sick leave and (vacation) leave.
WeekWNY VacationLeave	numeric	The number of absences with type vacation leave in a given week.
WeekWNY SickLeave	nominal	The number of absences with type sick leave in a given week.
WeekWNY Absence	nominal	Value tells if employee was absent at least 1 day in whole week.

2.2 Data prepossessing and feature engineering

Feature Engineering is an art (Shekhar A, 2018) and involves the process of using domain knowledge to create features with the goal to increase the predictive power of machine learning algorithms. In this section, we describe the newly constructed attributes using domain knowledge. Furthermore, we present the process of data cleaning. Before cleaning, the original dataset contains 2087 instances of individual employees. The engineered aggregate attributes using domain knowledge from timesheets profiles are presented in Table 3.

Table 3: Attributes representing the workers profiles

Attribute name	Type	Description
VacationLeave TotalDays	numeric	Total days of vacation leave for all weeks, which are defined in the timesheets data used for the descriptive attribute space.
SickLeave TotalDays	numeric	Total days of sick leave for all weeks, which are defined in the timesheets data used for the descriptive attribute space.
ShortTerm VacationLeave3	numeric	A count of how many times an employee was at vacation leave for at least 3 days per week.
LongTerm VacationLeave5	numeric	A count of how many times an employee was on vacation leave for at last 5 days per week.
ShortTerm SickLeave3	numeric	A count of how many times an employee was on sick leave for at least 3 days.
LongTerm SickLeave5	numeric	A count of how many times an employee was on sick leave for at least 5 days.
WinterVacation LeaveAbsence	numeric	The number of vacation leave days that were used in winter.
SpringVacation LeaveAbsence	numeric	The number of vacation leave days that were used in spring.
SummerVacation LeaveAbsence	numeric	The number of vacation leave days that were used in summer.
AutumnVacation LeaveAbsence	numeric	The number of vacation leave days that were used in autumn.
WinterSickLeave Absence	numeric	The number of sick leave days that were used in winter.
SpringSick LeaveAbsence	numeric	The number of sick leave days that were used in spring.
SummerSick LeaveAbsence	numeric	The number of sick leave days that were used in summer.
AutumnSick LeaveAbsence	numeric	The number of sick leave days that were used in autumn.
WinterVacation LeaveHoliday	numeric	The number of vacation leave days that were used in winter during school holidays.
SpringVacation LeaveHoliday	numeric	The number of vacation leave days that were used in spring during school spring holidays.
SummerVacation LeaveHoliday	numeric	The number of vacation leave days that were used in summer during school summer holidays.
AutumnVacation LeaveHoliday	numeric	The number of vacation leave days that were used in autumn during school holidays.

The period we are considering in our analysis is one year, that is composed of 52 weeks. For construction of the aggregate attributes, we have defined our seasons by weeks, defined as follows: (1) the winter season is defined from week 51 in the previous year to week 12 in the New year; (2) the spring season is defined from week 13 to week 25; (3) the summer season is defined from week 26 week to week 39; and (4) the autumn season is defined from week 40 week to week 49.

In addition, we also defined the school holidays by weeks, which are defined as follows: (1) the winter holidays are defined from week 7 to 8; (2) the spring holidays are defined from week 18 to 19; (3) the summer holidays are defined from week 26 to week 35; and (4) the autumn holidays are defined from week 44 to week 45.

After we cleaned up the initial dataset, we obtained a smaller number of dataset instances. This resulted in a dataset with 961 distinct rows or more precisely different employees. The main control statement for the data cleaning was a test if an employee has less than one VacationLeaveTotalDays in the defined period. This would mean that: (1) an employee that fulfills this condition doesn't work any more in company; or (2) the company doesn't use recording system anymore; or (3) the employee is student and for students the vacation leave days are not recorded as they are usually paid per working hour only.

The most of employees in the dataset are working in company type called "Izobraževanje, prevajanje, kultura, šport" (Education, translation services, culture, sports). In addition, most of the employees are coming from the region "Osrednjeslovenska" (Central Slovenia region). The largest number of absence vacation leave or holiday leave was in week 52, which is the last week in year 2019 which is expected.

3 DATA ANALYSIS SCENARIOS AND EXPERIMENTS

Research question. In general, in this paper we want to perform one-week ahead prediction of employee absence, using worker profile data, historical timesheet data aggregated on a week level, as well as aggregated attributes described in the previous section. We explore the task of predicting employee absence both as a binary classification task and as a regression task. In the experiments, we want to test if and how the aggregates attributes influence the predictive power of the built models both for the case of binary classification and regression.

Tasks. In the binary classification task, we want only to predict if an employee will be absent in a given week. For this case, we use the boolean attribute *WeekWNYAbsence* as a target attribute (WNY is the identifier of the target week). In the regression task, we want to predict the number of absence days. For this case, we use one of the following numeric attributes as targets *WeekWNYTotal* (for predicting the total number of absence days), *WeekWNYVacationLeave* (for predicting the number of vacation leave days), or *WeekWNYSickLeave* (for predicting the number of sick leave days).

Construction of the experimental datasets For the purpose of analysis, we construct two types of datasets: (1) the first type contain worker profile and timesheet absence profiles as descriptive attributes (see Figure 1a); and (2) the second type includes also timesheets absence aggregates (see Figure 1b).

In order to perform analysis, we need to properly construct the datasets used for learning predicting models. For example, if we want to predict workers absence for week 15, we use historical timesheets data from week 1-14 together with the aggregates calculated on this period as descriptive attributes.

We decided to split the year consisting of 52 weeks in four quarters (Q1: W1-W13, Q2: W14-W26, Q3:W27-W39, Q4:W40-W52), each containing 13 weeks. The absence data for the first 12 weeks were used as historical timesheet profiles, out of which

Descriptive attributes		Target attribute
Worker profile	Timesheet absence binary profile 1-(K-1) week	Week K Absence

(a) Without aggregate attributes

Descriptive attributes			Target attribute
Worker profile	Timesheet absence binary profile 1-(K-1) week	Timesheet absence aggregates 1-(K-1) week	Week K Absence

(b) With aggregate attributes

Figure 1: The structure of the data instances used for learning predictive models

the aggregate attributes were calculated. The absence of the 13th week was used a target attribute. For each quarter, we constructed two different variants of datasets, one containing the aggregate attributes and the other without the aggregate attributes. This procedure was done for both tasks: binary classification and regression.

Experimental setup. For our paper, we used Weka as main software [2] to execute predictive modelling experiments. WEKA is an open source software provides tools for data preprocessing, implementation of several Machine Learning algorithms, and visualization tools so that one can develop machine learning techniques and apply them to real-world data mining problems. In the experiments, for all methods we used the default method settings from Weka mining software. The evaluation method used was 10 fold cross-validation.

Methods. Here, we used different predictive methods implemented in the WEKA software with different settings. For the regression task, we compare the performance of the following methods Linear regression (LR), M5P (both regression and model trees)[3], RandomForest (RF) [4] with M5P trees as base learners, Bagg (Bag) [5] having M5P trees as base learners, IBK (nearest neighbour classifier with different number of neighbours) [6] and SMOreg (support vector regression) [7].

For binary prediction, we compare the performance of the following methods: jRIP (decision rules) J48 (decision trees) RandomForest (RF), Bagging (Bagg) having J48 trees as base learners, RandomSubSpace (RS) [8] having J48 trees as base learners, SMO (support vector machines) [9], and IBK (nearest neighbour classifier with different number of neighbours).

Evaluation measures. To answer our research question for the case of regression, we use several measures for regression analysis, such as: Mean Absolute Error (MAE), Root mean squared error (RMSE), and Correlation coefficient (CC).

For the case of classification, we use several measures for classification analysis, such as: the percentage of correctly classified instances (classification accuracy), precision, and recall.

Table 4: Predictive performance results. The bold value denotes the highest value when we compare datasets with (A) or without (NA) added aggregate attributes. The gray cells denote the best performing method for each dataset.

(a) Performance results for the regression task - RMSE measure (less is better)

Dataset	LR	MP5	M5P-R	RF	Bagg	IBK(K=1)	IBK(K=3)	IBK(K=7)	SMOreg
Q1-A	0.789	0.692	0.775	**0.688**	**0.64**	0.804	**0.687**	0.734	0.681
Q1-NA	**0.723**	**0.674**	**0.767**	0.729	0.647	**0.798**	0.693	**0.724**	**0.659**
Q2-A	1.692	**1.369**	1.422	**1.412**	1.438	1.894	**1.476**	**1.382**	1.617
Q2-NA	**1.44**	1.382	**1.396**	1.457	**1.379**	1.752	1.506	1.425	**1.497**
Q3-A	0.942	**0.919**	0.976	0.999	0.935	1.409	1.074	**1.015**	0.963
Q3-NA	**0.911**	0.929	**0.956**	**0.968**	**0.927**	**1.223**	**1.046**	1.017	0.969
Q4-A	**0.977**	**0.947**	**0.961**	**0.923**	**0.922**	1.222	**1.029**	1.005	**0.984**
Q4-NA	0.992	0.985	0.976	1.024	0.975	**1.186**	1.066	**0.999**	1.007

(b) Performance results for the classification task - Accuracy in% (more is better)

Dataset	JRip	j48	RF	Bagg	RS	SMO	IBK(K=1)	IBK(K=3)	IBK(K=7)
Q1-A	**87.429**	**90.810**	90.357	**90.833**	89.881	**92.762**	87.452	**91.810**	90.810
Q1-NA	**87.429**	**90.810**	**90.381**	89.857	**90.357**	90.833	**89.429**	**91.810**	**90.833**
Q2-A	63.645	**68.879**	65.751	65.419	66.736	**69.200**	58.153	**64.347**	**68.842**
Q2-NA	**66.466**	68.177	**67.118**	**66.441**	66.429	**66.773**	**65.049**	62.291	67.463
Q3-A	**84.429**	**84.404**	**83.288**	83.061	84.409	**86.677**	77.182	82.616	**85.333**
Q3-NA	83.737	83.520	82.379	**83.737**	**84.864**	86.449	**81.263**	**85.101**	84.879
Q4-A	**71.130**	67.277	**72.150**	**70.460**	70.305	**70.452**	**69.627**	**70.644**	**70.302**
Q4-NA	70.455	**68.266**	66.774	67.441	69.791	69.466	66.093	67.610	68.960

4 RESULTS AND DISCUSSION

Regression task[1]**.** In Table 4a, we present the results for RMSE measure. It indicates how close the observed data points are to the model's predicted values, and lower values indicate better fit. From the results, we can observe that in general Bagging of M5P trees obtains the best performance. Predicting absence in week 13 from Q1 is generally better without using aggregate attributes. We have similar behaviour for predicting absence in week 26 (Q2) and week 39 (Q3). Predicting absence for the last week in the year from Q4 is generally better done using additional aggregate attributes. If we consider MAE, the best performing method is SMOreg, and for Q1, Q2 better results are obtained without the use of aggregate attributes, opposite to the Q3 and Q4. Finally, if we consider CC the best performing method is Bagging, and for Q1 and Q4 better results are obtained without using aggregate attributes, opposite to Q2 and Q3.

Classification task[2]**.** In Table 4b, we present the results for accuracy. From the results, we can observe that in general SMO obtains the best performance. For Q1, we obtain better results if we do not include aggregate attributes. For Q2, Q3 and Q4 the best results are obtained by using the additional aggregate attributes. If we consider precision the best performing methods are SMO and JRip, while for recall the best performing method is IBK using 7 nearest neighbours.

5 CONCLUSION AND FUTURE WORK

The main goal of the paper was to test if adding additional timesheet aggregate attributes can influence the predictive power in the case of one-week ahead absenteeism prediction from timesheet data. The research was performed on data from year 2019, collected by the MojeUre work attendance register system. We used various predictive modelling methods formulating the prediction task as regression (predicting the number of absent days in a week) and classification (predicting if an employee will

be absent in a given week). To see the difference in performance, we performed experiments on datasets constructed on different quarters of the year. The best prediction method in the case of regression is Bagging and in general we could say that predictions are slightly better if we don't use aggregate attributes. The best method in the case of classification is SMO. Again almost same results with using or not using external aggregate attributes.

In future work, we plan to perform selective analysis of absenteeism using the same data based on different criteria, such as seasonality, closeness to holidays (before, after), critical weeks for certain professions etc. In addition, we plan to perform regional analysis and workers domain analysis which is based on company type. Moreover, more insight into absence patterns will be available after collecting several years of attendance data for each employee. Finally, we plan to compare the different granularity of prediction (day - based vs. week - based vs. half a month based vs. month based analysis).

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[1]Complete results for regression are presented at the following URL
https://tinyurl.com/yyp85vfr
[2]Complete results for classification are presented at the following URL
https://tinyurl.com/yo6h6d8

Monitoring COVID-19 through text mining and visualization

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ABSTRACT

The global health situation due to the SARS-COV-2 pandemic motivated an unprecedented contribution of science and technology from companies and communities all over the world to fight COVID-19. In this paper, we present the impactful role of text mining and data analytics, exposed publicly through IRCAI's Coronavirus Watch portal. We will discuss the available technology and methodology, as well as the ongoing research based on the collected data.

KEYWORDS

Text mining, Data analytics, Data visualisation, Public health, Coronavirus, COVID-19, Epidemic intelligence

1 INTRODUCTION

When the World Health Organization (WHO) announced the global COVID-19 pandemic on March 11th 2020 [25], following the rising incidence of the SARS-COV-2 in Europe, the world started reading and talking about the new Coronavirus. The arrival of the epidemic to Europe scaled out the news published about the topic, while public health institutions and governmental agencies had to look for existing reliable solutions that could help them plan their actions and the consequences of these.

Technological companies and scientific communities invested efforts in making available tools (e.g. the GIS [1] later adopted by the World Health Organisation (WHO)), challenges (e.g. the Kaggle COVID-19 competition [13]), and scientific reports and data (e.g. the repositories medRxiv [15] and Zenodo [27]).

In this paper we discuss the Coronavirus Watch portal [12], made available by the UNESCO AI Research Institute (IRCAI), comprehending several data exploration dashboards related to the SARS-COV-2 worldwide pandemic (see the main portal in Figure 1). This platform aims to expose the different perspectives on the data generated and trigger actions that can contribute to a better understanding of the behavior of the disease.

2 RELATED WORK

The many platforms that have been made publicly available over the internet to monitor aspects of the COVID-19 pandemics are mostly focusing on data visualization based on the incidence of the disease and the death rate worldwide (e.g., the CoronaTracker [3]). The limitations of the available tools are potentially due to

Figure 1: Coronavirus Watch portal

the lack of resolution of the data in aspects like the geographic location of reported cases, the commodities (i.e., other diseases that also influence the death of the patient), the frequency of the data, etc. On the other hand, it was not common to monitor the epidemic through the worldwide news (with some exceptions as the Ravenpack Coronavirus News Monitor [21]).

The Coronavirus Watch portal suggests the association of reported incidence with worldwide published news per country, which allows for real-time analysis of the epidemic situation and its impact on public health (in which specific topics like mental health and diabetes are important related matters) but also in other domains (such as economy, social inequalities, etc.). This news monitoring is based on state-of-the-art text mining technology aligned with the validation of domain experts that ensures the relevance of the customized stream of collected news.

Moreover, the Coronavirus Watch portal offers the user other perspectives of the epidemic monitoring, such as the insights from the published biomedical research that will help the user to better understand the disease and its impact on other health conditions. While related work was promoted in [13] in relation with the COVID-19, and is offered in general by MEDLINE mining tools (e.g., MeSH Now [16]), there seems to be no dedicated tool to the monitoring and mining of COVID-19 - related research as that presented here.

3 DESCRIPTION OF DATA

3.1 Historical COVID-19 Data

To perform an analysis of the growth of the coronavirus, we need to use the historical data of cases and deaths. This data is retrieved from a GitHub repository by John Hopkins University[4]. The data source is based mainly on the official data from the World Health Organization (WHO)[24] along with some other sources, like the Center for Disease and Control[2], and Worldometer[26], among others. This data provides the basis for all functionality that depended on the statistical information about COVID-19 numbers.

3.2 Live Data from Worldometer

Apart from historical data, live data about the COVID-19 number of cases, deaths, recovered, and tests are retrieved from the worldometer website. Although the cases might not be as official as the one provided by John Hopkins University (which is based on WHO data), this source is updated many times per day providing the latest up-to-date data about COVID-19 statistics at all times.

3.3 Live News about Coronavirus

The live news is retrieved from Event Registry [10], which is a media-intelligence platform that collects news media from around the world in many languages. The service analyzes news from more than 30,000 news, blogs, and PR sources in 35 languages.

3.4 Google COVID-19 Community Mobility Data

Google's Community Mobility [11] data compares mobility patterns from before the COVID-19 crisis and the situation on a weekly basis. Mobility patterns are measured as changes in the frequency of visits to six location types: Retail and recreation, Grocery and pharmacy, Parks, Transit stations, Workplaces, and Residential. The data is provided on a country level as well as on a province level.

3.5 MEDLINE: Medical Research Open Dataset

The MEDLINE dataset [14] contains more than 30 million citations and abstracts of the biomedical literature, hand-annotated by health experts using 16 major categories and a maximum of 13 levels of deepness. The labeled articles are hand-annotated by humans based on their main and complementary topics, and on the chemical substances that they relate to. It is widely used by the biomedical research community through the well-accepted search engine PubMed [19].

4 CORONAVIRUS WATCH DASHBOARD

The main layout of the dashboard displayed in figure 1 consists of two sides. It is split into the left table of countries, where a simple table of statistics is provided about countries along with the total numbers of cases, deaths, and recovered. On the right side, there is a navigation panel with tabs, each representing a functionality. Each functionality answers some questions and provides insights about a certain type of data.

4.1 Coronavirus Data Table

The data table functionality is a simple table that shows the basic statistics about the new coronavirus. It's taken from Worldometer as it's the most frequently updated source for coronavirus. The data table comes in two forms, one that is a simplified version which is the table on the left, and one contains the full information in a separate tab.

4.2 Coronavirus Live News

The second functionality is a live news feed about coronavirus from around the world. The feed comes from Event Registry, which is generated by querying for articles that are annotated with concepts and keywords related to coronavirus. The user can check for a country's specific news (news source in that country)
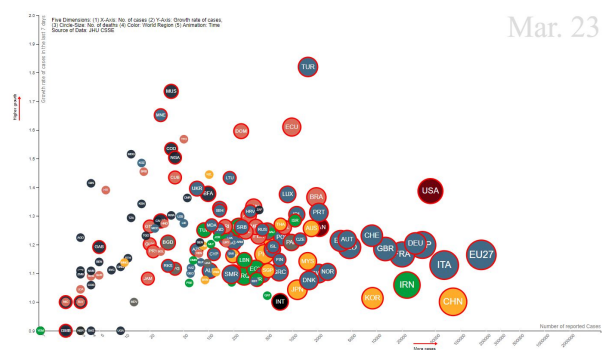
Figure 2: A snapshot of the 5D Visualization on March 23rd. Countries that were at the peak in terms of growth are shown high up like Turkey. Whereas countries that mostly contained the virus are shown down like China.

by clicking on the country name on the left table. As seen in figure 1.

4.3 Statistical Visualizations

The following set of visualization all aims at displaying the statistics about COVID-19 cases and deaths in a visual format. While they all provide countries comparison, each one focus on different perspective; Some are more complex and focus on the big picture (5D evolution), and some are simple and focus on one aspect (Progression and Trajectory). Besides, all of them have configuration options to tweak the visualization, like the ability to change the scale of the axes to focus on the top countries or the long tale. Or a slider to manually move through the days for further inspection. Furthermore, the default view compares all the countries or the top N countries, depending on the visualization. However, it's possible to track a single country or a set of countries and compare them together for a more focused view. This is done by selecting the main country by clicking on it on the left table and proceeding to select more countries by pressing the ctrl key while clicking on the country.

4.3.1 5D Evolution. 5D Evolution is a visualization that displays the evolution of the virus situation through time. It is called like that since it encompasses five dimensions: x-axis, y-axis, bubble size, bubble color, and time, as seen in figure 2. By default, it illustrates the evolution of the virus in countries based on N. cases (x-axis), The growth factor of N. Cases (y-axis), N. Deaths (bubble size), and country region (bubble color) through time. In addition, a red ring around the country bubble is drawn whenever the first death appears. The growth rate represents how likely that the numbers are increasing with respect to the day before. A growth rate of 2 means that the numbers are likely to double in the next day. The growth rate is calculated using the exponential regression model. At each day the growth rate is based on the N. cases from the previous seven days. The goal of this visualization to show how countries relate to each other and which are exploding in numbers and which ones managed to "flatten the curve", since flattening the curve means less growth rate. It's intended to be one visualization that gives the user a big picture of the situation.

4.3.2 Progression. The progression visualization displays the simple Date vs N. cases/deaths line graph. It helps to provide a simplistic view of the situation and compare countries based on the raw numbers only. The user can display the cumulative

numbers where each day represents the numbers up to now, or daily where at each date the numbers represent the cases/deaths on that day only.

4.3.3 Trajectory. While the progress visualization displays the normal date vs N. cases/deaths, this visualization seeks to compare how the trajectory of the countries differ starting from the point where they detect cases. This visualization helps to compare countries' situations if they all start having cases on the same date. The starting point has been set to the day the country reaches 100 cases, so we would compare countries when they started gaining momentum.

4.4 Time Gap

The time gap functionality tries to estimate how the countries are aligned and how many days each country is behind the other, whether that is in the number of cases or deaths. This assumes that the trajectory of the country will continue as it with taking much more strict/loose measurements, which is a rough assumption. It helps to estimate how bad or good the situation in terms of the number of days. To see the comparison, a country has to be selected from the table on the left. However, not all countries are comparable as they have very different trajectories or growth rates.

The growth of each country is represented as an exponential function, the base is calculated using linear regression on the log of the historical values (that is, exponential regression). Based on that, the duplication N. days, or the N. days the number of cases/deaths will double is determined. two countries are comparable if they have a reasonable difference is the base or doubling factor. If they are comparable, we see where the country with the smaller value fits in the historical values of the country with the larger numbers, with linear interpolation if the number is not exact, hence the decimal values.

4.5 Mobility

The mobility visualization is based on google community mobility data that describe how communities in each country are moving based on 6 parameters: Retail and recreation, Grocery and pharmacy, Parks, Transit stations, Workplaces, and Residential. The data is then reduced to 2-dimensional data while keeping the Euclidean proximity nearly the same. The visualization can indicate that the closer the countries are on the visualization, the similar the mobility patterns they have. The visualization uses the T-SNE algorithm for dimensionality reduction [23], which reduces high dimensional data to low dimensional one while keeping the distance proximity between them proportionally the same as possible. The algorithm works in the form of iterations, at each iteration, the bubbles representing the country are drawn. We used those iterations to provide animation to the visualization.

4.6 Social Distancing Simulator

The Social Distancing simulator is displayed in figure 3. Each circle represents a person who can be either healthy (white), immune (yellow), infected (red), or deceased (gray). A healthy person is infected when they collide with an infected person. After a period of infection, a person either dies or becomes permanently immune. Thus the simulation follows the Susceptible-Infectious-Recovered-Deceased (SIRD) compartmental epidemiological model.
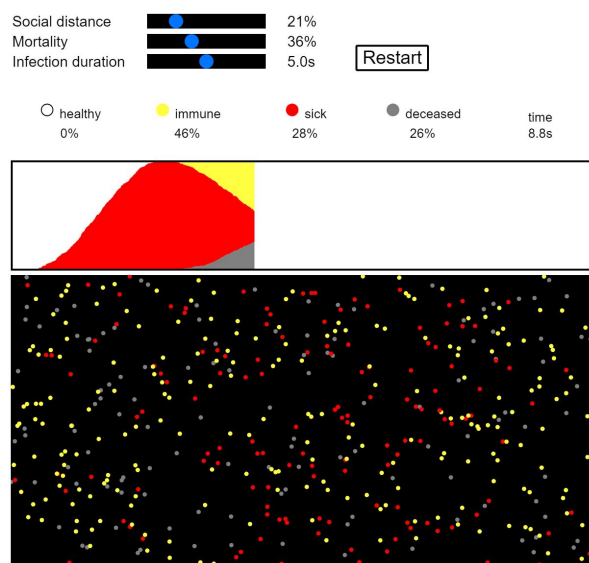
Figure 3: A snapshot of the Social Distancing Simulator. The canvas show a representation of the population. with red dots representing sick people, yellow dots representing immunized people, and grey dots represent deceased people.

The simulator is controlled by three parameters. First, Social distancing that controls to what extent the population enforces social distancing. At 0% there is no social distancing and persons move with maximum speed so that there is a great deal of contact between them. At 100% everyone remains still and there is no contact at all. Second, mortality is the probability that a sick person dies. If you set mortality to 0% nobody dies, while the mortality of 100% means that anybody who catches the infection will die. Finally, infection duration determines how long a person is infected. A longer time gives an infected person more opportunities to spread the infection. Since the simulation runs at high speed, time is measured in seconds.

4.7 Biomedical Research Explorer

To better understand the disease, the published biomedical science is the source that provides accurate and validated information. Taking into consideration a large amount of published science and the obstacles to access scientific information, we made available a MEDLINE explorer where the user can query the system and interact with a pointer to specify the search results (e.g., obtaining results on biomarkers when searching for articles hand-annotated with the MeSH class "Coronavirus").

To allow for the exploration of any health-related texts (such as scientific reports or news) we developed an automated classifier [5] that assigns to the input text the MeSH classes it relates to. The annotated text is then stored in Elasticsearch [18], from where it can be accessed through Lucene language queries, visualized over easy-to-build dashboards, and connected through an API to the earlier described explorer (see [8], [20] and [17] for more detail).

The integration of the MeSH classifier with the worldwide news explorer Event Registry allows us to use MeSH classes in the queries over worldwide news promoting an integrated health news monitoring [9] and trying to avoid bias in this context [7]. An obvious limitation is a fact that the annotation is only

available for news written in the English language, being the unique language in MEDLINE.

5 CONCLUSION AND FUTURE WORK

In this paper, we presented the coronavirus watch dashboard as a use-case of observing pandemic. However, this methodology can be applied to other kinds of diseases given the availability of similar data. For further development, we plan to implement a local dashboard for other countries as well which would provide local data in the local language. In addition, given the existence of more than seven months of historical data, we would like to build some predictive models to predict the number of cases/deaths in the next few days.

Moreover, we are using the StreamStory technology [22] in order to: (i) compare the evolution of the disease between countries by comparing their time-series of incidence; (ii) investigate the correlation between the incidence of the disease with weather conditions and other impact factors; and (iii) analyze the dynamics of the evolution of the disease based on incidence, morbidity, and recovery. This technology allows for the analysis of dynamical Markov processes, analyzing simultaneous time-series through transitions between states, offering several customization options and data visualization modules.

Furthermore, following the work done in the context of the Influenza epidemic in [6], we are using Topological Data Analysis methods to understand the behavior of COVID-19 throughout Europe. In it, we examine the structure of data through its topological structure, which allows for comparison of the evolution of the epidemics within countries through the encoded topology of their incidence time series.

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Usage of Incremental Learning in Land-Cover Classification

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ABSTRACT

In this paper we present a comparison of a variety of incremental learning algorithms along with traditional (batch) learning algorithms in an earth observation scenario. The approach was evaluated with the earth observation data set for land-cover classification from Europe Space Agency's Sentinel-2 mission, the digital elevation model and the ground truth data of land use and land cover from Slovenia. We show that incremental algorithms can produce competitive results while using less time than batch methods.

Keywords

remote sensing, earth observation, incremental learning, machine learning, classification

1. INTRODUCTION

Land cover classification is one of the common and well researched tasks of machine learning (ML) in the Earth Observation (EO) community [1]. The challenge is to classify land into different types based on remote sensing data such as satellite images, radar data, information on weather [12] and altitude. The most commonly used data are satellite images, which may vary in acquisition period, resolution or wavelength. A plethora of algorithms have explored the potential of using a single-date image [3] and even time series of images for the task [11, 13]. Extensive work with state-of-the-art accuracy was performed using methods of deep learning [14]. The latter report a high computational effort in the learning and forecasting phase, which reduces their potential for continuous tasks requiring a timely response. There have also been efforts to reduce learning and prediction times using intelligent feature selection [6, 7]. To the best of our knowledge, no cases have been reported where stream models have been used in an EO scenario. The primary purpose of incremental learning would be to reduce the computational cost of classification, regression, or clustering techniques, which, when dealing with large data provided by Sentinel 2 and other sources, can be a significant cost to organizations trying to extract knowledge from that data. One of the advantages of incremental learning is that it is not necessary to load all the data into memory at once when creating a model. We only need to store the model and the part of the data we are processing. This could be especially useful in various EO scenarios, as the data from Copernicus services is estimated to exceed 150PB.

2. DATA

2.1 EO data

The Earth observation data were provided by the Sentinel 2 mission of the EU Copernicus programme, whose main objectives are land monitoring, detection of land use and land changes, support for land cover creation, disaster relief support and monitoring of climate change [2]. The data comprise 13 multi-spectral channels in the visible/near- infrared (VNIR) and short wave infrared (SWIR) spectral range with a temporal resolution of 5 days and spatial resolutions of 10m, 20m and 60m [8]. The Sentinel's Level-2A products (surface reflections in cartographic geometry) were accessed via the services of SentinelHub[1] and processed using `eo-learn`[2] library. Additionally, a digital elevation model for Slovenia (EU-DEM) with 30m resolution[3] was used.

2.2 LULC data

LULC (Land Use Land Cover) data for Slovenia is collected by the Ministry of Agriculture, Forestry and Food and is publicly available [10]. The data is provided in shapefile format, with each polygon representing a patch of land marked with one of the LULC classes. Originally there were 25 classes, but we introduced a more general dataset by grouping similar classes together. The frequencies of 8 newly grouped classes are shown in Figure 1.

2.3 Feature Engineering

The EO data were collected for the whole year. 4 raw band measurements (red, green, blue - RGB and near-infrared - NIR) and 6 relevant vegetation- related derived indices (normalized differential vegetation index - NDVI, normalized differential water index - NDWI, enhanced vegetation index - EVI, soil-adjusted vegetation index - SAVI, structure intensive pigment index - SIPI and atmospherically resistant vegetation index - ARVI) were considered. The derived indices are based on extensive domain knowledge and are used for assessing vegetation properties. One example is the NDVI index, which is an indicator of for vegetation health and biomass. Its value changes during the growth period of the plants and differs significantly from other unplanted

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[1] https://www.sentinel-hub.com/
[2] https://github.com/sentinel-hub/eo-learn
[3] https://www.eea.europa.eu/data-and-maps/data/eu-dem#tab-original-data
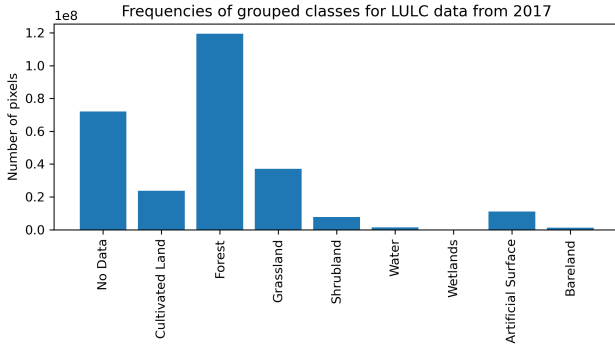
Figure 1: **Frequencies of grouped classes for LULC data from 2017 show that the new simplified classification preserves the most common classes separated and merges the less common classes. Classes with the lowest frequencies were selected for oversampling.**

areas. The NDVI is calculated as:

$$NDVI = \frac{NIR - red}{NIR + red}$$

Timeless features were extracted based on Valero et al. [11]. These features can describe the three most important crop stages: the beginning of greenness, the ripening period and the beginning of senescence [11, 13]. Annual time series have different shapes due to the phenological cycle of a crop and characterize the development of a crop. With timeless features, they can be represented in a condensed form.

For each pixel, 18 features per each of 10 time series were generated. From elevation data, the raw value and maximum tilt for a given pixel were calculated as 2 additional features. In total 182 features were constructed. From these features only a Pareto-optimal subset of 9 features was selected [6].

3. METHODOLOGY

Classification accuracy (**CA**) and **F1** score were calculated for **11** different ML methods, **6 batch** learning methods and **5 incremental** learning methods. All incremental learning methods are available in the `ml-rapids` (MLR)[4] library which has been developed in order to support the use of incremental learning techniques within eo-learn [4] library.

Hoeffding Tree (incremental)

Hoeffding tree (HT) is an incremental decision tree that can learn from massive streams. It assumes that the distribution of generating examples does not change over time. The Hoeffding tree begins as an initially empty leaf. Each time the new example arrives, the algorithm sorts it down the tree (it updates the internal nodes statistics) until it reaches the leaf. When it reaches the leaf, it updates the leaf statistics of all unused attributes. It then takes the best (A) and second-best (B) attributes based on standard deviation and calculates the ratio of their reductions. To find the best attribute to split a node the Hoeffding bound is used. First algorithm

[4] https://github.com/JozefStefanInstitute/ml-rapids
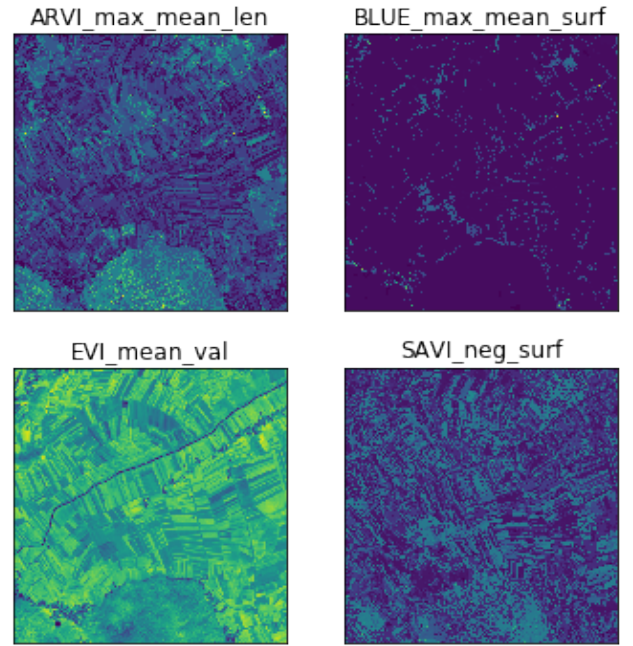
Figure 2: **Example of some of the timeless features.** `ARVI_max_mean_len` **shows the length of maximum mean value in a sliding temporal neighbourhood of ARVI index.** `BLUE_max_mean_surf` **shows the surface of the flat interval area containing the peak using the blue raw band.** `EVI_mean_val` **shows mean value of EVI index and** `SAVI_neg_sur` **shows the maximum surface of the first negative derivative interval of SAVI index.**

checks if the ratio is less than $1 - \epsilon$, where $\epsilon = \sqrt{\log \frac{1/\delta}{2n}}$ and $1 - \delta$ is desired confidence. If the ratio is small enough, meaning that attribute A is really better than attribute B, then the algorithm divides the node by that attribute.

Bagging of HT (incremental)

Given a standard training set D of size n, bagging generates m new training sets D_i, each of size n', by uniform sampling from D. Because the sampling is done with replacement, some observations can be repeated in each D_i. If $n' = n$, then for large n the set D_i is expected to have the fraction $(1 - 1/e)(\approx 63.2\%)$ of the unique examples of D, the rest being duplicates. Then, m HT models are fitted using the above m samples and combined by voting. To include a new sample, a random subset of models are selected according to Poisson distribution [9], and these models are updated with the sample in the same way as the HT model described above.

Naïve Bayes (incremental)

Naïve Bayes (NB) is a classification technique based on Bayes's Theorem. It lets us calculate the probability of data belonging to a given class, given prior knowledge. Bayes' Theorem is:

$$P(class|data) = \frac{P(data|class) \; times P(class)}{P(data)}$$

where $P(class|data)$ is the probability of class given the provided data. To add a new training instance, NB only needs to update relevant entries in its probability table.

Logistic Regression (incremental)
Logistic regression is a statistical model that in its basic form uses a logistic function to model a binary dependent variable. A model with two predictors x_1 and x_2 and a binary variable Y, denoted by $p = P(Y = 1)$, which gives us the odds of the values belonging to the class p. The relationship between these terms can be modeled with the following equation:

$$p = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2)}}$$

The parameters $\beta_0, \beta_1, \beta_2$ can be determined by stochastic gradient descend using logistic loss function.

Perceptron (incremental)
Perceptron is very similar to Logistic regression. It models a binary variable with the same activation function. The only difference is in the cost function that is used for gradient descend.

Batch learning methods
Batch learning methods learn from the whole training set and do not have to rely on heuristics (e.g. Hoeffding bound) or incremental approaches (like SGD) for building the model. The following batch methods have been tested: decision trees, gradient boosting (LGBM), random forest, perceptron, multi-layer perceptron, and logistic regression [5].

4. RESULTS

Results of the experiments are summarised in Figures 3, 4 and Table 1. Figures depict dependency of algorithm-specific F_1 score vs. its training and inference times. An ideal algorithm would be located in the top left corner, achieving full F_1 score with a training and inference time of 0. Any algorithm that has no other algorithm in its top-left quadrant (no algorithm is both more accurate and faster) belongs to a Pareto front, which means that this algorithm is optimal for a certain set of use-cases.
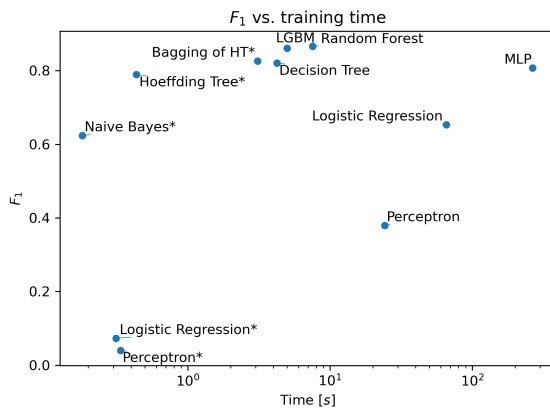
Figure 3: F1 score vs. training time of different models for predicting LULC classes. *Denotes incremental algorithms.
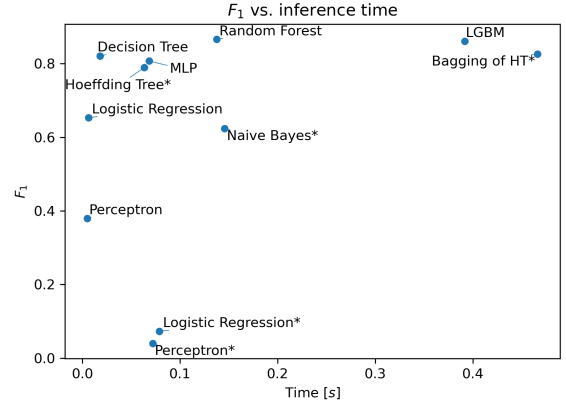
Figure 4: F1 score vs. inference time of different models for predicting LULC classes. *Denotes incremental algorithms.

We can observe that ml-rapid's Naïve Bayes, Hoeffding Tree, Bagging of HT, Decision Trees, LGBM and Random Forest belong to the Pareto optimal set of algorithms according to the training time and F1 score. Regarding inference times Logistic Regression, Decision Trees and Random Forest are the only Pareto optimal algorithms. The choice of algorithm depends on the available processing power and time. For a system that has a lot of time and resources available, it would be best to use Random Forest as it has the highest F1 score. In practice, this is not always feasible. For example, if the algorithm were used for an on-board system on the satellite, we could not afford to save all the data and would prefer to load only the model. With an incremental algorithm, the data could be collected, processed and discarded while the acquired knowledge would be stored in the model. Another preference for HT would be in a wrapper feature selection algorithm [6]. This type of algorithms do a lot of evaluations of the selected method. The main result is a subset of features that can later be used with other algorithms. The acquired set of features might be biased towards the method used, but the results would be obtained much faster.

From the confusion matrix of the HT algorithm shown in Figure 5, we can see that shrubland is often wrongly classified as forest, bareland or grassland and vice versa. This is mainly due to the unclear distinction between these classes (e.g. shrubland can be anything between bareland and forest) and poor ground truth data due to infrequent updates, low accuracy, and lack of detail (e.g. patch of land labeled as shrubland can also grassland and trees). The unclear distinction between certain classes may also explain confusion between wetlands and shrubland or wetlands and grassland, as wetlands may be covered with grass or shrubs. The lack of detail also contributes to misclassification between grassland and artificial surface, as not every small grassy area, such as park or lawn, is included in ground truth data. Finally, grass cultures, unused land overgrown by grass and rotation of crops are likely some of the reasons for confusion between cultivated land and grassland.
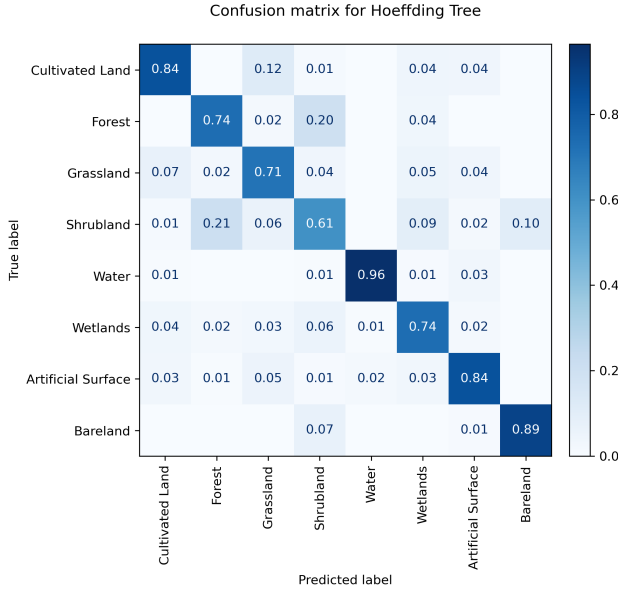
Figure 5: Confusion matrix of HT based model for predicting LULC classes.

	Training time	Inference time	CA	F1
LGBM	4.87	0.38	0.86	0.86
Decision Tree	4.18	0.02	0.82	0.82
Random Forest	7.53	0.14	0.87	0.87
MLP	264.67	0.07	0.81	0.81
Logistic Regression	63.50	0.01	0.67	0.65
Perceptron	24.05	0.01	0.45	0.38
Hoeffding Tree*	0.44	0.06	0.79	0.79
Bagging of HT*	3.07	0.46	0.83	0.83
Naïve Bayes*	0.18	0.15	0.64	0.62
Logistic Regression*	0.31	0.08	0.15	0.07
Perceptron*	0.33	0.07	0.14	0.04

Table 1: Comparison of models for predicting LULC classes. *Denotes incremental algorithms.

5. CONCLUSIONS

In our approach we have concentrated on effective processing. Our goal was to provide methods and workflows which can reduce the need for extensive hardware and processing power. Our goal was focused on use cases where a near state-of-the-art accuracy can be achieved with only a fraction of the processing power required by the state-of-the-art. We have researched stream mining algorithms. We have shown that these algorithms, even if they are not the most accurate or the fastest, take their place at the Pareto front in a multi-target environment, which means that some users might find them suitable for their needs and that they provide the best results for particular computational demand.

6. ACKNOWLEDGMENTS

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Predicting bitcoin trend change using tweets

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ABSTRACT

Predicting future is hard and challenging task. Predicting financial derivative that one can benefit from is even more challenging. The idea of this work is to use information contained in tweets data-set combined with standard Open-High-Low-Close [OHLC] data-set for trend prediction of crypto-currency Bitcoin [XBT] in time period from 2019-10-01 to 2020-05-01. A lot of emphasis is put on text preprocessing, which is then followed by deep learning models and concluded with analysis of underlying embedding. Results were not as promising as one might hope for, but they present a good starting point for future work.

1. INTRODUCTION

Twitter is an American microblogging and social networking service on which users post and interact with messages known as "tweets". Registered users can post, like, and retweet tweets, but unregistered users can only read them. Users access Twitter through its website interface, through Short Message Service (SMS) or its mobile-device application software. Tweets were originally restricted to 140 characters, but was doubled to 280 for non-CJK languages in November 2017. People might post a message for a wide range of reasons, such as to state someone's mood in a moment, to advertise one's business, to comment on current events, or to report an accident or disaster [5].

Bitcoin is a cryptocurrency. It is a decentralized digital currency without a central bank or single administrator that can be sent from user to user on the peer-to-peer bitcoin network without the need for intermediaries. Bitcoin is known for its unpredictable price movements, sometimes even to 10% on the daily basis. Bitcoin also serve as an underlying asset for various financial derivatives, which means that one can profit from knowing the future price changes.

Tweets data offer a constant stream of new information about people beliefs about Bitcoin. Since Bitcoin is very volatile asset, without any real-world value, its value is mainly driven by people's trust in it. Which means that possible up or down trends could be predicted by understanding sentiment of people tweets related to Bitcoin and other cryptocurrencies. Tweets data-set is combined with classical Open-High-Low-Close [OHLC] data-set for 5 minute time periods. OHLC data-set contain information about opening and closing price of given time period, its maximum and minimum price during observed time period and sum of volume and number of transactions made [4]. This present additional information how the market is behaving at any given point.

In financial mathematics derivatives are usually modeled with some kind of stochastic process. Most commonly some form of Brownian motion is used. In theory increment in Brownian motion is distributed as $N(\mu, \Sigma)$ independent from previous increment. This implies that prediction of a real time price change of a derivative is not possible, so the target goal should be changed accordingly. Instead of predicting the impossible, the goal of this work is to predict a change in a trend. Trend is calculated with exponential moving average, application of it can be observed in Figure 1.

Definition: Exponential moving average:

$$EMA(TS, n) = \alpha \cdot \left(\sum_{i=0}^{n-1} (1-\alpha)^i \, TS_{n-i} \right),$$

$$\alpha = \frac{2}{n+1}.$$
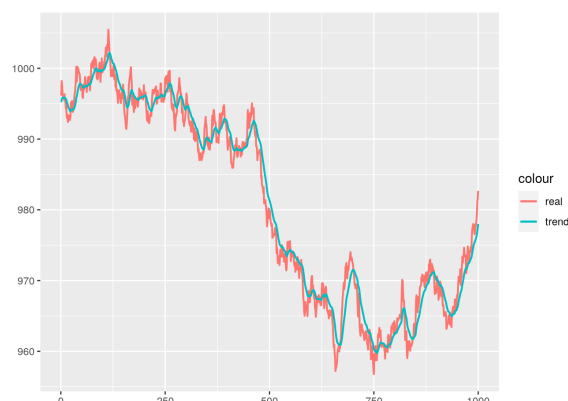
Figure 1: Example of exponential moving average

	time	tweets	follow	friends	tw1	tw2	tw3	open	high	low	close	volume	trans	ama
211772	2019-10-02 11:50:00	Acquisition Marks Broadridge Financial's First Foray Into Crypto Services #CryptoCurrency #crypto #blockchain https://t.co/OcYrkU3QUf	12557	12094	1674	78778	9080	1.1	4.4	5.6	4.4	154179.3	78	-0.0005918
211777	2019-10-02 11:55:00	Stratis (Oct 02) #STRAT $STRAT #BTC $BTC https://t.co/NkYIIIWkDo 🚀 Nash (NEX) about to Mo0n? ⟶ https://t.co/ibHB6cg51p √ https://t.co/xX6cMO4kYj	133665	139314	2450	1846824	5904	4.4	1.4	-0.7	1.4	167407.6	70	0.0169455
211782	2019-10-02 12:00:00	#bitcoin Price Risks Further Decline After Recovery Rally Stalls - CoinDesk #Prices #Markets https://t.co/SQtnAUUXGJ https://t.co/GA458MrfJk	51837	13150	7324	914865	2768	1.4	9.3	5.1	9.3	223545.8	104	0.9513366

Figure 2: Example of working dataset.

2. DATA DESCRIPTION

Collected tweets range from 01-10-2019 to 01-05-2020. We have filtered tweets by crypto-related hashtags. Originally tweets contained multilingual data, but only English one were extracted. Data-set still resulted in more than 5 000 000 tweets over a little more than a half year period. Dealing with such big data-set has proven to be too difficult of a task. But since a lot of tweets are just pure noise, this data-set can be reduced. Idea is to extract the tweets with the largest target audience. Since the data-set contain number of tweet's author friends and followers, we have extracted the tweets with maximum sum of both in a 5 minute period. Unfortunately, crypto world is relatively anonymous, so there is no Warren Buffet alike personalty, to whom we could gave extra weight.

Then we concatenated the reduced tweets with 5-minute OHLC data-set. Snapshot can be observed in Figure 2. Column names should be pretty self-explanatory, expect for "tw1","tw2","tw3", which stands for metadata information about tweets and "ama", which stand for current movement of trend. Continuous features are then normalized, "ama" is shifted one step into the future so it forms the target variable. Regression task has the most success with predictions.

3. TWEETS PROCESSING

Aim of this chapter is to focus on processing tweets. Tweets differ from regular text data, since many of them consist hyperlink, hashtags, abbreviations, grammar mistakes and so on. This excludes any pre-build preprocessing tools, like the one available in deep learning library Tensorflow [1] which is used for building deep learning models. In the Figure 2 we can see an example of some tweets. The cleaning process was executed in the same order as it is stated below. For each tweet the following process was executed:

- Escape characters were removed.

- Tweet was split by " ".

- All non alphanumeric characters were removed, including "#".

- All characters were converted to lower case.

- Usual stop-words were removed.

At this point data-set contain over 200000 different tokens, which is way to sparse for so limited data-set. At this point empirical cumulative distribution function was calculated and all tokens that have less than 50 appearances were removed. The dictionary size is now 2150.

Another thing to consider is how to process numbers that appear in between text. Obviously a separate token for each number is not acceptable, since it would negate all the work it was done so far. The following function was applied to process numbers. 5 more tokens were created and then numbers from a certain interval were assigned corresponding token.

- Small number: $X < 1000$.

- Medium number: $X \in [1000, 10000)$.

- Semi big number: $X \in [10000, 100000)$.

- Big number: $X \in [100000, 1000000)$.

- Huge number: $X \geq 1000000$.

Additional masking token were assigned for missing data. This wrap up dictionary, final length of dictionary is 2156.

Last thing in processing tweets is to handle their length. Not all tweets have the same length. One idea is to take the maximum length of all tweets, then mask the others so they all have the same length. Unfortunately this would take a lot of unnecessary space, which is a problem. Also long tweets does not mean informative tweet. In Figure 3 is plotted the empirical cumulative distribution function of tweets' length.
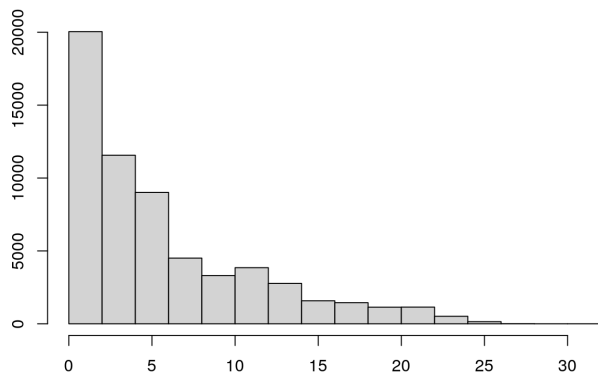
Figure 3: Histogram of tweets' length.

No additional manipulation of tokens were done. It is known that tokens "bitcoin" and "btc" means the same, and they could be join into one token, but they are left intact and the deep learning model will decide either they are the same or not.

4. DEEP LEARNING MODELS

Obvious choice for text models are recurrent neural networks, more specifically Long-Short-term-Memory [LSTM] recurrent networks [2]. They are usually combined with embedding layers, which transform singular token to vector of arbitrary size [6].

Since the task at hand is predicting the future, there is no good benchmark metric or model which could serve as a threshold for our model performance. So in order to see if the tweets can contribute anything, we have decided to build a shallow neural network of just OHLC data which would serve as a benchmark model. 80% of the data-set was taken as a training set, remaining was left out for validation. Split was the same in both models. Both time we used Adam optimizer [3] and mean-squared error [MSE] as a loss function. Training was stopped as soon as validation loss did not improve for 10 epochs. Batch size was 256.

Structure of a benchmark model:

- Input dense layer with 32 neurons.
- Stacked dense layer with 32 neurons.
- Stacked dense layer with 32 neurons.
- Output dense layer with 1 neuron.

Structure of a tweets model:

- Input embedding layer of size 64 (tweets).

- Stacked LSTM layer with 128 neurons.
- Stacked LSTM layer with 128 neurons.
- Second input layer with 64 neurons (OHLC).
- Concatenation.
- Stacked dense layer with 64 neurons.
- Output dense layer with 1 neuron.

Loss process of benchmark model can be observed in Figure 4, while loss process of tweets model can be observed in Figure 5. Orange color represent training set, while blue validation set. It is clear that the tweets model behaved a lot worse on training set than benchmark model, but on test set it has slightly lower MSE (benchmark: 13.78, tweets: 13.74). This implies that there is a lot of reserve in fitting of the tweets model, since the difference between the train and validation loss is so big. That is good since otherwise it seems that tweets do not contribute much for prediction. It is also worth noting that tweets model took way longer to learn, around 380 epochs compared to benchmark's model 40.
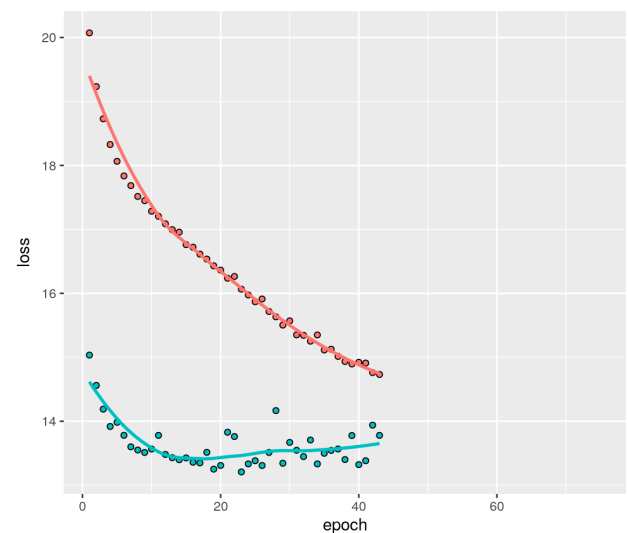
Figure 4: Loss process of benchmark model.
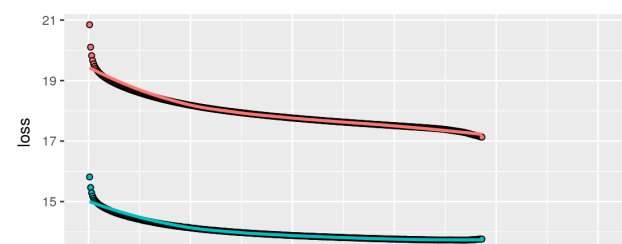
Figure 5: Loss process of tweets model.

5. ANALYSIS OF UNDERLYING EMBEDDING MATRIX

We have extracted underlying embedding matrix from tweets model. Since the model tried to minimize mean-squared error

Figure 6: TSNE projection of embedding matrix.

[MSE] of predicted trend and actual trend, the embedding matrix accordingly to MSE derivative. For analysis we will use cosine similarity as a metric. If 2 words are close in the embedding matrix, this does not mean that they are semantically similar in concept of everyday language, but it means that they are similar in concept of Bitcoin trend prediction. For example if model converged perfectly, and tokens "bitcoin" and "eth" have cosine similarity near 1, that would mean that they both have similar impact on Bitcoin trend. Which is not so hard to believe since it is known that all crypto-currencies are heavily correlated with one another. On Table 1 it can be seen cosine similarity of some of the most common tokens in the dictionary.

Table 1: Cosine similarity pairs of most common tokens.

Tokens Pair	Similarity
bitcoin, crypto	0.472
blockchain, entrepreneur	0.561
crypto, cryptocurrency	0.519
cryptocurrency, blockchain	0.560
volume, social media	0.508
ethereum, blockchain	0.557

We cannot be completely satisfied with results, but for such limited data-set they are not that bad. As it is with any embedding evaluation, it comes to certain amount of subjectivity what is good and what is not.

In order to gain the better perspective of obtained embedding we did a T-distributed stochastic neighbor embedding projection to 2 dimension and plotted 100 nearest pairs. Projection can be observed in Figure 6.

6. CONCLUSION

While the obtained model cannot be served as production model for automatic trading, it presents a nice future work opportunity. We will continue to collect tweets, and hopefully with time build a more accurate data-set and with some hyper-tuning of tweets models achieve improved prediction.

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Large-Scale Cargo Distribution

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ABSTRACT

This study focuses on the design and development of methods for generating cargo distribution plans for large-scale logistics networks. It uses data from three large logistics operators while focusing on cross border logistics operations using one large graph.

The approach uses a three-step methodology to first represent the logistic infrastructure as a graph, then partition the graph into smaller size regions, and finally generate cargo distribution plans for each individual region. The initial graph representation has been extracted from regional graphs by spectral clustering and is then further used for computing the distribution plan.

The approach introduces methods for each of the modelling steps. The proposed approach on using regionalization of large logistics infrastructure for generating partial plans, enables scaling to thousands of drop-off locations. Results also show that the proposed approach scales better than the state-of-the-art, while preserving the quality of the solution.

Our methodology is suited to address the main challenge in transforming rigid large logistics infrastructure into dynamic, just-in-time, and point-to-point delivery-oriented logistics operations.

Keywords

Logistics, graph construction, vehicle routing problem, spectral clustering, optimization heuristics, discrete optimization.

1.   INTRODUCTION

The complexity of operations in the logistics sector is growing, so is the level of digitalization of the industry. With data driven logistics, dynamic optimization of basic logistics processes is at the forefront of the next generation of logistics services.

Finding optimal routes for vehicles is a problem which has been studied for many decades from a theoretical and practical point of view: see [2] for a survey. The most prominent case is the Traveling Salesperson Problem (TSP), where the shortest route for visiting n locations using a single vehicle has to be determined. What is typically associated with the Vehicle Routing Problem (VRP) is a generalization of TSP where multiple vehicles are available. This class of routing problems is notoriously hard; it not only falls into the class of NP-complete problems, but also in practice it cannot be solved optimally even for moderate instance sizes.

Nevertheless, due to its practical importance, many heuristics and approximation algorithms for the vehicle routing problem have been proposed. Bertsimas et al. propose to an integer programming based formulation of the Taxi routing problem and present a heuristic based on a max-flow formulation, applied in a framework which allows to serve 25,000 customers per hour. A heuristic based on neighborhood search has been presented by Kytöjoki et al. in [4] and evaluated on instances with up to 20,000 customers. A large number of natural-inspired optimization methods have been applied to VRP, including genetic algorithms [7], particle swarm optimization [8], and honey bees mating optimization [9].

The particular approach of partitioning the input graph for VRP has been proposed by Ruhan et al. [5]. Here k-means clustering is combined with a re-balancing algorithm to obtain areas with balanced number of customers. Bent et al. study the benefits and limitations of vehicle and customer based decomposition schemes [6], demonstrating better performance with the latter.

In this paper, we present a methodology for large-scale parcel distribution, by utilizing optimization methods with large graph clustering. The paper is structured as follows. In Section 2, we present the technical details of the proposed methodology. We explain the algorithms and data structures used in each of the steps and discuss the interfaces required to link the steps into a working system. In Section 3, we demonstrate the performance of our methodology on two real-world use cases and compare it to the state-of-the-art on synthetic datasets. Finally, in Section 4 we include key findings, summarizing the strengths and limitations of the proposed approach.

2. METHODOLOGY

2.1 Overview

In this section, we present the details of the proposed methodology for large-scale cargo distribution planning. The methodology, illustrated in Figure 1, uses a three-step, divide and conquer approach to cargo distribution, where we reduce the size of the optimization problem by (i) abstracting the physical infrastructure into a sparse graph representation, (ii) partitioning the graph into smaller chunks (i.e. regions) and (iii) planning the distribution in each region independently. This allows us to run the optimization on large graphs while producing better local results.
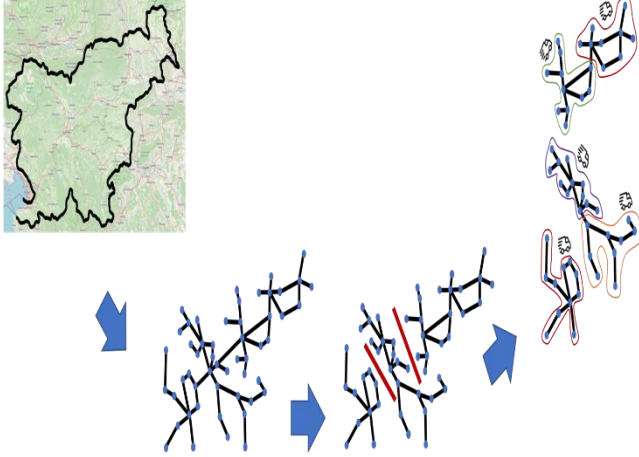
Figure 1: Three step methodology for logistics optimization.

Initially, we create a representation of the physical infrastructure as an abstract graph, representing each pickup and drop-off location as a node with edges as shortest connections on road in between.

Next, we partition the abstract graph with a spectral partitioning approach. The method is an adaptation of [10] to graphs, where we use the first k eigenvalues and eigenvectors of the graphs' Laplacian to construct the partitions. In each partition, we construct a distribution plan using an iterative search algorithm. From an initial solution, the algorithm constructs a linear search path by changing the position of a node in the distribution plan. To avoid local minima, it uses design-time blacklist rules which prevent the algorithm from oscillating in a local neighborhood. Each step is described in more details in the following sections.

2.2 Graph Construction

For graph construction, the Dijkstra SPF algorithm [11] was applied to identify neighbor relationships between the nodes in the OpenStreetMaps (OSM) dataset and construct the graph representation. By mapping post offices to the closest node on OSM, we tag the post office nodes for SPF search.

The search frontier is a baseline for the SPF procedure and represents the list of nodes whose graph neighbors are to be searched. The final graph is built by iterating with the SPF procedure through the list of all post offices in physical infrastructure (graph nodes), and consolidating results into final the sparse matrix – each iteration computes one row of the matrix.

2.3 Graph Partitioning

The partitioning step first represents the graph as a transition rate matrix $(Q)_{ij} = q_{ij}$, where q_{ij} represents the rate of going from node i to node j and is computed as the inverse minimal travel time (obtained from step 1) between the two nodes. With this approach,

the rate of going from i to j is represented in terms of the number of possible trips that the driver can make between the two locations in one hour.

The algorithm works by approximating the minimal k-cut of the graph, removing its edges and thus reducing the graph to k disconnected components. We adapt a spectral partitioning algorithm introduced in [10] to graphs.

The algorithm first symmetrizes the transition rate matrix as $Q_s = \frac{1}{2}(Q + Q^T)$, to ensure real-valued eigenvalues, and computes its Laplacian:

$$L = I - diag(Q_s \vec{1})^{-1} Q_s$$

Next, it computes the k eigenvectors of L, corresponding to the smallest k eigenvalues. It then discards the eigenvector corresponding to $\lambda_1 = 0$ and assembles eigenvectors $v_2, v_3, \dots, v_k$ corresponding to eigenvalues $\lambda_2 \leq \lambda_3 \leq \dots \leq \lambda_k$ as columns of matrix V. The rows of V are then normalized and used as input to the *k-means* clustering algorithm which constructs the final partitions.

2.4 Vehicle Routing

The vehicle routing step uses *Tabu search* [12] to construct the distribution plan. Starting with an initial solution, *Tabu search* constructs a linear search path by iteratively improving the solution in a greedy fashion until a stopping criterion is met. To avoid converging to local minima, *Tabu search* blacklists recent moves and/or solutions for one or more iterations using design-time rules.

In each iteration, the search process generates new possible solutions by removing a node from its current route and placing it after one of the other nodes in the graph, possibly on a different route. To mitigate scaling problems associated with generating $O(n^2)$ possible moves in each step, the algorithm only considers a handful of moves. Specifically, the probability of considering placing node i after node j is proportional to the inverse of the Euclidean distance $d(i, j)$ between the nodes.

Like other local search algorithms, *Tabu search* starts from an initial feasible solution which is constructed using a construction-based heuristic algorithm. The heuristic procedure iteratively selects a node and places it after one of the other nodes in a way that minimizes the travel distance. The procedure iterates until all values are initialized.

3. DEMONSTRATION AND RESULTS

In this section, we demonstrate the effectiveness of the proposed methodology on two real-world use cases and compare the methodology to the state-of-the-art in vehicle routing. The first pilot included two national logistics operators, namely Hrvatska Posta (Croatia) and Posta Slovenije (Slovenia). As the main focus of future logistics in Europe is to operate as one large homogenous logistics infrastructure, the two infrastructures were considered as one logistics graph. The second pilot included Hellenic Post (Greece) graph representation and data.

In initial testing, simulated data were used for modelling parcel flow with graph abstraction, graph processing, and optimization responses. The final instances were constructed from real infrastructure data to test the functionalities. The results are presented in the following subsections.

3.1 Evaluation on Large Synthetic Graphs

We now demonstrate the scalability of the proposed methodology by comparing its performance to the performance of the baseline *Tabu search* algorithm on synthetic graphs of various sizes, comparing both algorithms' running time and the total travel time in the generated cargo distribution plan. Our results show that the proposed methodology enables fast generation of distribution plans on graphs of up to 10,000 nodes, while also improving the quality of the generated result.

We simulate the logistics infrastructure by generating random planar graphs representing the road network and drop-off locations. First, we generate a cluster of n drop-off locations by sampling a Gaussian distribution around k randomly chosen locations. Next, we connect the locations with Delaunay triangulation [13], resulting in a planar graph. We compute the distance between two locations using the Euclidean metric and assign a 50 km/h speed limit to intra-city edges and a 90 km/h speed limit to inter-city edges. Part of a synthetic graph with 10,000 nodes is shown in Figure **2** below.
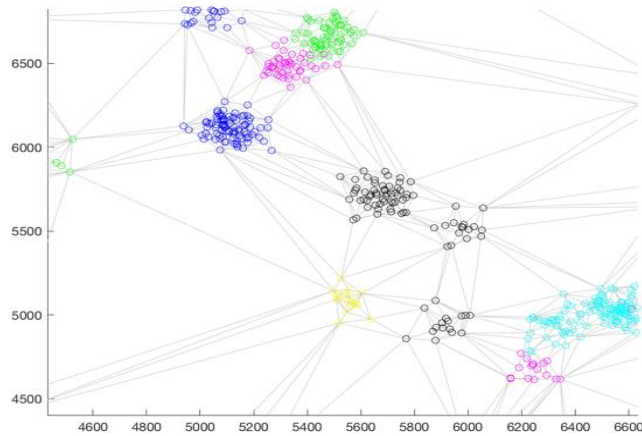
Figure 2**: Representation of simulated graph with 10,000 nodes.**

Table **1** summarizes the computation times of the proposed method along with the quality of the generated distribution plan and compares the results to *Tabu search* without prior clustering. We measure the quality of the generated distribution plan as the distance travelled by all vehicles according to the plan. In each row, we show the average of 10 trials on 10 different graphs.

Table 1**: Comparison of efficiency of Tabu search and proposed methodology.**

Graph Size	Proposed Methodology		Tabu search	
	Running Time	**Travel Distance [km]**	**Running Time**	**Travel Distance [km]**
1000	6.07min	64.7k	0.76min	85.5k
2000	10.07min	122.9k	2.98min	160.8k
5000	30.14min	259.2k	60.04min	428.2k
7000	39.29min	377.9k	166.79min	577.1k
10000	55.64min	552.2k	10.78h	845.1k

For the experiments we used a *Tabu* list with a length of 5% of the entities (locations) that the algorithm must check, and terminated the algorithm when there was no improvement in the solution for more than 10 seconds.

On large graphs, we see that the proposed methodology significantly reduces the computation time while preserving the quality of the result. The proposed methodology reduces the computation time on graphs larger than 5k nodes, providing a substantial saving of 91% on graphs with 10k nodes. We also observe that the quality of the output slightly improved when applying our divide-and-conquer methodology over *Tabu search.* The improvement ranges between 23% and 40% and is largely attributed to the significantly reduced search space in the partitions as compared to the entire graph.

3.2 Testing the instances on pilot use cases

The methods presented and tested on synthetic graphs were also tested on data from two pilot scenarios, namely Slovenian-Croatian post (Pošta Slovenije & Hrvatska Pošta) and Hellenic Post (Greece). In the pilot use cases, the analytical pipeline is used to process ad-hoc events in the logistics infrastructure. The ad-hoc events included were structured into three categories: new parcel request (ad-hoc order), event on distribution objects (vehicle break down) and events related to changes in border crossings – border closed (cross border event).

The instances built on simulated data were loaded with OpenStreetMaps data for abstraction of real infrastructure description into graph representation, as illustrated in Figure 4.
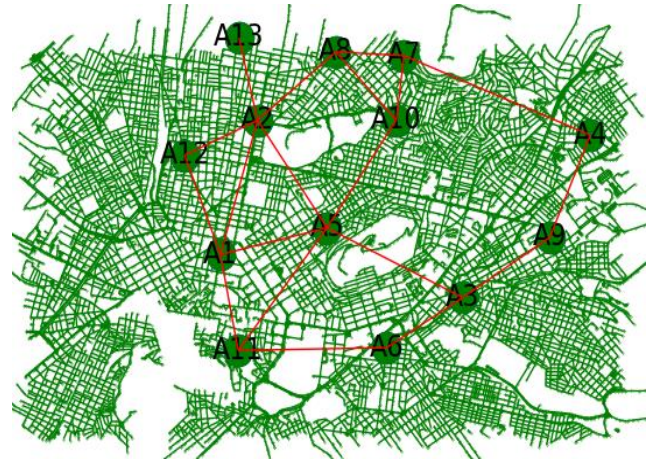
Figure 4**: A region of Posta Slovenia graph representation, using OpenStreetMap.**

A similar approach was used for the case of Hellenic Post, where the OSM data for the region of Greece were loaded into the graph abstraction instance. For traffic modelling of the vehicles, the SUMO simulator [14] was used with the regional map. For graph manipulations, the SIoT infrastructure was used to generate the social graph when an ad-hoc event was triggered. The social graph represented all entities (vehicles, etc.) in the infrastructure that are in the scope to be included in event processing. In this way, distribution objects were mapped to physical infrastructure for loading the objects into the graph representation for further optimization and distribution plan estimation
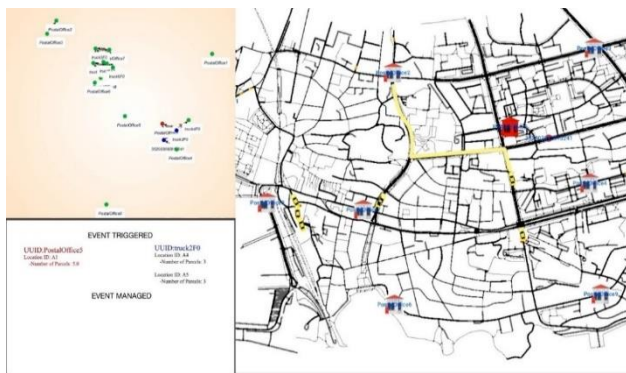
Figure 4**: Processing ad-hoc order on a pilot scenario, using SUMO simulator.**

An example of the social graph generation and ad-hoc event processing is presented in Figure 4, where a new ad-hoc request is processed by SIoT and analytical pipeline.

The results show that abstracting the logistics infrastructure and clustering the graph into regional structures enabled real-time processing of complex events in the logistics infrastructure. The response time for processing an ad-hoc event in regions of between 50 and 100 nodes was between 20 and 30 seconds. This is relatively fast compared to alternatively processing 1000 nodes or more

4.   CONCLUSION

In this paper, we presented an approach for generating cargo distribution plans on large logistic infrastructures. Our results show that the proposed approach can scale to graphs of up to 10,000 nodes in practical time while preserving and even slightly improving the quality of the result.

Since the main use case of logistics is point-to-point regional delivery and just-in-time delivery, these new services are oriented exactly to regional logistics optimization. More importantly, the approach enables to process ad-hoc events, such as new parcel delivery requests, events related to distribution vehicles, or to infrastructure. The ad-hoc event processing includes manipulating the graph representation and running the optimization methods in real-time. Since our method clusters and regionalizes large graphs, such approach can enable real-time processing of events on large graphs, by limiting the changes to the affected regional parts of the infrastructure.

However, while our approach can be combined with several state-of-the-art methods, its main drawback remains the inability to generate inter-region routes, making it suitable only for local and last-mile distribution plans. Future work will focus on investigating the generation of inter-region plans and connecting multiple regions into one distribution plan. Some of the options include introducing border checkpoints where cargo can be handed over to vehicles of neighboring regions, using dedicated inter-region "highway" channels, and using dedicated vehicles for cross-region deliveries.

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Amazon forest fire detection with an active learning approach

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ABSTRACT

Wildfires are a growing problem in the world. With climate change, the fires have a larger range an are harder to put down. Therefore it is important to find a way to detect and monitor fires in real-time. In this paper, we explain how we can use satellite images and combine it with knowledge of active learning to get accurate classifier for forest fires. To build the classifier we used active learning like approach. We train the classifier with one labeled image. Then used a classifier to classify the set of images. We manually inspected the images and relabeled wrongly classified examples and build a new classifier. In the paper, we show that in a few iteration steps we can get a classifier that can with good accuracy identify wildfires.

Keywords

remote sensing, earth observation, active learning, rain forest, wildfires, machine learning, feature selection, classification

1. INTRODUCTION

In last years wildfires are a growing problem for the world. Each year the number of forest fires around the world grow. In recent years we had growing number of fires in Amazon, Australia, Africa and Siberia. Because of high global warming and high temperatures, the wildfires have a bigger range and are also harder to put out. Forest fires are partially responsible for the air pollution [12], loss of habitat for animals. Amazon rain forest is also called the lungs of the world, because of oxygen production by the trees. The loos of forest also connects to a higher chance of floods and landslides [6]. Therefore the classification and monitoring of wildfires is an important task. It is important to know the time series of the spread of the fire. With that knowledge we can create models for future fire events, and to plan measures in case of wildfire.

The satellite images are a good source for observation of land type [5]. Therefore they could be used for monitoring forest fires. They can be detected on satellite images, but the area of Amazon is big and it would take a lot of time to manually label burned areas by forest fires. Therefore we should develop an algorithm that can detect fires.

There are already existing algorithms for fire detection using satellite images [6, 11], they inspect changes on satellite images to detect fires. Our solution to that problem is to use machine learning. Because we do not have prepared labeled data-set active learning like approach is our next candidate.

Active learning is the approach used when the labeled data are unavailable, and labeling data is too expensive or time-consuming. The algorithm starts with a small labeled data set and then use its predictions to train itself again. That way the algorithm can learn itself. Algorithms usually need additional input for some data points. In these cases, a human should label those data, and the algorithm can then correct its predictions. The active learning approach is used in many use cases (speech recognition, information extraction, classification, ...). Over the years, it proved to work relatively well [8].

In this paper we use active learning like approach to classify wildfires. By the principle of active learning approach, we label a small subset of data and then train the classifier. Then we manually check the classification results and correct the wrongly classified examples. We then use a new bigger data-set to train the new classifier. We continue with iterations until we are satisfied with the results. That way we can iteratively get a good classifier without labeling huge amounts of data.

2. DATA
2.1 Data Acquisition

In the article, we use data from ESA Sentinel-2 mission [3]. The sentinel-2 mission produces satellite images in 13 different spectral bands with wave lengths of ligt observed from approximately 440 nm to 2200 nm. The spatial resolution is between 10 and 60 m. It consists of two satellites that circle the earth with $180°$ phase. One point on the earth's surface is visited at least once every five days. In future we could use also use some other satellite data sources like available at www.planet.com [1]. Those data have revisit time of 1 day and might be even better candidate for accurate monitoring of wildfires.

To download data we use eo-learn library [9] that have integrated sentinel-hub[10] library used to access satellite data. Data were downloaded for the year 2019, with a spatial resolution of 30 m. The 30 m resolution was chosen because

burned areas usually extends through much bigger area than 30 m and a therefore higher resolution would not help us identify forest fires. But the processing of each image would take significantly more time than it did now.

2.2 Data Preprocessing

ESA already makes most of the preprocessing steps, like atmospheric reflectance or projection [4]. Therefore data is already clean and ready for use. For our experimentation purposes, we filtered out clouds for that purpose we used models available in eo-learn library.

In our experiments, we used all spectral bands, but the earth observation community developed many different indices that can be calculated from raw spectral bands and use them as a feature in our machine learning experiments. Indices that we used are NDVI, SAVI, EVI, NDWI, and NBR, defined in papers [7, 2]. As our feature vector we used all 13 raw bands and mentioned indices.

3. METHODOLOGY

In our experiments, we iteratively improved the classifier. In each iterative step, we looked at the images and determine if the classification was good or not. To do that most successfully we plotted the images in true color, where the burned area is usually dark, and if the fire is active the smoke is also visible. The other figure that we checked was image with RGB colors plotted Sentinel-2 bands 12, 11, and 3 (false color). Here most of the image is usually in shades of green. The burned area is dark gray color and the area currently burning is yellow or orange (Figure 2). With those two images, we have no problem checking if the area is burned or not.

We experimented with two different approaches. In the first approach, we evaluated the results of classification for each pixel and in the second experiment, we evaluated the average result for a bigger area determined with the clustering algorithm.

The classifier used in our experiment was logistic regression. We used it because it is quite an accurate classifier for earth observation and it can assess how strong the prediction is.

3.1 Experiment 1

First, we manually searched the area of the Amazon forest to find the first satellite image with a forest fire. Then we used that satellite image and labeled 270 pixels as fire area and 270 pixels as not fire area. We trained the logistic regression classifier and used it as our initial classifier in our iteration.

The iteration steps in our experiment were:
1. Use a classifier and classify pixels of a random images of the Amazon rain forest.

2. We took images that the classifier would classify with a forest fire. The images were classified as containing a burned area if at least 3 % of pixels on the image were classified as fire.

3. We checked those images and manually assigned them into two sets (true-positive and false-positive). We checked
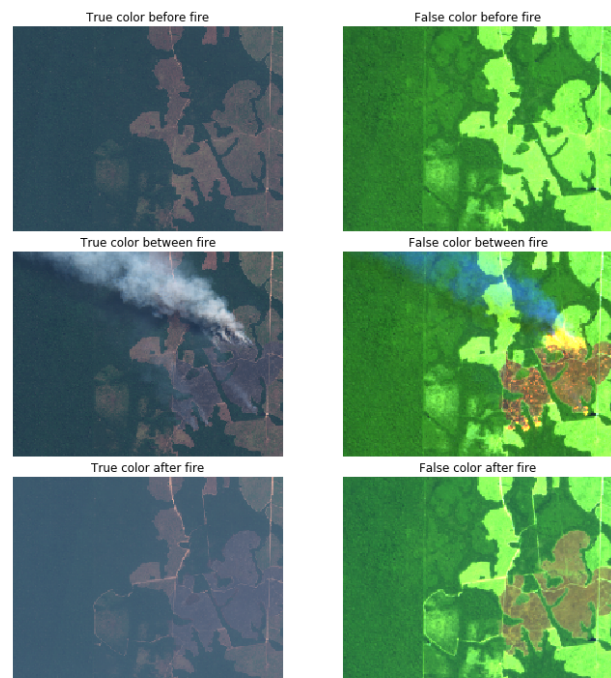
Figure 1: The Figure shows the true color and false-color images of the same area before, during and after the fire. These kinds of images can be used to manually determine burned areas.

only images, where the classifier classified fire. That is because we noticed that the classifier already, in the beginning, finds fire, but it picked up some other areas and objects as fire as well. Therefore we need to find those images and label them as not fire.

4. We used a false-positive set to add to data-set the pixels that the classifier classified wrongly and true positive examples to keep the data-set balanced. We chose in each iteration the two values for the probability of prediction in logistic regression. The first value was used to determine in false-positive images to find pixels that were classified with a probability above that value to add those pixels in the data set. And the second value was used to find pixels that contained forest fire. We changed those values because the algorithm is unreliable in the first iterations and low value in the images with fire would pick up a lot of noise in the data set. But with each iteration the algorithm became more reliable, therefore we could pick lower probability without much noise. The values are shown in the Table 1.

3.2 Experiment 2

The formation of the initial classifier and the first three steps in that experiment were the same as in the first experiment.

Additional steps in the experiment are:
4. For the evaluation of the classifier, we first made clustering with the K-Means algorithm to group similar pixels on each image. The idea of that step is to use a homogeneous group of pixels that probably represent the same ground cower. Those steps are useful because we noticed that K-

Iteration	FP	TP
Iteration 1	0.0	0.80
Iteration 2	0.4	0.70
Iteration 3	0.4	0.70
Iteration 4	0.5	0.60
Iteration 5	0.5	0.60
Iteration 6	0.5	0.50

Table 1: The table shows the values of the minimum average probability of a pixel being burned area for false-positive images (FP) and true-positive images (TP).

Means usually grouped fire areas in one or two clusters. We clustered the pixels in 6 clusters. That number was chosen because on most images that number split the area that way that clusters with fire were separated from not burned area. At the same time it did not split same ground types on too many clusters.
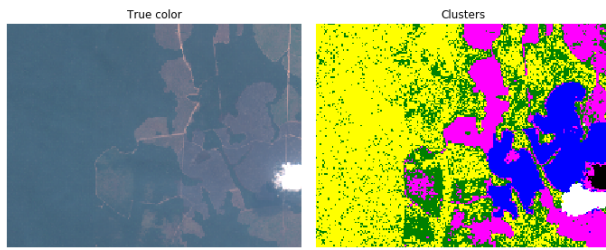
Figure 2: The figure shows how clustering groups different pixels. The burned area is all in one cluster.

5. Calculate the average probability of pixel representing forest fire for each cluster.

6. To choose what pixels to add in the data-set we once again determined two values. They defined above what average pixel probability should cluster have to add pixels from that cluster in the data set. The used values for each iteration are presented in Table 2.

Iteration	FP	TP
Iteration 1	-	0.75
Iteration 2	0.5	0.75
Iteration 3	0.5	0.60
Iteration 4	0.5	0.60
Iteration 5	0.5	0.60
Iteration 6	0.5	0.5

Table 2: The table shows the values of minimum average probability in the cluster for false-positive images (FP) and true-positive images (TP).

4. RESULTS

We tested the classifiers from each experiment on data set form the other experiment. To evaluate results we calculated F1 scores. The results are shown in Table 3.

The F1 scores are relatively high, but those data sets were constructed in a similar way, therefore the scores might be

	F1 score
Classifier from Experiment 1 predicting on data-set from Experiment 2	0.81
Classifier from Experiment 2 predicting on data-set from Experiment 1	0.78

Table 3: The F1 scores of classifiers.

higher than they would be on real images. In both experiments we used random images from the area of amazon, therefore some images might be in both training and testing set.

Figure 3 depicts a time-lapse of a wildfire progress. We can see that there are some small noise pixels that are classified wrongly, but they are relatively rare.
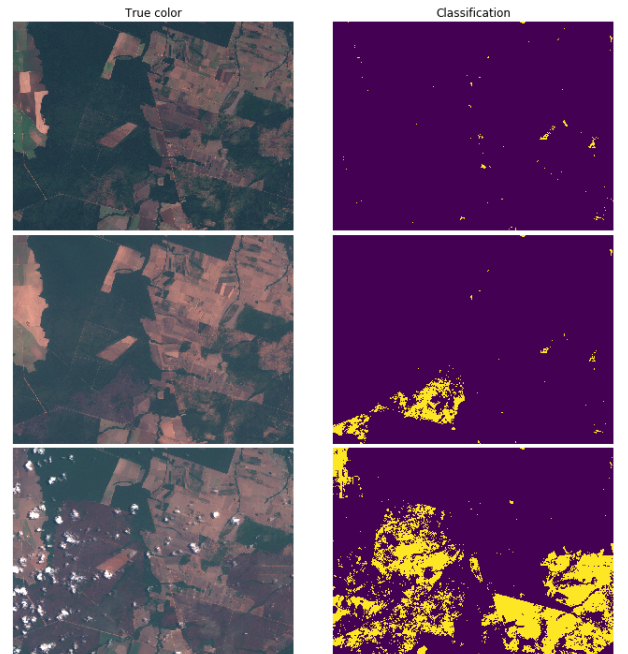
Figure 3: The sub-figures show the development of forest fire. On the left, we have true color satellite images and on the right, we have the classification result with our algorithm. yellow color depicts the burned area.

Another interesting thing to observe in our experiments is what the classifier learned and how it improved in each iteration. We noticed that in the first iterations of our experiments, the classifier did already find fire, but it also picked up many other areas as fire. One of the first improvements of the classifier was that it did not classify water areas (rivers and lakes) as fire. The other later improvements classifier were also some rocky areas. It also improved significantly in the agricultural areas, but in some cases, we could not train classifiers that there is no fire.

The classifier learned wrongly and we could not remove com-

pletely some agricultural areas and some roads in the cities. Most of the agricultural areas were classified correctly, but there were present some fields that no matter what we did were not classified correctly. This might be due to the fact that the field might be on the place that was previously burned and the algorithm still pick that up even though it was not visible from the imagery to us.

5. CONCLUSIONS

The approach with active learning seems promising and we can get relatively good classifiers in a short time. That way we could train a classifier for any classification task of satellite images. With that approach we do not need to check all images as we would if we would like to label all the data by hand. In the end, we get a relatively good classifier.

In this paper, we showed that it is possible in a relatively small number of iterations to get a good and reliable classifier of forest fires. Because satellite images are more accessible in last years than previously it could give us almost real-time insight in the Amazon rain forest.

In the feature one could use other satellite sources with better time-resolution to monitor wildfires. That way we could get more accurate view on the spread of fires.

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Zbornik 23. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2020

Zvezek D

Proceedings of the 23rd International Multiconference

INFORMATION SOCIETY – IS 2020

Volume D

Etika in stroka
Professional Ethics

Uredili / Edited by

Franci Pivec, Marjan Krisper, Matjaž Gams

http://is.ijs.si

7. oktober 2020 / 7 October 2020
Ljubljana, Slovenia

PREDGOVOR

Konferenca »Etika in stroka« je namenjena etiki v času informacijske družbe. Po Rushworth Kidderju je etika "znanost o idealnem človeškem značaju" oziroma "znanost o moralni dolžnosti". Richard William Paul in Linda Elder definirata etiko kot "nabor konceptov in principov, ki nas vodijo glede primernega in neprimernega obnašanja".

V času informacijske družbe je vtis, da se stare norme podirajo, da je osnova uspešnega političnega delovanja čim bolj uspešno zavajanje množic preko socialnih omrežij in pristranskih medijev. Tudi množice ljudi na socialnih omrežjih ne kažejo čedalje bolj civiliziranega obraza. Kot da resnica, moralnost, etika ne bi več obstajali, oziroma so nepomembni.

Posebej se to kaže v odnosu do znanosti oziroma dejstev oz. resnice. Ali je cepljenje škodljivo ali koristno? Ali lahko nasprotniki cepljenja nekaznovano povzročajo škodo svojim otrokom in otrokom drugih? Ali je omejevanje resnice s strani tehnoloških gigantov kot Google ali Facebook omejevanje svobode, ali pa gre za omejevanje hujskanja množic in sovražnega govora?

Zanimive teme za prispevke so naslednje: Etični kodeksi v računalništvu/informatiki, občutljivost univerzalne (filozofske) etike za digitalni svet, etična odgovornost IT strokovnjakov, IT v službi zavajanja, etika v e-trgovanju, etika digitalnega sodišča, etičnost Googla in Facebooka, avtentičnost e-dokumentov v arhivih, etika in umetna inteligenca, etika v robotiki.

Poseben poudarek je na aktualni temi: Etične smernice za zaupanja vredno Umetno inteligenco, na podlagi dokumenta Evropske komisije Ethics Guidlines for Trustworty AI, ki zajema ključna etična vprašanja informacijske družbe.

Drugo leto konference smo zbrali sedem zanimivih prispevkov. Ne ravno veliko število je najbrž posledica korone, bomo videli, kaj bo naslednje leto.

Franci Pivec, Marjan Krisper

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Should Algorithms Replace Teachers and Lecturers?

Naj algoritmi nadomestijo učitelje in predavatelje?

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ABSTRACT

Recent COVID-19 crisis had many consequences and education was one of the fields that was profoundly influenced and modified by the pandemic. Because of the social distancing new methods had to be applied, including distance and e-learning. These changes emphasized the importance of new approaches in education, including the use of software that can personalize education and differentiate instruction instead of human teachers. Not only could algorithms and robot teachers provide cheaper instruction for far bigger numbers of students, they also seem to be less biased and more objective than humans. However, with such steps education seems to be getting more and more individual and automated, thereby losing one of its main traditional aims: the formation and nurturing of learning or academic community.

KEY-WORDS

education, ethics, e-learning, robot teachers, artificial intelligence in education

POVZETEK

Nedavna kriza COVID-19 je imela veliko posledic, pri čemer je bilo izobraževanje med tistimi področji, ki se jih je pandemija najglоблje dotaknila in jih spremenila. Zaradi družbenega distanciranja smo morali uporabiti nove metode, vključujoč poučevanje na daljavo in e-poučevanje. Te spremembe so poudarile pomembnost novih pristopov v izobraževanju, vključujoč zamenjavo učiteljev s programi, ki lahko izobraževanje prilagodijo posamezniku in diferenciirajo poučevanje. Ne le, da lahko algoritmi in robotski učitelji nudijo cenejše izobraževanje veliko večjemu številu učencev, zdi se tudi, da so manj pristranski in bolj objektivni od ljudi. A po drugi strani se vendarle zdi, da izobraževanje s takšnimi koraki postaja čedalje bolj individualizirano, s čemer se izgublja eden njegovih tradicionalnih ciljev: ustvarjanje in negovanje učeče se oziroma akademske skupnosti.

KLJUČNE BESEDE

izobraževanje, etika, robotski učitelji, umetna inteligenca v izobraževanju

Humanist med informatiki: Jacques Berleur 1938 - 2020

Humanist among informaticists

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POVZETEK

Umrl je Jacques Berleur, inženir, filozof in teolog, ki je med prvimi opozoril na družbene in etične razsežnosti računalništva. To je raziskoval, o tem je pisal knjige, predvsem pa je organiziral strokovno javnost informatikov v okviru mednarodnih organizacij, še posebej IFIP in UNESCO. Posebej se je posvečal etičnim kodeksom v informatiki, ki so vse bolj potrebni, saj je stroka globoko vmešana v problematične pojave ogrožanja zasebnosti, nadzorovanja, širjenja laži in manipuliranja javnosti. S temi temami je bil Berleur osebno in s članki prisoten tudi v Sloveniji.

KLJUČNE BESEDE

Jacques Berleur, IFIP, družbena informatika, etični kodeksi

ABSTRACT

Engineer, philosopher and theologist Jacques Berleur has died. He was among the first to bring attention to the societal and ethical dimensions of computer science, which was the topic of his research and his books, but mostly he organised the professional public of IT specialists within international organisations, mainly IFIP and UNESCO. Berleur was especially dealing with ethical codes in in information science, which are getting increasingly necessary as the IT profession is deeply involved in the problematic occurences of privacy threats, surveillance, spreading lies and manipulation of the public. Through these topics, Berleur was also present in Slovenia, both in person and through his articles

KEYWORDS

Jacques Berleur, IFIP, social informatics, code of ethics

1 UVOD

 Letošnja že štirinajsta mednarodna konferenca Human Choice and Computers (www.hcc14.net), ki so jo tokijski organizatorji zaradi COVID-19 odpovedali, bi se morala začeti s posvetilom aprila preminulemu Jacquesu Berleurju. On je namreč pred skoraj štiridesetimi leti v IFIP (Mednarodni zvezi za obdelavo informacij) spodbudil poglobljeno obravnavo razmerja med računalniško tehnologijo ter človekom oz. družbo. Potrebo po tem je sicer utemeljil že desetletje prej takratni predsednik IFIP Hans Zemanek (v rani mladosti Domžalčan), ki je na Svetovnem računalniškem kongresu leta 1971 v Ljubljani (!) uspel z ustanovitvijo Tehničnega komiteja 9, namenjenega obravnavanju »netehničnih« vidikov računalništva. Znotraj komiteja je Berleur leta 1977 sooblikoval delovno skupino (WG 9.2) »Družbena odgovornost in računalništvo«, ki jo je mnogo let tudi vodil. Kasneje pa je ustanovil še posebno interesno skupino (SIG 9.2.2) posvečeno »Etiki računalništva«. Njegova zamisel je tudi Namur Award, ki je namenjena raziskovalcem

razmerja med računalništvom in družbo in je že s prvo podelitvijo zgovorno demonstrirala svoje kriterije – prejel jo je Joseph Weizenbaum.

2 DRUŽBENA INFORMATIKA

Kdo je Jacques Berleur? Rojen v Namuru, kulturnem središču valonske Belgije, je diplomiral iz gradbeništva na Univerzi Louvain. Takoj za tem pa je v Fourviéru pri Lyonu vstopil v jezuitski red, doštudiral teologijo in filozofijo ter bil 1971. ordiniran za duhovnika. V tistem času je papež Pavel VI. objavil Apostolsko spodbudo, v kateri je opredeljen tudi odnos cerkve do nove informacijske tehnologije: »Cerkev bi se čutila krivo pred svojim Gospodom, če teh mogočnih sredstev, ki jih človeški razum vsak dan bolj spopolnjuje, ne bi izrabila« (Pavel VI., 1976). Vrnil se je v rojstni kraj in postal predavatelj meta-informatike, filozofije in religiologije na Facultés Universitaires Notre Dame de la Paix (FUNDP), kjer je ostal do upokojitve leta 2003. Devet let je bil rektor in je v univerzitetnih krogih po svetu užival nesporen ugled (koordinator jezuitskih univerz), v domačem mestu pa veliko priljubljenost. S kolegom na univerzi Gérardom Fourezom, teoretičnim fizikom in matematikom, sicer pa prav tako jezuitom, sta osnovala raziskovalno področje »informatika in družba« in pred pol stoletja postavila malo univerzo Namur v središče obravnav etičnosti novih tehnologij. Razvila sta metodologijo za ocenjevanje tehnoloških inovacij in v tej luči opredelila izpostavljeno vlogo univerz, ki morajo po definiciji biti neodvisne (Berleur, Fourez, 1991).

 V Sloveniji je bil Berleur nekajkrat in je poznal Goriško, Ljubljano, v Mariboru pa je bil celo večkrat in je prejemnik mestnega pečata. Pod njegovim mentorstvom smo leta 2006. v so-organizaciji IFIP/TC9 ter SDI in IZUM izvedli HCC7 iz serije svetovnih konferenc, ki velja za prelomno glede uveljavitve   »družbene informatike« (Berleur, Nurminen, Impagliazzo, 2006). Potrjena je bila definicija Roba Klinga, preminulega med pripravami na konferenco, ki mu je bila nato tudi posvečena: »Družbena informatika je interdisciplinarni študij dizajniranja, uporabe in posledic informacijske tehnologije, upoštevaje njeno interakcijo z institucionalnim in kulturnim kontekstom« (Kling, 1999). Že pred konferenco smo objavljali Berleurjeve članke in intervjuje (Berleur, 2003, 2005). Sam sem ga prvič srečal na dunajski konferenci Knowright-95 (Pivec, 1995), ko me je prijazno nagovoril kot »nov obraz« in me za poldrugo desetletje angažiral kot predstavnika Slovenskega društva Informatika v TC9 ter v skupini za informacijsko etiko.

3 ETIČNI KODEKSI

Berleurjeva rdeča nit v IFIP so bili etični kodeksi računalništva(Berleur, 1996, 2004). V novi in naglo rastoči stroki, ki je posegla v vsa področja življenja, je bilo veliko nevarnosti za napačne presoje, a tudi za namerne manipulacije. Pravna regulacija ni dohitevala tehničnega razvoja in v takih

situacijah so odločilne moralne odločitve in etično vedenje samih raziskovalcev in razvijalcev. Družbeni razvoj vse bolj očitno poganjajo informacije na podoben način, kot ga je doslej poganjala nafta. Vemo, da je nafta tudi onesnaževala svet, tako v neposrednem kot v prenesenem pomenu. Se lahko to dogaja tudi z novim »energentom« – informacijami? V sedemdesetih je bilo to še hipotetično vprašanje, kar danes ni več: tudi uporaba informacij sproža vojne, povzroča neenakosti, omogoča velikanske goljufije, uničuje okolje, manipulira demokratične volitve, krati svobodo posameznikom in skupnostim itd.. Etični kodeksi niso celovita rešitev, vendar so pomembni, ker prebujajo moralno vest in legitimirajo razkrivanje »informacijskega zla«, npr. dejanja »žvižgačev«.

4 SKLEP

V družbi, gnani z informacijami, je ločevanje tehnološkega in družbenega razvoja nedopustno tveganje. Slavljeni 3K – kompjuterizacija, kontrola, komunikacija – so proti pričakovanjem neznansko otežili humanistično držo, ker je v poplavi informacij težko obvarovati resnico, ki je osnova humanosti. Prevlada laži, čemur brez dvoma botruje informacijska tehnologija, je največja grožnja človeštvu. Kritično mišljenje še nikoli ni bilo v tako globoki krizi kot danes, v preizkusni fazi pa je že vmesnik za povezovanje dvojih ali mnogih možganov, kar mora spodnesti naše sebstvo – kdo sploh smo (Hongladarom, 2015). Obramba zasebnosti je zato mnogo več kot le pravno vprašanje. Marvin Misky, sicer »oče« izraza umetna inteligenca, se je leta 1970 proslavil z napovedjo, da bo v treh do osmih naslednjih letih že na voljo računalnik s poprečno inteligenco človeka, ki bo znal brati in razumeti ter čutiti Shakespeara. Seveda doslej ni niti računalnika, ki bi prestal Turingov test »Igra imitacije« iz leta 1950(Bordat, 2020), kaj šele, da bi zmogel čutiti in fantazirati. Zgodilo pa se je nekaj drugega, kar je Berleura bolj skrbelo – ljudje so nehali brati in se navdihovati nad umetnostjo!

Ob Berleurjevi sedemdesetletnici so sodelavci v njegovem Namuru organizirali konferenco in mu posvetli publikacijo (Goujon in drugi, 2007), ki jo je Penny Duquenoy sklenila z naslednjimi besedami: »To je testament o delovanju Jacquesa Berleurja, ki zajema raznolike, poučne, prodorne in intelektualno spodbudne tekste, navezujoče se na njegovo delo in ugled. Prav nič presenetljivega ni v tem, ker je to najmanj, kar zasluži za njegovo neutrudno prizadevanje, pripadnost »stvari«, enkratnost, humor, toploto in ne nazadnje tudi gostoljubje, ki smo ga vedno deležni v njegovem Namuru. Hvala Jacques, vsem nam je veliko zadovoljstvo, da delamo s teboj«. Dodajam, da je nedvomno med tistimi, ki so tudi v Sloveniji spodbudili etično raziskovanje računalništva in informatike in je vredno, da se ga spominjamo.

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ETIKA IN MEDIJI

Etika in mediji

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ABSTRACT

V prispevku je analizirana etika svetovnih in slovenskih medijev predvsem na konkretnem primeru pisanja o Melaniji Trump in požigu krščanskih cerkev. Vira za ameriške medije sta predvsem CNN in Fox, za Slovenijo pa večinski mediji. Če so pisanja objektivna v časopisih, ki se proglašajo za vsaj približno sredinska in objektivna, potem mora biti število negativnih in pozitivnih mnenj o posamezni temi uravnoteženo, hkrati pa se morajo pisanja o tej temi pojavljati proporcionalno pomembnosti tematike. Opažena razlika sproža razne možne interpretacije, po vsem sodeč pa gre za polarizacijo medijev in prehod iz medijev v propagandna glasila. Prodor ideologije v medije je očiten, razlaga razlogov je zapletena.

KEYWORDS / KLJUČNE BESEDE

Etika in mediji, Etics and media

ABSTRACT

The article analyzes the ethics of the world and Slovenian media, especially on the concrete case of writing about Melania Trump and the burning of Christian churches. The source for the American media is mainly CNN in Fox, for Slovenia the majority media. If such writing is objective, then the number of negative and positive opinions on a particular topic should be balanced, and at the same time writing on this topic should appear relative to the importance of the topics. The observed difference triggers various possible interpretations, and apparently is a matter of polarization of the media and the transition from the media to the propaganda bulletins. The penetration of ideology into the media is obvious, hutring the democracy, while the explanation of the reasons is complicated.

1   UVOD

V tem prispevku se ukvarjamo z etiko [1][2] medijev v smislu, ali tisti mediji, ki zase trdijo, da so objektivni, tudi v resnici uravnoteženo, objektivno in korektno poročajo o ideoloških in politično vročih temah. Pregledali bomo nekaj konkretnih tem in analizirali poročanje predvsem v slovenskih medijih.

1.1. Anketa o medijih v ZDA

Po anketi Gallup/Knight poll v letu 2020 z naslovom "American Views 2020: Trust, Media and Democracy," [3], ki je zbrala ankete 20,000 Američanov (dosegljiva na kf.org/usviews20), so mnenja naslednja:

- *Mediji so ključni za dobro delovanje demokracije*: tako meni 84% Američanov; 49% pravi, da so mediji ključni in 35%, da so zelo pomembni.

- *Skoraj polovica vseh Američanov (49%) je v vprašalnikih označila, da so mediji zelo pristranski* (angleško: very biased). 56% Američanov ocenjuje, da so njihovi viri (tisti, ki jih uporabljajo) pristranski, 70% jih je zaskrbljenih zaradi tega. 8% jih meni, da skušajo mediji upravljati državo in so zato mediji postali škodljivi – to mnenje večinsko zastopajo republikanci, ki zastopajo desničarske poglede.

- *Američani večinsko menijo, da postajajo mediji propagandna glasila.* 74% jih meni, da pisanje medijev usmerjajo lastniki, 5% več kot leta 2017. Mnenja so, da so pristranska poročanja namenska, pri čemer jih 54% verjame, da prostrano prikazujejo dejstva, medtem ko jih 28% verjame, da si novinarji v celoti izmišljujejo lažne novice (angleško fake news).

- *Nezaupanje v medije je večje v desno usmerjenem delu populacije.* 75% republikansko usmerjenih ima negativno mnenje o vlogi medijev v ameriški družbi in 61% jih opravičuje napade na medije (predvsem s strani ameriškega predsednika). Nasprotno pa samo 22% demokratsko oziroma levo usmerjenih Američanov slabo misli o medijih in 70% jih pravi, da so napadi na medije neupravičeni.

Kot pravi Sam Gill, vodja anketiranja pri Knightu: "Večina Američanov je izgubila zaupanje v medije v smislu objektivnosti poročanja, kar je uničujoče za našo demokracijo."

1.2. Razširjanje mitov in neresnic

Nezaupanje v medije je povezano z nezaupanje celo v nesporna znanstvena dejstva, pojavlja se čedalje več posameznikov in združenj, ki zagovarjajo mite kot ploščato Zemljo, da Američani niso pristali na Luni, da kajenje ne škodi, da so koronavirus vpeljale multinacionalke z namenom cepljenja in čipiranja ljudskih mas, da cepljenje škodi – da je več mrtvih zaradi cepljenja kot zaradi bolezni (korekten opis je tule: https://en.wikipedia.org/wiki/Vaccine_hesitancy). Te trditve najdemo tako v svetovnih kot slovenskih analizah, z njimi se srečujemo v pogovoru s kolegi in znanci. Kako so take trditve našle pot med ljudi in se čedalje bolj razširjajo, je težko razložljivo, saj lahko vsakdo opazi, kako ladja začne izginjati iz vidnega polja, ko se oddalji po vodni površini, oz. vsakdo lahko poišče zgodovinske vire, kako je zaradi bolezni črnih koz umrlo 300-500 milijonov ljudi (https://en.wikipedia.org/wiki/Vaccine_hesitancy). Če bi slike

umrlih zaradi črnih koz postavili v vrsto, bi obkrožili naš planet. Šele s cepivi je človeštvo izkoreninilo bolezen leta 1979. Zato World Health Organisation anti-cepilce postavlja med 10 največjih zdravstvenih nevarnosti sedanjosti – z drugimi besedami: če bi te ideje našle pot do realizacije preko politikov, bi posredno povzročile milijone mrtvih vsako leto. Verjeti v ploščato zemljo najbrž ni pretirano škodljivo, vsaj neposredno, pomeni pa zanikanje osnovnega človeškega znanja in poneumljanje ljudi in eno izmed poslanstev avtorja je prenašati znanje v javnost [4][5]. Prenehanje cepljenja pa pomeni reda velikosti milijonov mrtvih vsako leto zaradi povečanega pojava nalezljivih bolezni.

V resnici znanost še naprej na večini področij dosega odlične rezultate, čeprav je tudi tu očiten prodor ideologije zlasti v raznovrstne družboslovne vede. V naravoslovju in inženirstvu pa je na osnovi anonimnega recenziranja vsaj v kvalitetnih revijah in na kvalitetnih konferencah praktično nemogoče objaviti ideološko obarvane polresnice ali neresnice. Zato je toliko pomembneje iz prave znanosti in izmed pravih znanstvenikov izločati tiste, ki dajejo ideologiji prednost pred stroko.

Prodori v resno znanost so redki in kratkotrajni, zaskrbljuje pa prefinjenost in sofisticiranost tovrstnih podtikanj v zadnjem času, kar jasno kaže, da so tudi strokovnjaki postali žrtev ideologije. Recimo v najboljši medicinski reviji na svetu, The Lancet, so leta 2020 objavili prispevek, da so antimalarijska zdravila kot hydroxychloroquine škodljiva [6]. Povezava s politiko in ideologijo je v tem, da je ameriški predsednik Donald Trump po televiziji večkrat propagiral koristnost tega zdravila na osnovi preliminarnih francoskih študij [7], ki so bile objavljene z opozorilom, da gre za prve študije. Prispevek o škodljivosti hydroxychloroquine v Lancetu pa je namerna potvorba z ideološko motivacijo, saj poroča o izjemno velikem številu pacientov, nespornih rezultatih in ostalimi pokazatelji obsežne študije. Ponaredek je tako kvaliteten, da recenzenti niso mogli opaziti goljufij, dokler ni po objavi prišlo do poglobljenih analiz podatkov in virov – recimo podjetje je imelo zaposlene, ki so med drugim delali v erotičnih storitvah, nekatere relacije so bile napačne, nihče ni imel informacij o testirancih z imenom in priimkom – kljub varovanju podatkov pa je potrebno včasih dopustiti možnost preverjanja.

Če smo prišli tako daleč, da potvarjajo celo najboljše znanstvene objave, če določeni načelno objektivni poklici izgubljajo verodostojnost in postajajo naklonjeni eni ali drugi politični opciji (celo nekateri znanstveniki objavljajo in celo nekateri sodniki sodijo po svojih ideoloških pogledih), potem so tovrstni pojavi v medijih najbrž pričakovani in toliko bolj pogosti.

2   MELANIJA TRUMP

V pobudi na Državnem svetu, da se postavi spomenik Melaniji Trump kot odgovor na požig njenega spomenika [5,8], je napisana naslednja vsebina: Donald John Trump je na volitvah 8. 11. 2016 postal 45. predsednik ZDA. Od 2005 je poročen z Melanijo Knavs, s čimer je prvič v zgodovini prva dama ZDA postala Slovenka. Melanija Trump je tako po Louisi Adams, ženi predsednika Johna Quincya Adamsa, šele druga prva dama, ki je rojena izven ZDA.[1]

Vloga prve dame ni opisana v ameriški ustavi, je pa sestavni del predsednikovega kabineta že od ustanovitve ZDA leta 1776. Prva dama opravlja naloge, kot so: javna osebnost, predsedniška predstavnica, glas ženske populacije, upravnica Bele hiše, udeleženka volilnih kampanj, gostiteljica državnih srečanj in zagovornica družbeno najšibkejših.[2] Zanimivost funkcije je tudi ta, da si vsaka aktualna prva dama izbere področje, na katerem bo aktivno sodelovala in ki praviloma ni politično opredeljeno. Tudi aktualna prva dama se je podala po poti svojih predhodnic. Sodeluje v šestih dobrodelnih aktivnostih, je ambasadorka ameriškega Rdečega križa, podpira zdravo življenje in gibanje, recimo kolesarstvo, podpira ženske aktivnosti in sodeluje pri izboru Ženske leta v ZDA. Posebno pozornost namenja ameriškim veteranom z različnimi poškodbami, bori se tudi proti zlorabam otrok. Med drugim je zaslužna za nastanek pobude, ki je nastala v sklopu akcije oziroma iniciative »Be Best«, ki se osredotoča predvsem na nekaj ključnih problemov otrok, s ciljem, da se otrokom omogoči primerne pogoje za razvoj, se jih nauči pomena socialnega, čustvenega in fizičnega zdravja ter se jih spodbuja, da postanejo čim boljši ljudje. Iniciativa »Be Best« se osredotoča na tri glavne stebre: dobro počutje otrok, spletno varnost, ki vključuje boj proti zlorabam otrok po spletu, in škodljivo uporabo mamil in opioidov.[3] Melanija Trump svojo pozornost in energijo usmerja v neideološke in nepolitične teme, predvsem si prizadeva za boljše odnose med ljudmi, za manj nasilja, manj zlorab, za zdravo življenje, za manj mamil in, kot omenjeno, predvsem za dobro šibkejših, kot so otroci.

Promocija domovine prve dame vsekakor pripomore k prepoznavnosti Republike Slovenije in lokalne skupnosti. Predvsem občina Sevnica kot kraj, kjer je bila Melanija Trump rojena in kjer je odraščala, je prvi dami posvetila veliko pozornosti[4]. Aktualno promocijo prve dame je po naročilu ameriškega investitorja in umetnika apliciral tudi domačin, ki je leta 2019 v Rožnem, ki sicer sodi v občino Krško, v njeno čast iz kosa lesa izdelal leseno skulpturo v naravni velikosti. Na žalost pa je lesena skulptura zdržala le dobro leto, saj so jo v začetku julija 2020 neznani storilci zažgali in tako poškodovali, da jo je bilo treba odstraniti. Požig lesene skulpture so povzeli tako domači kot tuji mediji[5], pri čemer je treba poudariti, da je uničevanje skulptur in kipov, ki je v zadnjem času prisotno tako v ZDA kot Evropi, sprto z normami visoke stopnje civiliziranosti in kulture.

Poleg dejstva, da je Melanija Trump med bolj znanimi Slovenkami vseh časov, je treba omeniti tudi, da nekateri svetovni in slovenski mediji o njej pogosto objavljajo kritične prispevke, ki bi se jih lahko interpretiralo kot ideološko-politične, lahko pa tudi kot diskriminacijo žensk ali seksizem, kar je nesprejemljivo. Zato bi z obuditvijo ideje o postavitvi njenega kipa jasno pokazali, da je slovenska družba civilizirana, kulturna, strpna, dobronamerna in da ceni dosežke sonarodnjakov, ne

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[1] Louisa Adams je bila rojena 12. 2. 1775 v Londonu.
[2] Shah, S. First ladies in the press: analysis of New York Times coverage of Hillary Clinton, Laura Bush and Michelle Obama, 2015, str. 3 in 4.
[3] Be Best, First Lady Melania Trump´s Initiative, dostopno na URL: https://www.whitehouse.gov/bebest/, 4. 8. 2020
[4] Več o promociji Melanije Trump in občine Sevnica dostopno na URL: https://www.delo.si/nedelo/torta-melanija-in-predsedniski-hamburger-

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[5] Požig lesene skulpture Melanije so povzeli vsi večji svetovni mediji kot so: NYTimes, CNN, BBC, TheGuardian, Reuters.

glede na področje njihovega delovanja. Ustrezno priznanje za njihove dosežke je treba izkazati tako športnikom, kulturnikom, znanstvenikom, politikom in drugim, ki širijo prepoznavnost Slovenije v svetu. Ni namreč vseeno, ali živimo v državi, v kateri se spodbuja prijaznost, pozitivno miselnost in dobrososedske odnose, ali pa v državi, v kateri se širita sovraštvo in nestrpnost.

Kaj pa o Melaniji Trump pišejo mediji? Na vprašanje v Googlu (Melanija Trump Fox News) najdemo 46.900.000 zadetkov, na (Melanija Trump CNN News) pa 14.900.000. Velika večina prispevkov v CNN ima tako ali drugačno negativno konotacijo, pogosto vezano na njenega moža Donalda Trumpa. Večina prispevkov v Fox Newsu pa – nasprotno – zagovarja Melanijo in predvsem njenega moža. Pogosto so poročanja obeh relativno objektivna in se prava razlika pokaže šele v poročanju o prejšnji prvi dami Michelle Obama. Melanija se za razliko od Michelle politično ne izpostavlja in se skuša ukvarjati z bolj življenjskimi vprašanji kot izboljšava izobraževanja otrok in za pravice žensk. Bolj kot pri Michelle Obama pri pisanju o Melaniji pogosto najdemo stavke o Donaldu Trumpu, ki so pozitivni ali negativni glede na en ali drug vir objave, čeprav je Melanija politično distancirana, kar je težko razumljivo - kot da prihaja do izjemne polarizacije medijev pri opisu tudi nepolitičnih tem. Razlika je opazna pri pisanju o obeh damah o oblekah, posamezni kretnji, kako je ali ni dala roko predsedniku, itd. Preneseno (skoraj prepisano) vsebino pogosto opazimo v slovenskih medijih, enako kritično do Melanije.

Slovenske novice, na primer, so 16. avgusta objavile »Zasačena Melania: Donalda hladno odrinila in nadaljevala sama«. Večer 16. junija 2020 piše: »Ne shajata dobro: Poznavalka razkriva, kako se posmehljivo za hrbtom kličeta Melania in Ivanka Trump«. Siol 8.11.2016 objavi: »Melania Trump je znanilka temnih časov za zahodne vrednote«. Primerjava objav z Michelle Obama in Barrack Obama ne vrne negativnih relacij v tovrstnem slogu. Nekatere objave o Melaniji so pripeljale celo do tožb v Sloveniji in po svetu, sodišča so ji dosodila nekaj odškodnin.

3   POŽIGI CERKVA

Narejena je bila analiza prvih 100 zadetkov na vprašanje v Googlu: »Požigi krščanskih cerkev«. O tej tematiki pišejo: Domovina, manj znan medij izrazite desne usmeritve: 15.7.2020: »Požigi cerkva so se iz Francije preselili v ZDA, a osrednji mediji o njih molčijo. V soboto je v zvezni državi Florida moški zapeljal z avtomobilom v notranjost cerkve in polil bencin, nato pa cerkev požgal. Osumljenec je nato iz kraja prizorišča zbežal, a so ga policisti prejeli in pridržali. To pa ni bil edini požar v cerkvah v Ameriki v preteklem vikendu. Preiskovalci preiskujejo še dva primera požiga cerkva. V sumljivih okoliščinah je zgorela 217 let stara katoliška cerkev sv. Gabriela v nadškofiji Los Angelesu in binkoštna cerkev v Limestonu, Alabama.«

Desno usmerjena Demokracija piše: »V Franciji so v povprečju dnevno napadene tri cerkve, ponedeljek, 15 april 2019. Kaj se je spremenilo v Franciji v zadnjih nekaj letih, da je do tega prišlo? Bi bil to lahko uvoz velikega števila ljudi, ki menijo, da smo kristjani med »najbolj zlobnimi bitji, kar jih obstaja« (Koran 98:6)? Ali pa je na to pomisliti preveč »islamofobno«?«

Versko usmerjeni časopis Družina navede: »Deset tisoč beguncev po požigu krščanskih cerkva, 25. 3. 2011, Islamski skrajneži so v jugozahodni Etiopiji požgali devetinšestdeset protestantskih cerkva, od tega jih je bilo šestinštirideset binkoštnih. Nasilje se je pričelo v mestu Asendabo, potem ko so se razširile govorice, da so v eni izmed cerkva v stranišno školjko odplaknili izvod Korana. Pripadniki islamskih skrajnežev so požgali tudi trideset domov, šolo in sirotišnico. Po navedbah človekoljubne organizacije 'International Christian Concern' (Mednarodna skrb za kristjane), ki pomaga žrtvam pregona, se je število kristjanov, ki so v zadnjih dneh zapustili svoje domove, povzpelo že na deset tisoč.«

Podobno poroča Nova24 in novice.najdi.si.

V medijih kot Delo, Časnik, Mladina, TV hišah RTV SLO ali POP TV in drugih iskanje ne vrne vsebinsko podobnega zadetka, vsaj preko Googla ne v prvih 100 zadetkih. Najde se sem in tja kakšen kratek prispevek o notredamski katedrali. Tudi v desnosredinskih medijih kot Slovencu ne najdemo obsežnih prispevkov na to temo, so le krajši kritični prispevku o uničevanju avtomobilov itd. muslimanov.

Požigi cerkva v Franciji so že pripeljali do evropskega predloga: »Predlog resolucije Evropskega parlamenta o požigih in uničevanju cerkva v Franciji, Evropski parlament, …

A. ker so cerkve v Franciji cilj vse pogostejših napadov, požigov in uničevanja;

B. ker se francoska vlada ne odziva na to drastično stopnjevanje napadov na verske objekte;

C. ker ti napadi pomenijo resno kršitev individualnih in kolektivnih pravic državljanov krščanske veroizpovedi;

1. poziva Evropsko komisijo, naj francosko vlado opomni na njene obveznosti do državljanov krščanske veroizpovedi, v skladu s katerimi mora zagotovi varnost in zaščito verskih objektov pred barbarskimi in obskurantskimi napadi.«, zato je toliko bolj nenavadno da objektivni večinski mediji o tem ne poročajo (ali pa poročajo tako, da iskanje preko Googla ne uspe).

Sporno je tudi požiganje križa v Strunjanu, ki se je zgodilo dvakrat: leta 2002 in leta 2013. Beli križ v ognju simbolno sicer spominja na KKK, rasistično organizacijo belcev oziroma tistih, ki so prepričani v superiornost belcev nad črnci. Ker pa so avtorji to izvedli kot umetniški dogodek, ni bilo kazenskih obsodb, čeprav je nastala tudi manjša umazanost križa. Ob obeh dogodkih pa je prišlo do polarizacije mnenj v javnosti in medijih – ali je to umetnostni dogodek ali pa gre za napade na verske simbole in spodbujanje sovraštva. Med mediji se je pojavila podobna porazdelitev kot pri pisanju o požigih – od odločne obsodbe do pravice svobodnega kulturniškega delovanja.

4   LAŽNE NOVICE

Izraz »lažne novice« je populariziral šele Donald Trump med volilno kampanjo pred štirimi leti. Tu navajamo opis iz angleške Wikipedije:

»Fake news, also known as junk news, pseudo-news, alternative facts, false news or hoax news,[1][2] is a form of news consisting of deliberate disinformation or hoaxes spread via traditional news media (print and broadcast) or online social media.[3][4] Digital news has brought back and increased the usage of fake news, or yellow journalism.[5] The news is then often reverberated as misinformation in social media but occasionally finds its way to the mainstream media as well.[6]

Fake news is written and published usually with the intent to mislead in order to damage an agency, entity, or person, and/or gain financially or politically,[7][8][9] often using sensationalist,

dishonest, or outright fabricated headlines to increase readership. Similarly, clickbait stories and headlines earn advertising revenue from this activity.[7]

The relevance of fake news has increased in post-truth politics. For media outlets, the ability to attract viewers to their websites is necessary to generate online advertising revenue. Publishing a story with false content that attracts users benefits advertisers and improves ratings. Easy access to online advertisement revenue, increased political polarization and the popularity of social media, primarily the Facebook News Feed,[3] have all been implicated in the spread of fake news,[7][10] which competes with legitimate news stories. Hostile government actors have also been implicated in generating and propagating fake news, particularly during elections.[11][12]

Confirmation bias and social media algorithms like those used on Facebook and Twitter further advance the spread of fake news. Modern impact is felt for example in vaccine hesitancy.[13] Fake news undermines serious media coverage and makes it more difficult for journalists to cover significant news stories.[14] An analysis by BuzzFeed found that the top 20 fake news stories about the 2016 U.S. presidential election received more engagement on Facebook than the top 20 election stories from 19 major media outlets.[15] Anonymously-hosted fake news websites[3] lacking known publishers have also been criticized, because they make it difficult to prosecute sources of fake news for libel.[16] The term "lying press"[17][18] is at times used to cast doubt upon legitimate news from an opposing political standpoint."

Pojav lažnih novic in ameriška kampanja sovpadata s povečano polarizacijo ameriških in posledično svetovnih in slovenskih medijev. Kar je pred leti še veljalo za neetično oz. v nasprotju z novinarskim kodeksom, je sedaj postalo nekaj normalnega – zavajati bralce, manipulirati z informacijami, uveljavljati medijsko propaganda tipa diktatorskih, nedemokratičnih režimov.

5 DISKUSIJA IN ZAKLJUČEK

Pojav polarizacije medijev se odraža tudi v spletnih aplikacijah, pa naj bo to Facebook ali Twitter. Po drugi strani pa prevelika svoboda spletnih medijev sama od sebe omogoči negativne pojave spletnih množic: anonimni posamezniki se izživljajo in ščuvajo k nasilju. Ko so spletni velikani to opazili, so začeli omejevati nasilne in sovražne izjave, video in audio posnetke ali lažne novice v smislu ploščate Zemlje in anticepilcev. Pri tem so pogosto uporabljali metode umetne inteligence, ki so bile načeloma izredno uspešne. Nekaj čudnih pojavov, kot začasna izločitev agadmatorja, je le stranski oziroma občasni problemček. Agadmator, oziroma Antonio Radić, hrvaški šahovski igralec in "YouTuber" ima od avgusta 2020 najpopularnejši šahovski kanal s 750.000 člani. Ko pa je nekega dne rekel, da beli pogosto premaga črnega, so ga za cel dan izločili kot vir sovražnega govora.

Na primeru pisanja o Melaniji Trump in požigih cerkva v Franciji smo pokazali, da nekateri mediji o tem poročajo, drugi pa praktično nič. Podobno se je pokazalo, a na drugi strani, ko smo analizirali npr. pisanje o migrantih, recimo o policijskem nasilju nad njimi, o množicah mrtvih migrantov pri prečkanju Sredozemskega morja ali o človekoljubnih akcijah migrantov. Te analize jasno kažejo, da so mediji v Sloveniji močno polarizirani in da se postavljata dve etični vprašanji:

Ali ni neetično biti tiho oz. ne obsoditi nekaterih nespornih zadev kot je nasilje ali požig umetniške stvaritve?

Ali ni neetično proglašati se za objektiven medij in ne poročati nič o levih ali desnih zadevah (pri čemer se je potrebno zavedati, da za deklarirano usmerjene medije ni neetično poročati samo svoj zorni kot - etični problem je trditi, da si objektiven in navijati za eno stran)?

Verjetno je poglavitni razlog za polarizacijo medijev polarizacija družbe, agresivna ideologizacija in politizacija zahodne civilizacije. Možno pa je tudi drugače: da so mediji povzročili polarizacijo družbe in da zavajajo pri trditvah o svoji objektivnosti, ko se hkrati spreminjajo v politična ali ideološka glasila. Analiza nasilja v ameriški družbi in medijev je že taka: kadar je množica ene strani napadala in požigala, so jo napadali predvsem mediji in politiki druge strani in obratno. Verjetno pa gre za obojestransko relacijo in je povezana s pojavom prevelikega kapitalskega kopičenja v elitah bogatašev in ljudskih množicah, odrinjenih in zmanipuliranih s strani medijev v lasti kapitalskih elit.

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Prispevek vernikov za bolj etično slovensko družbo

The Contribution of the Faithful for a more Ethical Slovenian Society

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POVZETEK

Sociologi religije predlagajo, da v sekularni državi učitelji v javnih šolah ne bi smeli izražati svoje vere. Postavili smo tezo, da prepoved izražanja krščanske vere vodi v ne etično obnašanje. Nasprotno pa izražanje vere, ki sledi evangeljskemu nauku, vodi v bolj etično družbo. Predstavili smo idejo sekularne države, izpostavili razliko med vero in religijo in končno pokazali pomen izražanja vere.

KLJUČNE BESEDE

Sekularna država, javna šola, verska praksa, religija, etika.

ABSTRACT

Sociologists of religion suggest that in a secular state, religion should not be professed in public schools by teachers. We put forward the thesis that banning the profession of the Christian faith leads to unethical behavior. Conversely, the profession of faith that follows Gospel teaching leads to a more ethical society. We presented the idea of a secular state, highlighted the difference between faith and religion, and finally showed the importance of expressions of faith.

KEYWORDS

Secular state, public school, religious practice, religion, ethics.

1 UVOD

V reviji CEPS Journal, št. 4/2019, ki izhaja na Pedagoški fakulteti Univerze v Ljubljani, je profesor dr. Aleš Črnič publiciral članek *Religion, education, and the Challenges of Contemporary Societies*. V njem se je osredotočil na mesto in vlogo religije v javni šoli v Evropi in v Republiki Sloveniji. To je tema, s katero se profesor Črnič ukvarja pri svojem raziskovalnem delu že dve desetletji. Z dr. Marjanom Smrketom in dr. Zdenkom Kodeljo je leta 2010 pripravil tudi *Strokovna izhodišča za razpravo o določitvi odnosa med javno šolo in religijo*. Rdeča nit njegovih pisanj o tej temi je prepričanje, da izražanje vere in verski simboli v javnih državnih izobraževalnih ustanovah ne morejo biti dovoljeni. Po njegovem mnenju dijaki in študentje sicer lahko izražajo vero z nošenjem verskih simbolov. Nasprotno pa profesorji ne smejo na viden način izražati svoje pripadnosti religiji ali verski skupnosti. Strokovna izhodišča pravijo, da učiteljica ne sme v šoli nositi islamske naglavne rute, profesor pa ne sme biti oblečen v redovno oblačilo. Po mnenju prof. Črniča, naj bi bila znamenja verske pripadnosti v javni šoli dovoljena le izjemoma kot demonstracijsko gradivo v pedagoškem procesu. Črnič se sklicuje na razsodbo Evropskega sodišča za človekove pravice, ki je odločilo, da je prisotnost križa na stenah učilnic v italijanskih javnih šolah kršitev dveh človekovih pravic: pravice staršev, da vzgajajo otroke v skladu s svojim religioznim ali filozofskim prepričanjem, in pravice učencev do verske svobode.(1) Profesorja Črniča cenimo kot znanstvenika in kolega, in ravno zato se nam zdi vredno in primerno, da njegovo pozicijo vzamemo za izhodišče našega razmišljanja, kako lahko kristjani prispevajo za bolj etično družbo v Republiki Sloveniji. Ne bomo se zaustavljali ob podrobnostih Črničevih člankov in ob predlogih za slovensko zakonodajo. Na temelju dejstva, da je možno prepovedati izražanje vere, postavljamo tezo, da prepoved izražanja krščanske vere, na splošno, vodi v manj etično obnašanje. Nasprotno pa spodbujanje izražanja vere, ki sledi evangeljskemu nauku, vodi v bolj etično družbo. Postavljamo dve vprašanji, ki izhajata iz problema prepovedi izražanja vere. Ali je taka prepoved pametna? Drugo vprašanje pa je bolj praktično: Ali je vernikom sploh možno preprečiti izražanje vere? Najprej bomo predstavili idejo sekularne države, ki se je razvila v evropskem kulturnem prostoru. Da bomo lahko v nadaljevanju razumljivo predstavili svojo trditev in odgovorili na vprašanji, pa bomo izpostavili tudi razliko med vero in religijo in končno pokazali pomen izražanja vere v vernikovem življenju.

2 IZRIVANJE RELIGIJE IZ JAVNEGA ŽIVLJENJA

Zagovorniki ideje o prepovedi izražanja vere v slovenskih javnih šolah poudarjajo, da je Slovenija sekularna država. Zaustavimo se nekoliko pri tej opredelitvi. Sociologi religije uporabljajo tri izraze, ki so si zelo podobni: sekularnost, sekularizem in sekularizacija. Že na prvi pogled ugotovimo, da vsi trije izrazi izhajajo iz iste latinske besede *saecularis*, kar pomen posvetno. V krščanski terminologiji si stojita sproti dve področji. Prvo zaobsega vse kar prihaja od Boga, torej Božje; kar je Bogu

posvečeno je sveto. Na drugi strani pa imamo to, kar prihaja od človeka; to je človeško ali posvetno. Iz omenjene latinske besede se je razvila beseda *saecularisatio*.

V evropskem srednjem veku si je Cerkev podredila politično oblast. S tem ni imela avtoritete samo na področju svetega, temveč tudi na področju posvetnega. Razum je bil podrejen veri oz. Božjemu razodetju; civilni vladarji pa so se morali podrediti cerkveni oblasti. Popolno oblast rimskega papeža je najprej začel spodnašati protestantizem, ki je z »zahodnim razkolom« zrelativiziral katoliški nauk, dokončno pa jo je spodneslo francosko razsvetljenstvo, ki je razum osvobodilo izpod vere. Razsvetljenci so zahtevali laizacijo šolstva in poučevanje znanja, ki temelji na razumu, neodvisno od Božjih resnic.(2) Francoska revolucija je z nacionalizacijo cerkvenih posestev pokazala, da Cerkev ni več gospodar v državi, ki so jo nekdaj imenovali »prva hčerka Cerkve«. Kasnejše revolucije v Evropi, dokončno pa revolucija leta 1848 je na simbolen način povedala, da je Cerkev ovira družbenemu razvoju v Evropi. V tem času se je že uporabljal izraz sekularizacija in sicer v povezavi s cerkvenim posestvom, ki je prehajalo v državno oskrbo. Tu ni šlo le za posestva, temveč za politično oblast, šolstvo, bolnišnice in gospodarstvo. V bistvu gre za »osamosvojitev dejavnosti, ki so v preteklosti bile pod nadzorom Cerkve«.(3) V tem smislu tudi danes besedo sekularizacija opredeljujemo kot »preobrazbo cerkvenega v posvetno« (4), tudi kadar gre za »odvzem ali prevzem cerkvenih posesti s strani države«(5). Profesor Krševan proces sekularizacije deli na tri nivoje: zmanjševanje religijskega vpliva na javno družbeno življenje, zmanjševanja vpliva religijske ustanove na njene pripadnike ter zavračanje verskih naukov (6). Pri sociologu Bergerju pa najdemo razlikovanje med sekularizacijo na ravni družbe in na ravni posameznika (7). Na ravni družbe se sekularizacija dogaja, ko se dejavnost cerkvenih institucij umika ali izriva iz javnega življenja. Na ravni posameznika pa se sekularizacija dogaja, ko vernik več ne sledi v polnosti navodilom religijske ustanove. Preprosto povedano, ko na področju vere in morale sam izbira, kaj bo sprejel in kaj ne. Predvsem, ko vernik vero izraža zgolj v zasebnem življenju, ne pa v javnosti.

Skratka, sekularizacija je dolgotrajen proces izginjanja vpliva religije iz javnega življenja. V času komunistične Jugoslavije je bila moderno reči, da je partija cerkveni vpliv omejila na zakristijo. Država, ki je vpliv religijske ustanove na javno življenje zmanjšala na najnižjo možno mero, se torej imenuje sekularna država. V Evropi se kot sopomenka sekularnosti uporablja tudi izraz laičnost. Sekularna država je laična država. V novejši evropski zgodovini sta proces sekularizacije pospešila komunizem in liberalizem. Prvi v vzhodni, drugi v zahodni Evropi. Vendar je pomembno poudariti, da je bil komunizem antireligiozen, ki je želel uničiti religijo. Če je sekularizacija proces izrivanja religioznega iz javnega življenja, potem je sekularnost stanje, v katerem posvetna oblast ne vpliva na cerkveno, ta pa ne na posvetno. Danes sekularnost izraža ločenost posvetnosti od religioznosti, ki jo izraža načelo »ločenosti Cerkve od države!«(8) Katoliška Cerkev je sprejela dejstvo, da nima oblasti na družbeno političnem področju. Javno življenje usmerja posvetna država.

Ideologija, ki zagovarja proces sekularizacije, se imenuje sekularizem. Ta ideologija »desakralizira moralo in vrednote ter osvobojenega od kakršnihkoli absolutnih resnic ustvari nov, od človeka ustvarjen sistem vrednot«(9). Liberalni sekularizem zagovarja svobodo govora, vesti in tudi svobodo na področju religije. Nihče ne more nikogar prisiliti v verovanje, kakor tudi nihče ne sme nikomur omejevati svobodo izpovedovanja vere. Tako imenovano versko svobodo je sprejela tudi katoliška Cerkve v svoj nauk na Drugem vatikanskem vesoljnem cerkvenem zboru. (10) Liberalni sekularizem je v 20 stoletju dosegel umik Cerkve v zasebno sfero in ji onemogočil vpliv na javno (posvetno) življenje. (11) Bistvo liberalnega sekularizma ni uničenje religije, temveč zahteva, naj se Cerkev umakne iz javnega življenja in se ukvarja z duhovnostjo. Tamimi je celo zapisal, da je liberalni sekularizem religijo pustil prepuščeno samo sebi, »naj uspe ali propade!« (12). Po tem načelu se sekularne države niso več zanimale za religijo in so religijskim ustanovam pustile popolnoma proste roke pri njihovem delovanju znotraj njihovih ustanov. Lahko rečemo »sekularnost« v polnem pomenu besede.

To je veljalo do preloma tisočletja. Takrat pa je zahodni svet izkusil islamski ekstremizem, ki je upravičenost načela sekularnosti postavil pod vprašaj. Država se je začela močno zanimati za delovanje religijske skupnosti. Predvsem za delovanje islamskih skupnosti v Evropi. To pomeni konec sekularne države oz. prehod v post sekularnost. Vredno je omeniti, da je liberalni sekularizem naredil napako, ker je duhovnost, na kar je omejil delovanje religije, razumel le kot pobožne molitve vernikov. Ampak življenje po veri obsega mnogo, mnogo več kot zgolj recitiranje molitev.

3   VERA IN RELIGIJA

V slovenskem akademskem prostoru so po uvedbi komunistično ateističnega političnega sistema vprašanja verske problematike popolnoma izločili iz univerzitetnega izobraževalnega programa. Tekom let pa je, tako političnim voditeljem, kakor tudi odgovornim na univerzi, postalo jasno, da je religija dejstvo, ki ga znanost ne more zanemarjati. Ljubljanska univerza se je zato začela resno znanstveno ukvarjati z religijo. Toda zgolj z sociološkega stališča. Sociolog govori o tem, kar vidi. Prešteli so verske skupnosti v državi, ugotavljali, koliko ljudi obiskuje verske obrede ter pripravili navodila za vzgojo »državnih kadrov«, kjer je bilo izpostavljeno, da je religija znamenje zaostalosti oz. da se resen znanstvenik z Bogom ne ukvarja. Napovedali so, da bo religija popolnoma izginila, ko bo znanost napredovala. Sociološka znanost se namreč lahko ukvarja z dejstvi, ki jih lahko vidi, prešteje, primerja oz. količinsko ovrednoti. Ta metodologija pa ne opazi bistva religioznega dogajanja. To pa je vera. Religije ne bi bilo brez vere. Kjer pa je vera, se pa nujno pojavi tudi religija. Skratka, sociolog religije, ki nima izkustva vere, zato religije v polnosti niti ne more razumeti. Ateistični opazovalec religije namreč ne opazi vere. Ta mu je nedostopna, ker nima izkustva o njej. Če hočemo razumeti religijo v polnosti, moramo stopiti na področje teologije. Teolog pa izhaja iz svojega izkustva verovanja in religijo lahko razume v veliki večji meri od ateističnega sociologa. Vsekakor je danes popolnoma evidentno, da velika večina ljudi veruje.

4   DEJSTVO VEROVANJA

Po podatkih, ki jih najdemo v Britanski enciklopediji, približno 85 % danes živeče človeške populacije pripada različnim religijam oz. verskim skupnostim.(13) Tudi v preteklosti ni bilo bistveno drugače. Morda je bil odstotek vernih še celo nekoliko večji. Tu ne gre za zanemarljive številke.   Po podatkih

statističnega urada Slovenije je leta 2002 tudi Slovenija kazala podobno podobo vernosti: nekaj čez 70 % Slovencev veruje in pripada verskim skupnostim (14). Zakaj človek veruje?

5 RAZLOGI ZA VEROVANJE

Znanost je o verovanju v zadnjem desetletju odkrila marsikaj novega. Najpomembnejše novejše spoznanje o veri je, da imajo ljudje (tudi ateisti) del možganov vnaprej specializiranih za verovanje oz. za vero in da imajo postopki verovanja svojo kemijo, svoje kemično-biološke procese (15). Od tod sledi kar nekaj zanimivih izpeljav in analiz. Danes na splošno velja, da so določeni deli možganov vnaprej pripravljeni za svojo funkcijo, recimo za vid ali govor. Ljudje nismo nepopisan list, ki ga v celoti oblikuje okolje. Seveda je končno oblikovanje človeka in njegovih možganov skupek prirojenih in pridobljenih lastnosti, vendar zadnja desetletja poudarjajo pomen genetike in predispozicij človeških možganov. Dr. Noam Chomsky, ameriški znanstvenik, je med prvimi, sicer na področju lingvistike, to tezo postavil na abstraktnem nivoju na osnovi eksperimentov. 29. marca 2005 so mu celo podelili častni doktorat ljubljanske univerze.

Ker so sposobnosti možganov ključnega pomena za uspeh človeštva in ker je del možganov specializiran za vero in ne za, recimo, še boljšo matematiko, je verovanje očitno ena ključnih lastnosti za evolucijski uspeh ljudi. Zamislimo si dve ljudstvi iz preteklosti. Eno verno in eno neverno. Izkazalo se je, da je evolucija za zmagovalca izbrala verno ljudstvo. Pri tem je potrebno upoštevati, da možgani porabijo približno 20 % energije, torej je verujoči del možganov velika dodatna obremenitev. Pa se je dodatni vložek očitno izplačal. Rečemo lahko torej, da je trditev o koristnosti verovanja zgodovinsko in evolucijsko dejstvo (16).

Mi pa postavljamo tezo, da človek veruje, ker je bitje odnosov, torej zato, ker je povezan z drugimi. To je najgloblji in prvi razlog človekovega verovanja. Moderna teologija nas uči, da je vera predvsem človekov odnos s presežnim; z vsem, kar naravo presega. S tujko to imenujemo transcendenca. Prvo človekovo izkustvo transcendence pa je odnos z drugim, s slehernim drugim, ki ga v življenju sreča. In prav v tem vsakdanjem odnosu se človek sreča in se srečuje z nekom, ki ga presega. Človek je namreč bitje, ki se v odnosu do drugega ne zadovolji s čutno predstavo (vizualno sliko, glasom, tipom) drugega, temveč v bližnjem išče in spoznava, čeprav se zdi, da je človeka že našel in spoznal. Kaj človek prepoznava v človeku? Pravzaprav čuti, da se v odnosu do drugega ne more omejiti le na to, kar vidi, sliši ali otiplje, temveč se v drugem skriva nekaj, kar je veliko več kot zgolj »neko telo« ali zgolj neka »duša«. Verjame, da bo to »nekaj več« v drugem našel in se zato pri svojem iskanju nikoli ne zaustavi. Ker spozna, da drugega ne more nikoli v polnosti razumeti, zaobjeti in nikdar posedovati, verjame (nima pa dokazov, da bi to vedel), da v drugem obstaja nek popolnoma Drugi, ki je nedoumljiv. In ker je tako drugačen, ga zapiše z veliko začetnico. Sluti, čuti, izkuša in veruje, da je drugi le podoba nekoga, ki ga išče.

Vera je človekova sposobnost, da v odsotnosti neke osebe prepoznava tudi njeno prisotnost. Kljub temu, da Boga ne vidi, prepoznava njegovo prisotnost; v odsotnosti osebe, katero telo so pokopali na pokopališču, pa prepoznava prisotnost te osebe. To prepoznavanje izraža tako, da osebo nagovarja. V religiji to

nagovarjanje odsotnih oseb, ki jih vernik kliče s »ti«, imenujemo molitev. Ampak molitev še zdaleč ni edini izraz vere.

6 IZRAŽANJE VERE OHRANJA VERO IN SPODBUJA ETIČNO DRŽO

Znamenje vernosti je v bistvu izpolnjevanje Božjega razodetja, oz. nauka, ki ga je verska ustanova svojim članom zapovedala. V religiji je nekaj bistvenega in nespremenljivega, veliko pa je le obrobnega, torej v pomoč, da se bistvo ohrani. In ta pomoč se, glede na potrebe, iz obdobja v obdobje spreminja. V krščanskem življenju je Božje razodetje nespremenljivo, to je ustava Katoliške cerkve. Sem lahko prištejemo Božje zapovedi: Ne laži, ne kradi, ne ubijaj… Kako se bo vernikovo življenje po evangeliju izražalo v posameznih zgodovinskih obdobjih, pa urejajo odloki, zakonodaja posameznih koncilov, glede na okoliščine in potrebe. Ker je interes Cerkve, da njeni člani ohranjajo vero, Katoliška cerkev v cerkvenih zapovedih svojim vernikom določa versko prakso, ki jo lahko imenujemo institucionalna, npr.: »Bodi ob nedeljah in zapovedanih praznikih pri sveti maši, pôsti se zapovedane postne dni, spovej se svojih grehov vsaj enkrat v letu in vsaj v velikonočnem času pojdi k obhajilu, sklepaj zakon po cerkvenih določbah …« Cerkveno učiteljstvo vernikom določa, kako naj izražajo svojo vero in jim s tem pomaga in daje oporo za ohranjanje in krepitev njihove osebne vere. Če pa Cerkev spozna, da se je življenje spremenilo, se morajo spremeniti tudi cerkvena navodila. Pri religijskem dogajanju lahko versko prakso in obrede primerjamo s posodo, ki ohranja vsebino - vero. V zgodovini se je posoda že velikokrat zamenjala in se še bo zaradi cilja, da se vera ohranja neokrnjena. Skratka, verovati pomeni vero izražati tako, kakor zapoveduje verski nauk oz. Božje razodetje.

Vera pa ni izbirna dejavnost ali človekov hobby, s katerim bi se ukvarjal zaradi obilice prostega časa. Vera je odnos, v katerem se je človek znašel oz. mu je bil podarjen. Na popolnoma enak način, kakor se je človek znašel v življenju, ki mu je bilo podarjeno in ga želi ohranjati in podaljšati, tako vernik želi ohranjati vero. To pa lahko stori le tako, da vero izraža! Verniki prepoznavajo v zapovedih in prepovedih absolutno avtoriteto oz. absolutno resnico, ki jim omogoča ohranjanje vere.

Izražanje vere je vedno tuzemsko, konkretno; to so dejanja vsakdanjega življenja. Zato so vse religije tuzemeljske in potrebujejo nek zemeljski ustroj. Ni nekega abstraktnega komuniciranja z Bogom, ampak je le pogovor s simboli, podobami in besedami. Za vernika je izražanje vere nekaj podobnega kakor je dihanje za človeško telo. Če preneha dihati, se konča telesno življenje. Tako tudi človek preneha biti vernik, ko se njegova vera preneha izražati. Zato resni verniki, ki želijo ohraniti svojo vero, nikoli ne prenehajo z versko prakso. Zagotovo jo spreminjajo, ne morejo pa ne izražati tega, kar nosijo v sebi. Vera torej ne izginja, le izrazi vere se spreminjajo. Res je, da se izražanje vere po navodilih ustanove pogosto zanemarja, hkrati pa je tudi res, da danes ljudje intenzivneje hrepenijo in veliko bolj iščejo duhovnost kot v preteklosti, vero pa izražajo na sebi lasten način in s tem nehote spreminjajo ustanovo, ki ji pripadajo.

Če pa podrobneje pogledamo, vidimo, da je filozofija in sekularna družba te iste Božje zapovedi, s katerimi verniki izražajo svojo vero, poimenovala z besedo »etika«, torej, kot nauk o dobrem, kot vodilo za preživetje človeka in človeštva.

7 FUNDAMENTALIZEM IN EKSTREMIZEM

Če se vernik odloči, da bo svoje življenje utemeljil na Božji besedi in se tega tudi striktno drži, ga imenujemo fundamentalist. Tisti trenutek pa, ko bo želel prisiliti tudi ljudi v svoji okolici, da bi živeli kot živi on, se spremeni v ekstremista. Verski ekstremizem je prisila drugih k sprejemanju vrednot, ki jih spoštuje ekstremist.

Pri izražanju vere moramo razlikovati med različno pomembnimi dolžnostmi v religiji. Prav gotovo je velika razlika med vzdržkom mesa na postni petek in abortusom. Gotovo! Toda, če nekdo ne spozna sam, da je spočeti otrok človeško bitje, ali če nekdo ne spoštuje svetosti človekovega življenja, ga tudi ekstremist ne bo mogel k temu prepričati. Zato je tudi dokument Drugega vatikanskega koncila o verski svobodi jasen: pri oznanjevanju vere ne sme biti prisile, nobene prisile. Načeloma to pravilo poznajo tudi muslimani. Tudi vernikom se posamezne verske vrednote ne more in ne sme s silo ukazati, da se spolnjujejo. Fundamentalizem je v svoji osnovi nekaj dobrega, ekstremizem pa je nekaj slabega, ker vključuje nasilje nad drugimi. Vsekakor pa izpovedovanje vere oz. življenje po Božjih zapovedih ni ekstremizem.

Ker omenjamo islamske ekstremiste, velja opozoriti, da v islamskem svetu na najdemo niti približek sekularizacije, ki je v zadnjih stoletjih prežela krščansko Evropo. Zato tudi ne moremo govoriti o sekularnih islamskih državah. V ozadju stojijo teološki razlogi. V izvirnem islamu namreč interpretacija Božjega razodetja ni možna. Krščanska teologija, ki pa zagovarja nujnost razlaganja Božje besede, je omogočila in dopustila sekularizacijo in sekularnost. Islamska teologija namreč v svojem temelju nasprotuje razlaganje Božjega razodetja, ker koransko besedilo je nastalo po nareku »od zgoraj«! Muslimani v Evropi, ki sicer dopuščajo razlaganje koranskega besedila, so se v očeh pravovernih muslimanov v arabskih državah oddaljili od pravoverne linije. Zato v islamskem svetu šariatsko pravo še danes ureja javno življenje. Islam daje vedeti, da biti zvest Bogu pomeni svoje zasebno in javno življenje podrediti Božji volji. Ko se je torej islamski fundamentalizem soočil z evropskim sekulariziranim svetom, je izbruhnil nasilni terorizem. Islamski fundamentalisti ne morejo razumeti in ne sprejeti sekularizacije. Zato so se iz fundamentalizma prelevili v ekstremizem.

8 DISKUSIJA IN SKLEP

V slovenski družbi in politiki pogosto poslušamo trditve, da sta vera in religioznost zasebni zadevi. Kadarkoli se v parlamentu sproži debata o zakonih, ki obravnavajo področje religioznosti, nekateri poslanci povedo, da je Cerkev ločena od države. Ampak vera je toliko zasebna zadeva posameznika, kolikor je ljubezen zasebna zadeva zaljubljenega dekleta in fanta. Vso pravico imata, da se skupaj, z roko v roki, sprehajata v javnosti, vso pravico imata, da se poročita tudi pred oltarjem. Tu ne moremo govoriti le o pravicah, temveč o potrebi. Ljubezen se mora izražati navzven, drugače izgine. Enako je z vero. Verniku prepovedati izražati vero je nekaj podobnega, kakor če bi človeku prepovedali dihati. Zato pa so se toliki kristjani »zadušili« in se v času komunizma iz pobožnih ministrantov prelevili v zagrizene nevernike. Tudi danes marsikateri kristjan

izgubi vero iz preprostega razloga, ker se prepusti javnemu mnenju, da vere »ni moderno« izražati po institucionalnih merilih. Če uporabimo še eno primero, bi dejali, da je vera toliko zasebna zadeva vernikov, kakor je zasebna zadeva vernikov posejanost cerkva po slovenskih mestih in gričih. Turisti, ki pridejo v Slovenijo, jih morajo opaziti. Iz teh znamenj lahko sklepajo, da v Sloveniji živijo verni kristjani. To je podoba slovenskih katoličanov, iz katere lahko, tudi tisti, ki bi to podobo sicer radi zavili v temo (nočno osvetljevanje cerkva in očitek svetlobnega onesnaževanja), prepoznajo podobo Boga, ki jo verniki nosimo v sebi. Z gotovostjo lahko potrdimo, da nihče ne more preprečiti vernikom izražanja vere. Zakonodaja lahko prepoveduje verske simbole v javnih prostorih sekularne ustanove, toda noben zakon ne more preprečiti učitelju ali javnemu uslužbencu izražanje vere v javnem življenju, pa četudi je predsednik države. Ne zato, ker bi bili verniki privilegirani, temveč zato, ker noben zakon ne more človeku preprečiti etične drže, četudi jo prepoznava kot Božjo voljo. To pa tudi nakazuje odgovor, da prepovedovanje izražanja vere ni modra politična poteza. Ker so Božje zapovedi temelj etične drže, bi tako dejanje v bistvu prepovedalo etično obnašanje. Ločitev Cerkve od države omogoča avtonomno delovanje obeh ustanov, nikakor pa nima namena posameznikom onemogočati verskega izražanja. Kakor je danes samo po sebi umevno, da lahko vsak človek v javnosti izraža svojo spolno usmerjenost, tako bi morala tudi slovenska sekularna država dovoljevati in omogočati vsem, tudi javnim osebam, izražanje vere. S tem ne bi privilegirala nobene religije, bi pa slovenska družba postala veliko bolj etična. Zagotovo velja poudariti, da izražanje vere ali pričevanje za evangelij samo po sebi še zdaleč ni ekstremistično dejanje.

Na najpomembnejši kolesarski dirki po Franciji leta 2020 blesti Primož Roglič, ki si je dal na roko vtetovirati križ in se tudi pokriža pred začetkom vožnje. Slovenski kolesar pa hkrati izraža visoko etično držo, ko sotekmovalce opozarja na nevarnosti. Tudi na drugih javnih igriščih športniki izražajo svojo vero. Nekaterim slovenskim gledalcem to ni všeč. Ampak dejstvo je, da vera ne pomeni le prepričanja, temveč je predvsem način življenja. Čim bolj verniki sledijo verskemu nauku, tem več lahko prispevajo za bolj etično slovensko družbo.

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Vloga religij pri oblikovanju globalne etike

The role of religions in shaping a global ethics

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POVZETEK

Religije so v preteklosti bistveno pogojevale moralne standarde v posameznih družbah. V sodobni globalni družbi smo priča močni prepletenosti različnih religij in svetovnih nazorov, zaradi česar tudi lokalne skupnosti postajajo vse bolj večreligijske in večkulturne. Številni globalni izzivi, kot so ekološka kriza, odprava revščine, preprečevanje vojn in nasilja, kličejo po oblikovanju globalne etike. Hans Küng je s somišljeniki zasnoval *svetovni etos*, ki združuje bogato moralno tradicijo vseh velikih religij, da bi zagotovil svetovni mir in pravične odnose med narodi. Pomembno vlogo pri širjenju zavesti o globalni odgovornosti ima tudi religijski in etični pouk v javnih šolah. Aktualni dokumenti evropskih institucij spodbujajo, da bi bili vsi učenci deležni ustrezne izobrazbe na religijskem in etičnem področju, kar je najboljše zagotovilo za mirno sožitje med ljudmi različnih pogledov in za preprečevanje vsake oblike radikalizacije.

KLJUČNE BESEDE

Medreligijski dialog, svetovni etos, religijski pouk, etična vzgoja,

ABSTRACT

In the past, religions have significantly conditioned moral standards in different societies. In modern global society, we are witnessing a strong intertwining of different religions and worldviews, which is the reason why local communities are becoming increasingly multireligious and multicultural. Many global challenges, such as ecological crisis, the eradication of poverty, the prevention of war and violence, call for the formation of a global ethics. Hans Küng and his like-minded associates designed a world ethos that combines the rich moral tradition of all the major religions to ensure world peace and just relations among nations. Religious and ethical education in public schools plays an important role in raising awareness of global responsibility. Latest documents from the European institutions encourage all students to obtain appropriate education in the field of religion and ethics. This is the best guarantee for peaceful coexistence between people of different worldviews and serves as prevention from any form of radicalization.

KEYWORDS

interreligious dialogue, world ethos, religious instruction, ethical education

1 POMEN RELIGIJ ZA ETIKO NEKOČ IN DANES

Temeljna predpostavka etike je, da je človek svobodno bitje, ki se na podlagi svojega razumnega razmišljanja odgovorno odloča. Podlaga za njegovo vrednotenje je njegov temeljni pogled na svet in človeka. Presojanje o tem, kaj je vredno, kaj je dobro, kaj je treba storiti tukaj in sedaj, je odvisno od tega, kako človek gleda na svet in kakšen pogled ima na uresničeno človeško življenje. Glede na opredelitev, kdo je za posameznika človek, kaj je v življenju človeka najpomembnejše in kakšno je mesto človeka znotraj celotnega svetu, prihaja do preudarnih in odgovornih odločitev, kako naj se posameznik odloča, da bo uresničil svoje človeško življenje. Vizija uresničenega človeškega življenja je torej horizont posameznih etičnih odločitev.

Posameznik oblikuje svoj pogled na svet znotraj družbenega in kulturnega življenja, v katerega je rojen. Njegovo razmišljanje je v marsičem pogojeno s kulturo, tradicijo, jezikom in religijo svojega okolja. Preden posameznik pride do samostojnega razmišljanja in odločanja o svojem življenju in o svojem delovanju v družbi, je deležen vzgoje s strani svojega primarnega socialnega okolja in seveda tudi drugih zunanjih vplivov, ki sooblikujejo njegov pogled na svet. Osebna svoboda posameznika je poleg drugih vplivov v marsičem pogojena tudi z družbenim okoljem in vzgojo.

V tradicionalnih družbah so imele glavno vlogo pri opredeljevanju smisla celotnega sveta in človekovega mesta v njem religije. Religije so predstavljale osnovno kohezijsko silo družbe. Na podlagi njihovih temeljnih pripovedi so pripadnikom določene skupnosti razlagale njihov izvor, njihovo poslanstvo, njihove cilje. Dajale so podlago za družbeno ureditev, urejale obredno življenje in s prazniki določale življenjski ritem. Podajale so tudi razlage za soočanje s konfliktnimi situacijami v življenju in s tem prispevale k osmišljanju individualnega in skupnega življenja v družbi. Kot take so bile religije s svojimi pripovedmi in obredi tudi podlaga za moralno življenje posameznikov in skupnosti. Religije so določale kodeks etičnega obnašanja, ki so ga morali posamezniki upoštevati, sicer so bili izključeni iz te družbe. Pri utemeljevanju svojega etičnega nauka

so se religije sklicevale na božjo avtoriteto ali na nauk karizmatičnega ustanovitelja.

Z oblikovanjem moderne družbe po francoski revoluciji religija nima več odločilne vloge v javnem življenju. Svoje mesto ima zgolj še v osebnem življenju posameznikov. To, kar sedaj oblikuje podlago za skupno življenje, je pripadnost določenemu narodu, določeni kulturi oz. odločitev samostojnih oseb, da želijo živeti v skupni državi na podlagi določenih skupnih vrednot (npr. svobodo, enakost, bratstvo). Pri iskanju odgovorov glede izvora sveta in človeka, mesta človeka v celotnem svetu ipd. se moderni človek opira na spoznanja znanosti, ki se z eksponentno hitrostjo razvija na vseh področjih. Znanstvena spoznanja sedaj predstavljajo neovrgljiva dejstva, na katera se lahko opirajo posamezniki in skupnosti pri urejanju življenja. Podlaga za skupno življenje ne predstavlja več etični kodeks, ki bi bil utemeljen v religiji, ampak spoštovanje temeljnih človekovih pravic, ki izhajajo iz univerzalne narave človeške osebe. Brezpogojno spoštovanje dostojanstva človeške osebe postane osnova za oblikovanje etike brez religijske podlage.

Na najbolj ekspliciten način je ta proces izpeljal Immanuel Kant (1724−1804), ki za izvor moralnosti postavi razum, ki se mu ni potrebno sklicevati na kakšno še bolj temeljno avtoriteto. Kant se je hotel izogniti nevarnosti relativizma zaradi pluralnosti krščanskih veroizpovedi in etiki dati temelj, ki bi bil univerzalno zavezujoč. Njegova formulacija kategoričnega imperativa se glasi: »Deluj tako, da lahko velja maksima tvoje volje vselej hkrati kot načelo obče zakonodaje.« [1] Kant izhaja iz razsvetljenskega prepričanja, da lahko človek s svojim razumom prepozna univerzalno človeško naravo, ki jo v enaki meri spoštuje v sebi in v vseh drugih ljudeh. Z vsebinskega vidika se Kantova etika ne razlikuje od tradicionalne krščanske etike, formalno gledano pa se ne sklicuje več na religiozno avtoriteto, ampak na obči človeški razum.

2 MEDRELIGIJSKI DIALOG ZA OBLIKOVANJE GLOBALNE ETIKE

Sodobni svet bistveno zaznamuje proces globalizacije in medsebojne prepletenosti različnih kultur in religij znotraj globalnega sveta. Bolj kot kadarkoli v zgodovini človeštva je treba najti skupne etične temelje, ki bodo omogočali sožitje med različnimi narodi, državami, religijami in kulturami. Številni globalni izzivi, kot so onesnaževanje okolja, klimatske spremembe, odprava revščine, preprečevanje vojn in nasilja, izkoriščanje poceni delovne sile, zatiranje manjšin in obrobnih, migracije, pandemije ipd. kličejo po oblikovanju globalne etike. Mirno sožitje, ki zagotavlja človeka vredno življenje, ni možno brez minimalnega strinjanja glede etičnih vrednot in drž. [2] Pluralna družba, v kateri živijo skupaj pripadniki različnih religij in svetovnih nazorov, potrebuje temeljno soglasje glede osnovnih etičnih načel. Hans Küng je že v devetdesetih letih prejšnjega stoletja opozarjal, da je mogoče globalne probleme rešiti samo s pomočjo skupnega svetovnega etosa. »Ni človeškega sobivanja brez svetovnega etosa narodov. Ni miru med narodi brez miru med religijami. Ni miru med religijami brez dialoga med religijami.« [2]

Prav na področju etike se v zadnjih desetletjih povezujejo strokovnjaki na različnih medverskih konferencah in projektih in iščejo skupno etično jedro vseh religij, ki bi bilo podlaga pravičnejšemu in bolj humanemu svetovnemu redu. Etika povezuje različna verstva in svetovne nazore. V iskanju skupnega etičnega jedra vsega človeštva se je pokazalo, da so etične norme kulturno pogojene, zato je treba vsako etično vsebino najprej razlagati znotraj njenega zgodovinskega, družbenega in verskega konteksta. Nekateri so zato prepričani, da je etika kot taka odvisna od kulture in posledično relativna. Drugi pa trdijo, da na podlagi univerzalne človeške narave obstajajo določene vrednote in norme, ki presegajo kulturno pogojenost in imajo univerzalno veljavo.

Slednje je prepričan že omenjeni teolog Hans Küng. Po njegovem mnenju najdemo določene temeljne prvine moralnosti v vseh kulturah sveta. »Nenapisane etične norme predstavljajo po prepričanju kulturnih antropologov 'skalo', na kateri je zgrajena človeška družba. To lahko imenujemo 'pra-etos', ki predstavlja jedro skupnega etosa človeštva oz. svetovnega etosa.« [4] To jedro lahko najdemo po Küngovem prepričanju v vseh religijah in v vseh kulturah.

Konkretni poskus določitve vsebine globalne etike predstavlja Deklaracija o svetovnem etosu, ki je bila sprejeta na zasedanju »parlamenta svetovnih verstev« v Čikagu 4. septembra 1993. Na začetku čikaške deklaracije, ki jo je zasnoval Hans Küng, so predstavnice in predstavniki različnih verstev opisali takratno krizno stanje, ki se je izražalo v svetovnem gospodarstvu, ekologiji in politiki. Avtorji se strinjajo, da znotraj različnih verskih izročil obstaja skupni etos, s katerim se je mogoče zoperstaviti usodnim globalnim spremembam. »Trdimo, da med religijami obstaja soglasje, ki je lahko osnova za svetovni etos. Obstaja minimalno temeljno soglasje o zavezujočih vrednotah, trdnih standardih in temeljnih moralnih prepričanjih.« [5] Vsi ljudje bi lahko sprejeli to jedro etičnosti, pri čemer pa avtorji poudarjajo: »S svetovnim etosom ne mislimo nove globalne ideologije, tudi ne enotnega verstva onkraj vseh obstoječih verstev, še najmanj pa prevlado enega verstva nad ostalimi. S svetovnim etosom mislimo na temeljno soglasje glede trdnih zavezujočih vrednot, neizpodbitnih meril in osebnih temeljnih drž. Brez temeljnega soglasja na področju etosa grozi vsaki družbi prej ko slej kaos ali diktatura in posamezni ljudje bodo obupani.« [5]

Temeljna zahteva svetovnega etosa je zelo preprosta: »Z vsakim človekom po potrebno ravnati človeško.« To temeljno načelo je podkrepljeno s Kantovim kategoričnim imperativom in z zlatim pravilom, ki ga je mogoče najti v različnih kulturah in verstvih. Iz te temeljne zahteve se oblikuje širi temeljne etične usmeritve, ki jih je mogoče najti v večini verstev: 1. Kultura nenasilja in spoštovanje vsakega življenja (Ne ubijaj oz. spoštuj življenje!); 2. Kultura solidarnosti in pravično gospodarstvo (Ne kradi oz. živi pošteno!); 3. Kultura strpnosti in življenje v resnici (Ne laži oz. govori resnico in živi v resnici!); 4. Kultura enakih pravic in partnerstva med moškim in žensko (Ne zagreši spolne nemoralnosti oz. spoštujte in ljubite se med seboj!). Avtorji deklaracije spodbujajo posameznike v verskih skupnostih, da oblikujejo tudi svoj specifičen etos: »Naj povedo, kaj pravi njihovo versko izročilo o smislu življenja in smrti, o vztrajanju v trpljenju, o odpuščanju krivice, o nesebičnem darovanju in nujnosti odpovedi, o sočutju in veselju. Vse to bo poglobilo, bolj natančno opredelilo in konkretiziralo že prepoznani svetovni etos.« [5] Na koncu je naslovljen apel na vse ljudi. Svet se bo spremenil na bolje samo, če bo prišlo do temeljitega in širokega preoblikovanja moralne zavesti na individualni in družbeni ravni.

Veliko je podobnosti glede temeljnih etičnih načel med različnimi religijami in kulturami, a kljub vsemu ne smemo idealizirati danega položaja. Dejansko obstajajo tudi nasprotujoče si moralne norme med različnimi kulturami. Poglejmo samo norme, ki določajo vlogo ženske v družbi, norme glede verske strpnosti, glede oblik kaznovanja ali glede oblike vladanja. »Na usoden način je bila hotena konvergenca često onemogočena zaradi različnih načinov izražanja, zgodovinskih bolečin in zagrenjenosti ter zaradi pomanjkanja primernega okolja za odprt dialog.« [6] Različne verske skupnosti imamo za seboj obremenjujočo prtljago iz preteklosti, ki v sogovornikih vzbuja odpor in nezaupanje. Krščanstvu se tako očitajo križarske vojne, čarovniški procesi, zatiranje znanosti, diskriminacija žensk in homoseksualcev … Pomembno je razčistiti s preteklimi bremeni in poskušati razumeti določene pojave znotraj njihovega zgodovinskega in kulturnega okolja. Hkrati je za globalno etiko potrebno vzpostaviti polje zaupanja med vsemi udeleženci znotraj pluralnega sveta. Brez zaupanja ni mogoče zgraditi etičnih temeljev za prihodnost globalne družbe.

Univerzalnost etike je cilj, h kateremu stremimo in ga tudi sooblikujemo, ne pa že dano dejstvo. Nemogoče je točno določiti, katere so dejanske univerzalne moralne norme, hkrati pa bi zanikanje normativne univerzalnosti vodilo v etični relativizem. Morajo torej obstajati utemeljene in brezpogojne moralne dolžnosti, ki jih je mogoče dokazati s pomočjo razumskega argumentiranja. Pri tem ne gre za razsvetljenski ideal abstraktnega razuma ali za postopkovno racionalno sklepanje v smislu modernih naravoslovnih znanosti. Gre za racionalnost, ki se zaveda povezave med normativno obvezo in družbeno pogojeno izkušnjo smisla življenja in temeljnih vrednot. Na podlagi te racionalnosti ne bo mogoče postavljati absolutnih norm, ki bi veljale neodvisno od vsakega konteksta.

Za pravilno razumevanje potrebujemo hermenevtični pristop k etičnim vprašanjem: »Vsak ključni pojem je potrebno natančno opredeliti v svojem dejanskem pomenu.« [7] Etična pojmovanja so zgodovinsko, kulturno in družbeno pogojena, zato je nujno, da predstavimo pristen pomen posamezne etične norme ali etične vrednote. Velikokrat pride do konfliktov zaradi napačnega razumevanja pomena ali nepoznavanja kulturnega konteksta določene etične opredelitve. Pri iskanju globalne etike je zato nujno, da kar se da upoštevamo zgodovinsko in kulturno ozadje posameznih izjav. »Hermenevtika, ki se poglablja v življenjsko okolje, ima za cilj, da bi zahtevo po zmožnosti univerzalizacije obvarovala pred tako uporabo, ki bi pozabila na zgodovinskost in bi se zato izkazala za iluzorno.« [8] Uči nas skromnosti, svari pred prehitrimi sklepi, da so neke norme univerzalne in da presegajo kulturno pogojenost.

Če je naloga etike, da posreduje to, kar je lastno človeku, če mu torej daje smernice, kako naj bi živel kot človek ne glede na spol, raso ali družbeni položaj, potem etično razmišljanje nikoli ne more zapasti v popolno različnost, ki ne bi bila več združljiva. Tudi v sodobni pluralni družbi še vedno obstaja nujnost, da preko argumentirane razprave o dobrem in slabem iščemo skupni imenovalec naše človeške narave.

3 POMEN RELIGIJSKEGA POUKA ZA ETIČNO VZGOJO V PLURALNI DRUŽBI

V veliki večini evropskih držav se etična vzgoja v javnih šolah izvaja znotraj religijskega pouka oz. alternativnega pouka etike.

[9] V preteklosti je bil religijski pouk v večini držav konfesionalne narave, kar pomeni, da so posamezne verske skupnosti skrbele za to, da je pouk potekal v skladu z njihovimi verskimi prepričanji in vzgajal učence za pripadnost njihovi verski skupnosti. Zaradi večreligijskega in večkulturnega konteksta prihaja do prenove na področju izvajanja religijskega pouka z namenom, da bi se učenci usposobili za življenje in delovanje v raznoliki in pluralni družbi. Nekatere države so konfesionalni pouk nadomestile z nekonfesionalnim (Danska, Švedska, Velika Britanija), večinoma pa iščejo načine, kako bi integrirale poznavanje drugih verstev in svetovnih nazorov v uradno še vedno »konfesionalni« pouk. Eden od primarnih ciljev religijskega pouka je tudi etična vzgoja, ki omogoča dialog in sožitje med pripadniki različnih pogledov na svet.

V zadnjih dvajsetih letih se je *Svet Evrope* večkrat izjasnil o nujnosti nepristranskega religijskega pouka v izobraževanju zaradi zagotavljanja mirnega in strpnega sožitja znotraj večkulturne in večreligijske družbe. *Priporočilo 1720* o izobraževanju in veri države članice spodbuja, da zagotovijo pouk o religijah za vse učence na osnovnošolski in srednješolski ravni. Dokument poudarja, da sta »dobro splošno poznavanje religij in čut strpnosti, ki iz tega izhaja, bistvena za izvrševanje demokratičnega državljanstva.« [10] Zadnji dokumenti (*Priporočilo 1962* iz leta 2011 ter *Resolucija 2076* in *Priporočilo 2080* iz leta 2015) kažejo na obrat v stališčih Sveta Evrope do konfesionalnega religijskega pouka. Če so prejšnja priporočila dajala prednost nekonfesionalnemu religijskemu pouku, pa je sedaj izrecno povedano, da je tudi konfesionalni religijski pouk združljiv z vzgojo za medkulturnost, če upošteva določene smernice: medsebojno spoštovanje, zaščita človekovih pravic, demokracija, strpnost, sprejemanje razlik kot nekaj normalnega, skupen pogled v prihodnost. [11] Evropske institucije torej poudarjajo, da morajo tudi javne šole zagotoviti vsem učencem določeno znanje o religijah in jih s tem pripravljajo na življenje v večkulturni in večreligijski družbi. Če je sprava prevladoval poudarek na negativni verski svobodi, ki je državam nalagal, naj v javnih šolah ne vsiljujejo nobenega (ne)verskega prepričanja, pa je v zadnjem času opaziti bolj vključevalen odnos do religij in verskih skupnosti. Nevtralnost šole je mogoče doseči s pluralnostjo pristopov in ne s splošnim izključevanjem religij. Pouk o religijah in o religijskih dejstvih ima svoje mesto v javnih šolah in predstavlja pomembno razsežnost pri medkulturni vzgoji današnjih otrok. [12]

Številne iniciative na različnih ravneh znotraj evropskega prostora, ki v zadnjih dveh desetletjih poudarjajo pomen poznavanja religijskih vsebin za celostno vzgojo in izobraževanje v večkulturnem in večreligijskem okolju, v Sloveniji niso dobile ustreznega odmeva in se jih v glavnem ignorira. Zaradi napetost znotraj večkulturnih okolij potekajo v različnih evropskih državah iniciative za spodbujanje medsebojnega spoštovanja in globalne odgovornosti med mladimi. Ferrari ugotavlja, da vlada danes v Evropi širok konsenz tega, da morajo države in njihove šole v ta namen okrepiti religijsko znanje. »Podajajo se vsaj naslednji štirje razlogi: (1) potreba, da se preseže religijsko neznanje, ki preprečuje razumevanje, in s tem neznanje o osrednji razsežnosti osebnega in skupnega življenja (2) potreba, da se razume in na novo uredi religijsko pluralnost, ki zahteva znanje o različnih religijah, npr. o islamu (3) potreba, da se sooči z vprašanjem o smislu, ki postaja vedno bolj pereče po padcu velikih sekularnih

ideologij, in (4) potreba, da se vzgaja za državljanstvo, za vzajemno strpnost in za spoštovanje 'drugega'.« [13] Če želimo spodbujati oblikovanje globalne etike, potem je treba začeti pri vzgoji otrok, ki morajo poznati lastno izročilo in biti hkrati odprti za druge. Pri oblikovanju identitete posameznika in skupnosti ima tudi v sodobni družbi religija še vedno svoje mesto, zato jo tudi javna šola ne sme preprosto ignorirati.

Eden od zanimivih projektov, ki jih podpira EU, je tudi preoblikovanje vsebin pri religijskem pouka v Belgiji z namenom, da bi se preprečila radikalizacija med mladih. Projekt nosi naslov »Educate to Build Resilience« in v njem kot partner sodeluje tudi Teološka fakulteta UL. [14] V Belgiji imajo dijaki možnost izbire med petimi vrstami konfesionalnega religijskega pouka (katoliški, protestantski, pravoslavni, judovski in islamski) ter nekonfesionalnim poukom etike. Projekt je zastavljen tako, da mladi pridobijo osnovno znanje o drugih religijah, kar naj bi spodbudilo medsebojno razumevanje in sočutje (šest osnovnih modulov, ki dajejo temeljno znanje o vsaki religiji). Hkrati pa znotraj svoje skupine poglobijo poznavanje svoje religije oz. nekonfesionalne etike zato, da bi bili bolj odporni na manipulacije s strani radikalnih skupin (štirje poglobitveni moduli, ki kritično ovrednotijo izročilo posamezne religije). Cilj takega pristopa je, da bi se mladi lahko identificirali s svojo (ne)religijsko pripadnostjo, da bi bolje spoznali svoje izročilo in ga tudi kritično ovrednotili. Ob tem pa spoznavajo tudi izročilo drugih religij in se učijo dialoga in medsebojnega spoštovanja ter med seboj oblikujejo prijateljske vezi. Prav reševanje skupnih izzivov, kot so vprašanje varovanja okolja, pravična razdelitev dobrin, migracije, so priložnost za poglobitev medsebojnih odnosov in iskanje skupnih etičnih temeljev v različnih religijskih in kulturnih izročilih.

V zaključku ponavljamo predlog, da bi tudi v Sloveniji za vse učence v osnovni in srednji šoli uvedli nekonfesionalni religiozni pouk »religijska kultura in etika«, katerega glavni namen bi bil poznavanje izročil različnih religij in njihov pomen za osebno in družbeno življenje v preteklosti in danes. [15] Poseben poudarek bi moral biti na vzgoji za medsebojno spoštovanje in oblikovanje globalne etike. Opažamo namreč, da je religijska pismenost med mladimi v Sloveniji čedalje slabša, kar predstavlja nevarnost krepitve predsodkov do ljudi, ki razmišljajo drugače. Že raziskava »REDCo«, ki je potekala med leti 2006 in 2009 v osmih evropskih državah, je pokazala, da imajo mladi, ki ne poznajo osnovnega znanja o religijah, mnogo več predsodkov pred drugače mislečimi in težje stopijo z njimi v stik. Večina tistih dijakov, ki so imeli v šoli religijski pouk, je bolj odprta za pogovor o verstvih in svetovnih nazorih z učenci iz drugih okolij kot dijaki brez religijskega pouka. [16]

Pri religijskem pouku šola pomaga učencu, da spoznava poglede posameznih religij na temeljna vprašanja in do njih oblikuje svoj odnos. V medreligijskem kontekstu sooči in preveri svoje lastno razmišljanje v odnosu do stališč drugih religij in prepričanj. V dialogu z drugače mislečimi se oblikuje njegova lastna identiteta. Drugi ga ne ogroža, ampak ga bogati in spodbuja, da prečiščuje svoj lastni pogled na svet. Bistveno pri vzgoji za medreligijski dialog je temeljno spoštovanje vsakega človeka, ne glede na to, ali se strinjamo z njegovim pogledom na svet ali ne.

Zaradi sekularizacije, globalizacije, migracij, potovanj, digitalne povezanosti z vsemi deli sveta se spreminja tudi religijska podoba naše države. Predvidevamo, da bo slovenska

družba v prihodnje bolj heterogena, kar predstavlja za področje vzgoje in izobraževanja poseben izziv. Vsekakor mora šola poleg znanja o tradicionalni religiji našega okolja predstaviti tudi osnove ostalih religij, predvsem tistih, ki imajo v Sloveniji večje število vernikov. Poznavanje nauka in običajev drugih verstev bo prispevalo k zmanjšanju predsodkov in k večjemu spoštovanju soljudi. Treba je izpostaviti prispevek posameznih religij k razvoju civilizacij, hkrati pa opozoriti tudi na konflikte in napetosti med religijami v zgodovini in danes. Objektiven vpogled v dejstva bo učencem pomagal razumeti pomen in vlogo religij za življenje posameznika in družbe in jih spodbudil, da ne glede na svojo religijo ali svetovni nazor gradijo raznoliko skupnost v medsebojnem spoštovanju in odgovornosti.

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Etika in informatika

Osebni pogled

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POVZETEK

Prispevek podaja razmislek o kodeksih etike. V začetku prikazuje zgodovino sprejemanja etičnega kodeksa Slovenskega društva INFORMATIKA. V nadaljevanju se dotakne etike kot take, nekaterih primerov, čigava je odgovornost poleg tiste, ki jo imajo strokovna združenja, na koncu pa podaja še nekaj misli, kako bi lahko ravnali v prihodnje.

KLJUCNE BESEDE

etika, informatika

1 UVODNA POJASNILA

Predvsem naj na samem začetku pojasnim, da sem aktiven na področju računalništva in informatike že dolga desetletja, vendar moja ožje področje delovanja etika ni bila. Prvič sem se z njo bliže srečal, ko sem bil prvič izvoljen za predsednika Slovenskega društva INFORMATIKA. Na enem od sestankov izvršnega odbora je bila izrečena – in seveda brez nadaljnjega tudi sprejeta - pobuda, naj društvo sprejme kodeks poklicne etike. Pri tem se je naslonilo na ameriško združenje Association for Computing Machinery (ACM) kot vidno tehnično profesionalna organizacijo, ki je prijazno dovolilo, da njen kodeks društvo uporabi, seveda ne v izvirni obliki. Preveden je bil v slovenščino, nekoliko prilagojen slovenskim razmeram in sprejet leta 1998. Poleg tega je imenovalo še disciplinsko komisija, ki je imela nalogo in pristojnost obravnavati primere kršenja kodeksa. Prvi kodeks društva je bil obsežen, štel je namreč kar osem strani, dotikal pa se je področij, ki niso neposredno predmet etičnih razmislekov.

Zaradi obsežnosti besedila je bila kasneje sprejeta pobuda, da bi kodeks poenostavili tako, da bi obravnaval le etična vprašanja, ne bi se pa dotikal področij, ki so urejena s statutom, kot na primer kdo lahko postane član društva, kakšne so njegove dolžnosti in pravice in podobno. Leta 2010 je društvo sprejelo nov kodeks, ki je bil že izvirno delo. Ta kodeks šteje tri strani in velja še danes.

Za etično presojo morebitnih etično spornih primerov je bila imenovana petčlanska etična komisija iz vrst zaupanja vrednih oseb. Vredno je poudariti, da vse od sprejetja prvega kodeksa do časa pisanja tega prispevka ni bil obravnavan niti en primer nespoštovanja etičnega kodeksa društva. Vprašanje je sicer, ali v resnici ni bilo primera, ki bi zaslužil obravnavo pred etično komisijo, vendar je treba vedeti, da velja kodeks etike le za člane društva. Znanih je nekaj razvpitih primerov, ko so

informatiki ravnali neetično in tudi nezakonito, vendar niso bili člani društva in zato društvo ni reagiralo.

Dejavnost društva na področju etike pa se ni omejila zgolj na sprejetje kodeksa etike. Do leta 2014 je organiziralo samostojno ali v sodelovanju šest posvetov Etični forum informacijske družbe, na katerih so udeleženci predstavili svoje poglede in razpravljali o aktualnih vprašanjih etike v informatiki in družbi sploh. Zbornik šestega foruma povzema dejavnost društva na področju etike.

V tem poglavju predstavljen oris prizadevanj društva na področju etike bi bil pomanjkljiv, če ne bi omenili dr. Marjana Krisperja, ki je dal pobudo, da je društvo sprejelo prvi etični kodeks, in pri ACM izposloval, da je slednji dovolil uporabo svojega kodeksa za potrebe društva. Drugi, ki ga prav tako ne gre spregledati, je mag. Franci Pivec, ki je bil glavni avtor sedaj veljavnega etičnega kodeksa društva. Oba, dr. Krisper in mag. Pivec, sta bila tudi predstavnika društva v tehničnih odborih International Federation for Information Processing (IFIP).

2 ZA KAJ V BISTVU GRE PRI ETIKI?

Poklicna etika ima dolgo zgodovino. Verjetno prvi uveljavljeni kodeks poklice etike je prisega, ki se ji mora prikloniti vsak mlad zdravnik. Pripisujejo jo starogrškemu zdravniku Hipokratu s Kosa in je zato znana kot Hipokratova prisega. Z njo so bila postavljena načela zdravniškega poklica, ki so, če odštejemo navajanje grških bogov, spoštovana še danes. Verjetno najbolj splošno znano načelo je Primum non nocere[1]. Kakor so nastajali novi poklici, tako je postajala očitna tudi potreba, da se strokovnjaki držijo poleg poklicnih tudi etičnih norm. Pri etiki gre v bistvu za osebne odločitve, ki vplivajo na druge. Ni namreč vse, kar je tehnično izvedljivo in pravno dopustno, tudi etično sprejemljivo. Etična norma pove, kaj je

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[1] Predvsem ne škodovati.
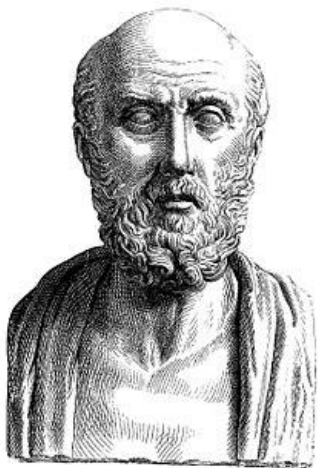
Slika 1: Hipokrat (460–370 pr. Kr.)

prav, zato so lahko dejanja neetična, tudi če so pravno neoporečna, da tehnične izvedljivosti niti ne omenjamo.

Zgornji razmislek nas spomni na neštevilne primere, ki smo jih doživljali sami in pri katerih se gre zahvaliti verjetno le slučaju, da nismo bili močno oškodovani. Pri tem mislim na sporočila po elektronski pošti, ki so zlonamerna na različne načine: izsiljevanje, črvi, virusi in podobno. Skupni imenovalec je vdor v zasebnost. Glede tega so vlade bolj odzivne kot na področju varnosti, vendar se bojim, da poudarek ni v pravi smeri. Večinoma so države sprejele neke vrste zakone o varstvu podatkov, osebnih ali drugačnih, vendar je jih je težko izvesti in še težje uveljaviti.

Moramo razumeti, da se zasebnost konča, ko zapustimo zasebne prostore. Na javnih mestih lahko zahtevamo osebno integriteto, da ne bomo fizično nadlegovani, verbalno napadani in podobno zlorabljani, vendar se v javnosti ne moremo pretvarjati, da smo nevidni ljudje. Lahko smo fotografirani in spremljani na javnih mestih, prvič, ker nismo doma, in drugič, ker to pomembno poveča našo varnost v javnosti. Vsi vemo (a komaj kdaj priznamo), da je vsa naša komunikacija nadzorovana in registrirana, bogve kje in kolikokrat, začenši z Echelonom v sedemdesetih letih, ki je bil od takrat večkrat nadgrajen. Resnično verjamem, da ni izgubljena bitka, ampak vojna za zasebnost. Tega sicer nisem vesel, ampak takšno je življenje. Torej bi se moral zakon osredotočiti na sankcioniranje zlorabe osebnih podatkov in ne na predpisovanje dovoljenega zbiranja, roke hrambe in podobno. Sankcija bi morala biti dovolj stroga, da bi tistim, ki bi kršili zakon, zmanjkalo posla. Preprosto temu rečemo preventiva.

Obe zgoraj omenjeni problematiki imata skupni imenovalec - etika. Poklicna združenja so večinoma sprejela etične kodekse, vztrajati pa morajo tudi, da njihovo članstvo spoštuje sprejete etične kodekse. Zelo verjetno v glavnem ni tako. Pravzaprav obstajajo oglasi in celo konference o etičnem hekanju. Po mojem prepričanju je to protislovno. Ali lahko kdo pri zdravi pameti pomisli na etični vlom, etično krajo ali kakšno drugo etično kaznivo dejanje? Vse to se dogaja v javnosti, kljub temu pa oblasti, širša javnost in še najmanj strokovna združenja ne reagirajo. Verjamem, da bi se položaj znatno izboljšal, če bi

javni razpisi vključevali klavzulo, ki bi zahtevala, da izvajalci predstavijo svoj etični kodeks.

3 KAKO NAPREJ

Vsi se zavedamo, da je varnost pomembna v vsakdanjem življenju, tako organizacije na splošno kot organi oblasti. Državljani zaščitimo svoje premoženje na različne načine z namestitvijo različnih varnostnih naprav v domove, avtomobile in drugo premoženje. Poleg tega organizacije najemajo varnostne službe, da čim bolj povečajo svojo varnost. Oblasti razumejo nujnost varovanja, zato imamo zakone, policijo, vojsko in podobno. Toda takoj, ko vstopimo v kibernetski prostor, se razmere spremenijo - žal ne na bolje za nas. Smo sami. Nekatere države, na primer Slovenija, so odprle portale, na katerih lahko državljani prijavijo poskuse ali zlorabo svojih podatkov ali denarja. Ne vem, kako deluje drugje, toda v tu, ko prijavim poskus zlorabe, je odgovor: Hvala, ker ste prijavili incident. Moja reakcija je, Hvala za tako storitev! Kot da bi prišli na policijo in jim povedali, da so vas napadli, policija pa bi se vam zahvalila, da ste jim to povedali. Sporočilo je jasno: prestopniki jo bodo vsaj v primeru spletnega kriminala poceni odnesli, saj so oškodovanci praviloma napoteni na zasebni pregon.

Bistvo je, da gre za odgovornost. Ljudje smo osnovna kategorija in za svoje boljše in varnejše življenje smo ustanovili države, vlade in oblasti. Imamo pravico zahtevati, da smo varni tako v vsakdanjem svetu kot v kibernetskem prostoru. Osnovno vodilo je, da tisto, kar v resničnem svetu ni dovoljeno, ne sme biti dovoljeno tudi v virtualnem svetu. V tem pogledu države niso storile dovolj. Naslednji, ki morajo opraviti domačo nalogo, so ponudniki storitev. Kako je mogoče, da v svojo e-pošto prejemamo izsiljevalska sporočila, viruse, črve in vse vrste nevarnih kod, tudi če je na voljo množica programske opreme za preprečevanje tega? Vlade bi morale uvesti stroge zahteve, ki bi ponudnike storitev zavezovale, da varujejo račune svojih uporabnikov vsaj tako, kot varujejo svoje.

4 NAMESTO ZAKLJUČKA

Če pogledamo po svetovnem spletu, bomo našli množico kodeksov etike, vprašanje pa je, ali jih je res toliko potrebnih. Verjetno je nekaj poklicev, ki jih ne moremo stlačiti v Prokrustovo posteljo brez škode za njihovo izvajanje in dobrobit izvajalcev. Na misel pridejo zdravniki, pravniki, učitelji in še kdo, vendar pa večina poklicev ni tako posebnih, da ne bi mogli najti etičnega skupnega imenovalca. Kaj je na primer tako posebnega pri gradbenikih, da ne bi mogli uporabiti kodeksa elektrotehnikov ali strojnikov?

Druga misel, ki se porodi, je, da so kodeksi poklicne etike v splošnem predolgi in preobsežni. Urejati poizkušajo vse znane in bodoče primere kršenja etičnih norm, vendar je žal tako, da več, ko je napisanega, več ostane nenapisanega. Glede presoje etičnega ravnanja bi morali pač zaupati tistim, ki so jih organizacije za to izbrale.

Tretje, kar bi bilo mogoče predlagati, je, da bi oblasti preganjale tovrstni kriminal po uradni dolžnosti. Dejansko gre za kriminal in odnos države do njega bi moral biti enak kot v primerih klasičnega kriminala.

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13. Mednarodna Konferenca o prenosu tehnologij – 13. ITTC
13th International Technology Transfer Conference – 13 ITTC

Uredila / Edited by

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PREDGOVOR

Spoštovana ministrica, spoštovani direktor, dragi kolegi, prijatelji, sodelavci pri prenosu znanja in tehnologije!
Prisrčna dobrodošlica tudi iz Centra za prenos tehnologij in inovacij na Institutu »Jožef Stefan«.

To je četrti dogodek Konzorcija za prenos tehnologij v Sloveniji, ki ga sestavlja 8 pisarn za prenos tehnologij. Sodelujemo že skoraj 3 leta. Hvaležni smo Ministrstvu za izobraževanje, znanost in šport, da je priznalo poklic za prenos tehnologije in zagotovilo petletni projekt za podporo našim dejavnostim. To sodelovanje praznujemo.

Rada bi se zahvalila vsem 8 partnerjem v konzorciju, ki so prispevali po svojih zmožnostih. Lepa hvala tudi ostalim konferenčnim partnerjem, ki so skušali prispevati po najboljših močeh.

Prav tako bi se rada zahvalila našemu direktorju za njegovo stalno podporo v vseh letih. Čeprav smo bili pogosto prepuščeni svojim zmožnostim, smo jih smeli uporabljati v korist inštituta in tehnološkega prenosa na inštitutu. Tudi ta konferenca je rezultat tega popustljivega okolja, ki je podprlo razvoj vseh področij.

To je 13. Mednarodna konferenca o prenosu tehnologij po vrsti. Od nekdaj se je prilagajala duhu časa, saj je vključevala ugledne mednarodne govornike, predstavitve industrijskih tehnologij in nagrade za najboljše inovacije raziskovalnih organizacij. Te nagrade so bila skozi leta podeljena več različnim slovenskim raziskovalnim institucijam, od katerih so mnoge sedanji partnerji našega konzorcija TTO.

Skozi vsa leta je konferenca vključevala tudi B2R srečanja, na katerih so raziskovalci in podjetja lahko razpravljali o konkretnih vprašanjih. Vključevala je okrogle mize za soočanje različnih mnenj in raziskovalne predstavitve, ki so prikazale vrhunske slovenske znanstvene rezultate. Konferenca je tako raznolika in prav je tako, saj poskuša vključiti vse segmente, ki so ključni za izvedbo znanja in prenos tehnologije.

Vendar se še vedno najdejo novi izzivi, s katerimi se lahko spoprimemo. Danes bo Svetovni urad za intelektualno lastnino na tem dogodku podelil dve mednarodni nagradi - IP Enterprise Trophy in medaljo WIPO za izumitelje. Zahvaljujemo se WIPO za prijazno podporo in soorganizacijo dogodka ter se zahvaljujemo slovenskemu uradu za intelektualno lastnino, ki je to sodelovanje omogočil.

Druga novost konference je rubrika z znanstvenimi prispevki o prenosu tehnologij. Pomembna je, saj si prizadevamo izboljšati učinkovitost prenosa tehnologije. Pri teh prizadevanjih je potreben objektiven pristop, ki se ponuja z znanstvenim načinom razmišljanja - spodbuja analizo, razprave na podlagi podatkov in se podaja v neznano, kjer še vedno veliko vprašanj ostaja neodgovorjenih.

Na primer, predlagani novi slovenski zakon o raziskavah, razvoju in inovacijah uvaja nove spodbude za sodelovanje z industrijo in sodelovanje v projektih EU. Toda zakaj bi bolj spodbujali sodelovanje v projektih EU kot sodelovanje v industrijskih projektih? Kaj natančno šteje za sodelovanje z industrijo? Kakšna naj bi bila odslej vloga spodbud, ki temeljijo na

komercializaciji, ki so bile na voljo do zdaj? To so pomembna vprašanja, na katera je treba odgovoriti pred izvajanjem nove zakonodaje.

Prav tako je v novi zakonodaji mogoče zaznati dejavnosti prenosa tehnologije, kar je zelo pozitivno sporočilo. Ampak, ali zakon dejansko opisuje TTO z vrsto strokovnjakov? Ali pa je treba financiranje med raziskovalci na tanko razporediti, da bi se sami ukvarjali s svojimi odnosi med industrijo in akademskim svetom? Kot je povedala gospa ministrica, je ministrstvo pripravljeno podpreti izvajanje instrumenta TTO tudi v naslednjem finančnem obdobju in to pozdravljamo. Ministrstvo pozivamo, naj v predlagani novi zakonodaji jasno formalizira TTO in naj pravočasno predstavi svoje konkretne načrte za poklic prenosa tehnologije v Sloveniji, da bodo TTO neprekinjeno delovale.

Naj na koncu poudarim še, da sta znanost in prenos tehnologije dolgoročni dejavnosti. Naši današnji rezultati v glavnem niso v našo korist takoj, ampak v korist družbi, v kateri želimo, da živijo naši otroci. Zato moramo visoko ceniti duh skupnosti, si prizadevati za svojo popolnost, hkrati pa pomagati tudi drugim, da jo dosežejo .

Hvala vam.

Dr. Špela Stres, MBA, LLM, Vodja Centra za prenos tehnologij in inovacij, Institut Jožef Stefan, vodja organizacijskega odbora konference 13. ITTC

FOREWORD

Dear Minister, dear Director, dear colleagues, friends, co-workers of transfer of knowledge and technology!
A kind welcome also from the Center of technology transfer and innovation at the Jožef Stefan Institute.

This is the 4th event of the Consortium of Knowledge and Tech-transfer in Slovenia, comprising 8 Tech-Transfer Offices, which have been collaborating now for almost 3 years. We are grateful to the Ministry of Education, Science and Sports to have acknowledged the tech-transfer profession and secured a 5-year project to support our activities. We celebrate this collaboration.

I would like to thank all 8 partners in the consortium, each has contributed according to their capacity. Warm thanks also to the other conference partners who tried to contribute in any way possible for them.

I would also like to thank our director for his continuing support throughout the years. Although we were mainly left to our own devices, we were allowed to use them for the benefit of the institute and the tech-transfer at the institute. Also this conference is a result of this permissive environment, who supported development of all fields.

This is the 13th International Technology Transfer Conference in a row. It has always adjusted to the spirit of the time, by including distinguished international speakers, Pitch Presentations of Industry ready Technologies, and the Awards for best innovation from research organizations. These awards have been through the years awarded to several different slovenian research institutions, many of them current partners of our TTO consortium.

Throughout the years the Conference also included the B2R Meetings where researchers and businesses could discuss concrete issues. It included Round Tables to confront different opinions and Research Presentations to show off with the superb Slovenian scientific results. The Conference is so diverse, and it is so, because it tries to incorporate all segments, crucial for the execution of the knowledge and tech-transfer.

However, there are still new territories to venture to. Today, the World Intellectual Property Office will bestow two international Awards at this event – IP Enterprise Trophy and WIPO Medal for Inventors. We thank WIPO for their kind support and co-organization of the event, and we extend our gratitude to the Slovenian IP Office, who made this collaboration possible.

Another novelty of the conference is the Section with scientific contributions on tech-transfer. The section is important, as we strive to improve efficiency in tech-transfer. In that effort an objective approach is needed, and it is offered through the scientific way of thinking – it encourages analysis, data based discussions, and venturing into the unknown, where still many questions lay unanswered.

For example. The proposed new Slovenian Law on research, development and innovation introduces new incentives for cooperation with the industry and for collaboration in the EU projects. But why a higher impetus for EU than for industry project collaboration incentives? What exactly counts as a cooperation with the industry? What should from now on be the role

of the commercialization based incentives that were in place so far? These are important questions to be answered before the implementation of the new legislation.

Also, one can sense the tech-transfer activities in the new legislation, which is a very positive message. But, is the law actually outlining a TTO with a set of experts? Or is the financing to be thinly spread among the researchers to deal themselves alone with their industry-academia relations? As the Lady Minister said, the Ministry is willing to support the implementation of he TTO instrument also in the next financing period and this is a very positive message. We urge the Ministry to clearly formalize the TTOs in the proposed new legislation, and to lay out their concrete plans for the tech-transfer profession in Slovenia in time for the TTOs to operate continously.

To conclude, science and tech-transfer are long term activities. The results we produce today are mainly not for our own immediate benefit, but for the society we want our children to live in. Thus we need to value highly the spirit of the community, strive for our own perfection, but also assist others in reaching it.

Thank you.

Dr. Špela Stres, MBA, LLM, Head of the Center for Technology Transfer and Innovation, Jožef Stefan Institute, Head of Organizing Committee of the 13 ITTC

ORGANIZACIJSKI ODBOR, PRIDRUŽENI PARTNERJI IN SPONZORJI / ORGANIZING COMMITTEE, ASSOCIATED PARTNERS AND FINANCERS

The main organizer of the 13th ITTC Conference is Jožef Stefan Institute.
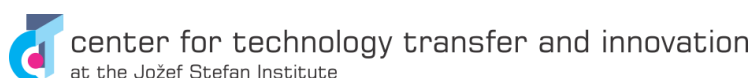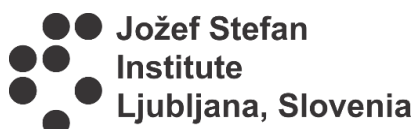
The organizing committee:

Dr. Špela Stres, MBA, LLM, Jožef Stefan Institute

Doc. dr. Urška Fric, Faculty of Information Studies in Novo Mesto

Robert Blatnik, M. Sc., Jožef Stefan Institute

Marjeta Trobec, M. Sc., Jožef Stefan Institute

The 13th ITTC Conference is organized in collaboration with the International multiconference Information Society (IS2020).

The 13th ITTC Co-organization partners are:

Slovenian Intellectual Property Office (SIPO)

World Intellectual Property Organization (WIPO)

Chamber of Craft and Small Business of Slovenia

SPIRIT Slovenia - Public Agency for Entrepreneurship, Internationalization, Foreign Investments and Technology

Faculty of Information Studies Novo mesto

Agricultural Institute of Slovenia

Slovenian association of technology transfer professionals (SI-TT)

The 13th ITTC Associated partners are:

National Institute of Chemistry

National Institute of Biology

University of Primorska

University of Maribor

University of Ljubljana

Scientific research centre Bistra

RDA Koroška - Regional Development Agency for Koroška

Regional Development Agency Posavje

Development Centre Novo mesto

University of Malta

Center for Technology Transfer, University of Belgrade

SIS EGIZ

Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins

IP Management Poland

GIS – Transfer Center Foundation

Slovenian Innovation Hub - European Economic Interest Grouping, SIH EEIG

The Research-to-business meetings at the 13th ITTC Conference were co-organized in collaboration with the Enterprise Europe Network partners:

Chamber of Craft and Small Business of Slovenia

SPIRIT Slovenia - Public Agency for Entrepreneurship, Internationalization, Fore-ign Investments and Technology

University of Primorska

University of Maribor

Chamber of Commerce and Industry of Slovenia

Area Science Park

Austrian Research Promotion Agency

Innovation Center of the Faculty of Mechanical Engineering in Belgrade

Ss. Cyril and Methodius University in Skopje

Fundación para el conocimiento madri+d

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Fundació Universitat-Empresa de les Illes Balears (FUEIB)

Tera Tehnopolis

Not Enterprise Europe Network partners:

ITC – Innovation Technology Cluster

DIH Agrifood – Digital Innovation Hub for Agriculture and Food production

The Conference is co-financed by:

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Enterprise Europe Network

Co-financing Enterprise Europe Network's part of R2B international brokerage event of Sector groups BioChemTech and ICT Industry&Services that are formed and co-financed entirely by the Enterprise Europe Network.

A decade of Knowledge Transfer in Slovenia

Desetletje prenosa znanja v Sloveniji

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ABSTRACT

In this paper, we describe the last decade of the Knowledge Transfer development in Slovenia. Knowledge transfer is based on the development of legislative tools, governmental financial tools and performance of the Public Research Organizations in Slovenia. The overview shows and evaluates in numbers what has been achieved. It also presents the fields in which knowledge transfer experts will have to act further in collaboration with Government, Professional Associations and Public Research Organization (PRO) leaderships. Conclusions are drawn to suggest further steps on the path of KT development in Slovenia.

Keywords

spin-off, spin-out, R&D contracts, Intellectual Property Rights (IPR) sales, legislation changes, public research organizations, boundaries, conditions, technology transfer, eco-system

POVZETEK

V prispevku opisujemo zadnje desetletje razvoja prenosa znanja v Sloveniji. Prenos znanja temelji na razvoju zakonodajnih orodij, vladnih finančnih orodij in raziskovalni uspešnosti javnih raziskovalnih organizacij v Sloveniji. Pregled v številkah prikazuje in ocenjuje, kaj je bilo doseženega. Nudi tudi vpogled v področja, kjer bodo v prihodnje strokovnjaki za prenos znanja v sodelovanju z vladnimi, strokovnimi združenji in vodstvi javnih raziskovalnih organizacij (JRO) morali nadgraditi dosedanja prizadevanja. Sklepne ugotovitve predlagajo nadaljnje korake na poti razvoja KT v Sloveniji.

Ključne besede

spin-off, spin-out, pogodbe za raziskave in razvoj, prodaja pravic intelektualne lastnine, spremembe zakonodaje, javne raziskovalne organizacije, meje, pogoji, prenos tehnologije, ekosistem

1. INTRODUCTION

Slovenia is a small country with 2 million inhabitants in Central Europe and 6980 registered researchers [1], the 19th in thus measured research strength out of 127 evaluated countries.

The efficiency of the Intellectual Property Rights (IPR) management system in a country can be evaluated through the successful commercialization of patents and secret know-how originating from Public Research Organizations. The commercialization is taking place through new company creation, IPR licensing and sales and direct R&D collaboration with companies.

The efficiency of the IP management system in Slovenia can be sought from a comparison of the results of three separate time-periods in which the Slovenian governments attempted to manage IPR collectively, using different mechanisms, through Technology Transfer Offices (TTOs). These were the periods of 2009-12, 2013-2014 and 207-2019 (the instrument is active until June 2022, not yet completed).

Since the independence of Slovenia in 1991, a particular legislative system with respect to public research generated IPR has been established. The legislative system, in the case of Slovenia affects the strength and the quality of a national IP management regime.

2. THE LEGISLATIVE CONTEXT

2.1 Slovenian legislative context

The Republic of Slovenia has established universities and public research institutes (PRIs) with *Institutes Act* (1991) [2] and *The Higher Education Act* (1993) [3]. Financing of research work on universities and PRIs (jointly named Public Research Organizations, (PROs)) is implemented with the assistance of the *Slovenian Research Agency* in accordance with various regulations [4].

The researchers compete for the financing of their research plans. They do so in regular time intervals (every year for projects, every four to six years for programmes). Evaluation of the proposals is done on the basis of certain criteria. Thus, it is possible to claim that the financing of research from the public budget is project and programme organised. To a certain degree, such a frequent selection and unavailability of stable long-term financing should support positive selection in the research sphere and enable researchers to work creatively in a relatively secure environment.[1]

With the Act on inventions arising from employment (1995) [5], the Republic of Slovenia has introduced an arrangement similar to the Bayh-Dole Act of the USA. The inventions arise from PROs. All the inventions resulting from the state budget financing, are owned and managed by the PROs. Certain conditions regulate the management of the mentioned inventions. These conditions need to be met, for the PROs to become the owner of the actual invention. These conditions are described in Article 21 and 22 of the Act on inventions arising from employment and are related to the Industrial Property Act.

All EU member states (except Italy and Sweden) – manage their inventions in the way the Republic of Slovenia does, with respect to the responsible PROs. The state renounces the right of ownership of the inventions in favour of the PROs. Consequently, these PROs, as legal entities, are also responsible for commercialization of inventions. Researchers are not personally responsible for the commercialization of inventions,

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[1] The status of researchers as civil servants and the absolute impact of the ARRS selection system are not discussed here.

but may capitalize financially (in Slovenia minimum is in the amount of 20 % of the gross related PRO income) in case of successful commercialization takes place. The researchers are thus incentivized to participate, and practically all PROs in Slovenia nowadays have internal PRO Acts distributing the benefits defined by the law.

With the *Supportive Environment for Entrepreneurship Act* (2007) [6] and the accompanying *Record on Keeping Rules on the Innovative Environment* [7]) a legal base for a supportive environment for innovation was created in Slovenia. Entrepreneurship incubators, university incubators and technology parks were explicitly mentioned in Article 2 of the *Record on Keeping Rules on the Innovative Environment*. Each of those supportive organizations was supposed to, in a manner described in the Record, support development and cooperation of the start-up and young enterprises. Technology transfer offices were mentioned by the *Record on Keeping Rules on the Innovative Environment* but were not financed through being part of the listed entities by the same Record.

Last but not least, based on the *Industrial Property Act* (2001) [8] the Slovenian Intellectual Property Office (Article 5 of the Industrial Property Act) was founded, with the main function to accept patent and other intellectual property right applications, manage the related procedure, related registers of rights, provide information services and represent the Republic of Slovenia at WIPO, EPO and other international organizations.

3. TECHNOLOGY TRANSFER OFFICES

In a substantial proportion, the Slovenian science and research activity is financed from public funds - in part from the national public budget, partly from the EU budget (European projects). A considerable proportion of the funding also comes directly from the Slovenian enterprises, which are the generator of public budget.

Therefore, the public research organizations (PROs) are well aware of the fact that the increase in competitiveness of the Slovenian economy also depends on the quality of the cooperation between science and industry.

However, looking at the commercialization side of Intellectual Property Right (IPR), in the end of the first decade of the 21st century, it was obvious that the knowledge and technology transfer potentials were not being fully exploited. The reasons could be sought in the less developed parts of the innovation support system – the intermediaries, which would assist in the commercialization of IPR – the Technology Transfer Offices (TTOs).

3.1 The governmental level

The legal framework for active management of the IPR generated by the PRO, has been set during the period of 1991-1995. The transfer of knowledge and inventions to the market should have been, by law, since 1995, supported by the PROs themselves. In particular the PROs should have been managing the IPR, generated/owned by the PROs. In practice the management and transfer activities should have been actively carried out by the entities, defined by legislation through the *Act on inventions arising from employment*. These entities are called the technology transfer offices (TTO) of the PROs. In addition, the Offices of technology transfer were in explicitly mentioned in the *Record on Keeping Rules on the Innovative Environment*.

Unfortunately, such offices have not been given further legitimacy until 2011, when the Resolution on Research and Innovation Strategy 2011-2021 [9] Slovenia has been adopted. Therefore, IPR in PROs was typically generated on a day-to-day basis without proper assessments of it being made, without commercialization procedures having been considered.

The question of IPR for the market has been raised several times through the years, but since there was little interest in looking at this problem from an integrative point of view, integral solutions were not implemented for almost another decade.

3.2 The institutional level

PROs in Slovenia were very agile in collaboration with the industry during the 1970's and 1980's. This resulted in some very early adoptions of internal Acts on acquiring and management of the IPR by the PRO, which enabled at least incentivizing the researchers with rewards on IPR production (if not management of IPR). The quickest to act was Institute of Chemistry (KI) in 1979, followed by Jožef Stefan Institute (JSI) in 1998, University of Ljubljana (UL) in 2006, National Institute of Biology (NIB) in 2007, University of Maribor (UM) in 2009, University of Primorska (UP) in 2010 [10]. All such Institutional Acts underwent several changes through the years.

Unfortunately, the PROs were not quick to pick up the pace with IPR management, to enable systematic, sustainable and consistent management of IPR generated, and to prevent any issues, as defined in relevant competition, integrity and corruption legislation.

The PROs were creating TTOs at different times and with different efficiencies. The first TTO in Slovenia was founded at JSI in 1996, followed by UM in 2005, University of Ljubljana in 2007, KI in 2010 (first jointly with JSI, then separated in 2012), UP in 2010, NIB in 2010, Agricultural institute of Slovenia (KIS) in 2015, Faculty of Information Studies Novo mesto (FIŠ) in 2017 [11], [12].

Several of the TTOs changed their organizational structure to become more agile and to be able to sustain themselves. Some several times, formal incorporations ranging from an outside company 100% owned by the University, through a separate and financially independent Unit of an Institute to an office or a section within some other entity (the Rectorate of the University, a Faculty or an incorporated Institute of the University).

3.3 The EU context

The *Framework for Research, Development and Innovation* suggests that the field of establishing new enterprises, arising from the knowledge, developed at the research organizations, should be regulated. According to this Framework, commercialisation via spin-offing is allowed (and desirable), if the profits from commercialisation activities are provided as funds for further research activities.

On the other hand, European and domestic competition law prohibit anti-competitive agreements. Thus, any anti-competitive provisions in commercial agreements are void and unenforceable which could lead to the entire agreement being unenforceable. However, the European Commission has produced a number of so-called block exemptions which make certain 'safe harbours' available to companies.

The Technology Transfer Block Exemption (TTBER [13]) covers technology licensing agreements in relation to most intellectual property rights (IPRs), providing a safe harbour to

companies active in this business area and in business relations with Public Research Organizations (PROs), too. If an agreement falls within the terms of this block exemption, the companies concerned can be confident that it will not be subject to scrutiny.

Furthermore, "Commission Recommendation on the management of intellectual property and knowledge transfer activities and Code of Practice for universities and other public research organizations", requests the establishment of control over the performance of technology transfer activities to the industry, which since 2013 EC countries, including Slovenia, are recommended to follow.

4. THE FINANCING OF THE TTOs
4.1 The lack of dedicated financing
Even though changes have been observed during the first decade of the 21st century, in European and national legislation, the problem of operationalization of TTOs through dedicated financing in fact remained open. A situation at the end of the first decade of the 21st century was still a gross neglect of the TTOs and their activities by the government.

On the one hand this forced most TTOs to have only 1 or two employees, mainly dealing with other issues of the institution (e.g. PR, research project administration). The two exceptions in size and activities, JSI with 6-15 employees and later TehnoCenter UM with 4-8 employees at the time, however, had little institutional financial support, and had to provide financing for their work from projects (EU projects, work for industry).

Thus, the long-lasting effort for financial support to the TTOs from the side of the government began already in 2008.

4.2 The three phases of the projects
The first partial solutions to the TTO financing started to be generated by the government with the support of the Association of Technology Transfer Professionals of Slovenia (Association SI-TT) already in 2009. Those were the KTT projects and they can be divided into three groups.

4.2.1 INO projects: 2008-2011
Firstly, the INO projects of 2008, 2009, 2011 were financed by the (former) Technology and Innovation Agency (TIA) with the support of the Ministry of Science. These projects involved partners as Slovenian Business and Regional Development Agencies, but also some of the Public Research Organizations. The glass ceiling has been broken, but the projects still focused mainly on promotion and organization of events. These projects explicitly focused on counting the number of leaflets produced and workshops organized. Less focus was devoted to actual Key Performance Indicators (KPIs) that would influence the industrial progress of the country, as number of contracts and their size, patents filed etc.

4.2.2 KTT project: 2013-2014
Secondly, the initial project KTT, lasting from 2013 through 2014, was the first project within which in particular technology transfer in Slovenia was *systematically* (albeit not sustainably) funded. During this first period national funds from the Ministry of Economy were made available for such financing. There were 6 partners involved in the project, but (due to late evaluation and late start) the project only lasted for 16.5 months.

4.2.3 KTT-2 project: 2017-2022
A long three-year period followed with no financing. During that time the Association of Technology Transfer Professionals of Slovenia (Association SI-TT) tirelessly tried to intervene with the Ministry of Science, the Ministry of Economy and the Government Office for Development and European Cohesion Policy, for the KTT project to be renewed and the TTOs to be financed again. This difficult period was intermittent only by harsh and belligerent negotiations among the existing TTOs. The negotiations were initiated by the JSI, but were difficult to lead due to different and partially articulated points of view.

There was a period of genuine despair due to government's focus on the NUTS3 division of the funds, and the unwillingness to introduce an umbrella accounting, which would affect KTT as operating throughout the country (instead of in a particular NUTS3 region). During this period, with no clear framework and leadership from the side of the government, the idea of the exclusionary operation of a possible new consortium grew among some TTOs. The idea was that some TTOs would be members, others would be left out. Consequently, the willingness of partners to rationally check their capacity, capabilities and achievements with the aim of cooperation remained low, the uncertainty caused the tensions and the competition among the partners to grew. The actions of the leaderships of the PROs, which held separate meetings for Universities and for Institutes, did not add a positive note into the confusion and distrust. Actually, the only joint meeting of the PRO leaderships was organized by JSI on June 12th 2014 in order to evaluate possible further steps, already before the KTT project (phase 2) ended.

After 3 years of turmoil, finally, in June 2017 the government decided to finance TTOs of Slovenia with a 5-year project. The current KTT project's mission is twofold: the strengthening of links and increasing the cooperation of PROs and industry and the strengthening the competences of TTOs, researchers and enterprises. Most (80%+) of the finances go to human resource financing.

As of now, all TTOs in Slovenia are jointly collaborating in this project. This *collaborative all-inclusive TTO setup* is considered by most of the utmost importance for coherent further development of the TTOs in Slovenia, but was not an initiative of the government. The government anticipated a competitive call where some of the TTOs would outbid the others, practically eliminating some or preventing others from developing skills at their institution. Such a development would have had disastrous effects on the development of the Technology Transfer scene in Slovenia. Moreover, the rules of the project prohibited active assistance from one PRO to the other, so no PRO can or could take on a case from the other PRO. Some PROs would thus in the exclusive model remain completely unsupported, as far as knowledge and technology transfer is concerned. Both of these features (long gaps between financing and the possible exclusion of some TTOs) need urgently to be rethought for further development – and prevented.

Against the spirit of the 2017 governmental call, the JSI as the consortium leader managed to join forces with all existing TTOs, small and big, some already in existence for a while and kicking-off and some just created. This was not an easy enterprise: some of the larger PROs in Slovenia were at the time interested in forming an exclusive consortium, leaving the other TTOs out of the loop, preventing their further development. Their idea was that not all the TTOs in Slovenia, but only a selected few should have access to the financial support. Against all odds, thanks to the efforts of the JSI and the timely

support of the Ministry of Science in 2017, this did not happen. In 2017 all of the institutions that could join the consortium, were invited to do so, and the coordinator made their accession possible, although with several difficulties regarding the quality of the official documentation initially provided.

The current KTT project, 2017-2022, comprises 8 partners, all public research organizations (PROs), represented by their respective technology transfer offices (TTOs), namely, 4 leading institutes and 4 renowned universities.

This helped to forge a network of TTOs in Slovenia, striving for development – competing, but under the leadership of JSI with a logic of the utmost inclusivity.

Every operational TTO in the country has its place in this current TTO project and it should remain so.

On the other hand, inclusivity also has its negative issues. In a huge project with many partners not necessarily everything is running smoothly. Sometimes also tensions tend to interrupt the day-to-day business. The issue of research competition, which appears to be rather smoothly managed by the researchers and the PRO leaderships, is often exhibited as a ruthless and futile brawl on the level of the TTOs. Such tensions are enabled and propelled by the fact that besides by the exhaustive expert work of the TTO, results can currently still also be defined and achieved in a political manner as they are not concrete and precise enough.

The situation resembles the Performance Enhancement System (PES) crisis of the Enterprise Europe Network (EEN) from the period 2014-2016, when the European Commission worked tirelessly to improve the standards of the PES results to a solid and concrete set of PES, which can be easily comparable through the EEN partners. The analytics is done by the EASME and is of utmost importance in EEN development and partner improvement. An improvement is sought from the side of the Ministry to enable such monitoring and analysis of the results in a contextual content manner, in addition to the (albeit very complicated) financial monitoring.

Based on this experience and example, the scientific approach to defining the technology and knowledge transfer KPIs is of the utmost importance in Slovenia. In particular it is necessary to enable fair comparison among the KTT partners, based on monitored, unalterable and unique parameters. It is important to ease out the tensions of the unproductive competition in the world where the Technology transfer industry itself needs still to be professionalized. The objective numbers, comparable among the partners, would enable a better standing and a community, focused purely on development instead of power games.

Lastly, a capacity of all partners to accept the creation of a community of equals who do the best they can in their own fields and on their own institutions, without making a special effort to prevent others' excellence, could also be further improved.

There are as of today no confirmed information on prolongation of this financing, thus the same issue as in 2014 will resurface in two years, in June 2022. What comes next? The system has been set up, people have been brought together to create new and larger, operational TTOs, and educated. The government should be urged to officially lay out their plans to enable planning of the TTOs' future activities.

4.3 The Center for technology transfer and innovation of JSI

The Center for Technology Transfer and Innovation at the Jožef Stefan Institute is currently the coordinator of the project KTT (2017-2022), the coordinator of Enterprise Europe Network Slovenia, and is a financially independent unit of Jožef Stefan Institute, Slovenia, involved in many different international projects.

CTT has been the coordinator of the INO projects in 2008, 2009 and 2011, with different partners (e.g. NIB, KI, UM); the coordinator of the KTT project 2013-2014 under the supervision of Ministry for economics and development; and is also the coordinator of the KTT-2 project 2017-2022 under the supervision of the Ministry of Science, Education and Sports. It should be noted, however, that the coordination of the current project KTT-2 was offered by the JSI to all other partners. In particular it was offered to the UL as the largest university in Slovenia, with similar innovation output as JSI. The offer was not accepted, not in 2017 and not in 2020, when it was repeated.

CTT prepared the project documentation and the proposed financing was split according to the size (in research FTE) of the PRO. The UM was awarded extra financing, following its proposal to coordinate the activities of the consortium in the Eastern NUTS3 region of Slovenia, and due to a claim of a significantly higher output than the corresponding one, relative to the research FTE. JSI made this increase possible by reallocating a share of their own budget to the UM. In addition, a share of the proposed KTT 2017-2022 budget was split equally among all 8 partners, disregarding their size in research capacity, to acknowledge that events and public relations activities require the same effort regardless the size of the institution and the level of results offered by the particular PRO.

The employees of CTT helped lobby for such the KTT-2 consortium project in their roles within the Association SI-TT. They worked coherently and tirelessly for more than 15 years towards a common goal: a creation of a network of Slovenian Technology Transfer Offices. This network is now partially operational. These activities resulted in an active consortium of 8 TTOs and JSI and CTT is currently responsible for executing this project financing scheme.

We urge the government to decide about further support of the TTOs in Slovenia as soon as possible to allow for planning of any transition necessary. Apart from the problem that the financing is running out in June 2022 and that the newly employed and trained personnel will need to plan their further existence, there are also two other issues to be covered.

Firstly, even though well informed from the relevant professional body, the Association SI-TT, the Ministry for Science, Education and Sports decided not to include any mention of the need for, existence or possible financing of the Technology Transfer Offices in the proposal for the new Legislative Act on Research, Development and Innovation in 2019. Several corrections have been made to the proposed Act since then, none of them explicitly denoting the role of Technology Transfer Offices in the system.

And secondly, to allow for the creation of spinoff companies with possible financial investments from the side of the Public Research Organizations, high-level parts of legislation would need to be altered, for example the Act on Public Finances. This can only be done with strong political support and understanding of all involved stakeholders, who, to a great

extent have limited understanding of the spinout/spinoff situation. The new Act on Research, Development and Innovation, proposes to overcome this obstacle by overriding the legislative background, but remains yet to be approved.

Thus, to this day, in the absence of legislative changes, there is only one option for successful and fair creation of new enterprises from the institutions of knowledge. This option is the creation of spinout companies with the ultimate requirement for the transparent accounting for the public expenditure.

5. PURPOSE OF THE TTO FINANCING

5.1 Industry relations

The goal of all of the KTT projects was and is to support the industry in Slovenia, rather than an outflow of knowledge abroad or great profit for PROs. Collaboration between PROs and SMEs in Slovenia should be strengthened.

The general process of collaboration [14] is based on several parallel processes. First the internal processes of research institutions need to provide the context and the content of possible collaboration, and with assessments of technology and market the principle decisions are taken. Then the IP rights management can commence. This phase usually lasts for more than two years in which enough time is provided to carry out the processes of finding a domestic or foreign partner for licensing, continuing R&D collaboration or to build up a team for spin-off creation.

Slovenian companies prefer contract and collaborative cooperation to buying licenses and patent rights. Also, a relatively low added value per employee and a low profit margin are not stimulating the research-industry collaboration. On the other hand, Slovenian knowledge, as high profile as it turns out to be in terms of highly cited publications per capita, is small in volume due to Slovenia's small number of inhabitants. As a consequence, the trademark of Slovenian science, IPR or R&D services is not well known abroad.

Primarily domestic, but also international R&D connections should be improved to allow for maximum development of the trademark of Slovenian science for industrial use.

5.2 Creation of new companies from PROs

Companies from PROs can be created either as spinouts (a separate legal entity, which is licensing the IPR from the PRO, but the entity is owned by the inventors) or as spinoffs (an entity owned partially by the PRO, at least in the share of the invested IPR).

The process of building a team for creation of new companies from PROs, involves team building, and education in entrepreneurship. If provided and guided, it can result in spin-off creation, VC involvement and market activities.

Issues, limiting the entrepreneurship activities, are connected to the pull-push principles of technology transfer and the conditions in the state economy. Firstly, the legislation does not allow for the Public Research Organization (with a limited option for the Universities to do so) to co-own and co-manage the newly created business. This severely limits the Organization's interest in the activity. Secondly, even if the creation of spinoffs were allowed, there is a limited capacity of business-oriented experts within the Public Research Organizations, who would be capable of monitoring and steering the spinoff company from the side of a PRO. Too rigid

monitoring from the side of a PRO can ruin the spinoff's prospects for growth. Secondly, the same limitation applies for the consultancy available to the Organization, which is in addition to being inexperienced and partly professional, also costly.

The non-moderated situation with unclear options of the entrepreneurial researchers yields unregistered spinout companies of the Public research organizations. This situation is easily moderated via internal policy acts, structuring the process of company creation according to the current legislative limits. Such processes are in place at least at the JSI and UL, possibly also at other PROs in Slovenia, but not all researchers resort to take such routes.

The legislation should be adopted to allow not only for creation, but primarily for successful management of IPR as an investment in spinout companies.

5.3 Investing into IPR

Intellectual, and for the purpose of this article in particular industrial property, is of high importance for development of particular peoples, companies, countries. Indeed, the use of legally protected intellectual property for development of the country is a strategic decision that cannot be done overnight.

Patent system has many positive and less positive aspects, therefore many experts from various universities call for a reform of this system in order to realise its prime objective – "to support and encourage innovativeness".

Despite the above stated, it is important to invest in patents and other forms of intellectual property (IP). Investments in intellectual property increases licensing opportunities and the IP position of the Slovenian knowledge worldwide.

Currently IP costs can be supported within some national instruments (e.g. RRI, Eureka, some start-up funding initiatives), but mainly for companies. KTT is so far the only instrument enabling financial support for investments into IPR at the side of PROs.

Instruments that support investment - and not merely paying for intellectual property rights - should be further developed in Slovenia.

5.4 Strengthening the TTOs competences

The goal of the KTT project is to establish technology transfer centers in Slovenia as integral parts of PROs, which shall, first and foremost, strive to serve the interests of the researcher and the PRO. The TTOs shall assist the researcher throughout the entire procedure of the industry-research cooperation, by raising competences and educating, taking care of legal and administrative issues, and promote research achievements among the industry. Lastly, TTOs shall support the cooperation already established by research groups.

To achieve that goal, a further stable financing should be provided, divided into two parts: a smaller part to be devoted to further promotion activities (events, brochures etc). The majority of the financing should be devoted to actual market activities leading to capitalization of the created IPR.

It is true that a significant part of knowledge, created by the PROs, is transferred via other paths: teaching, publications, conference, STEM activities. The TTO should be involved in all of those as an information provider, when needed and appropriate.

However, the first and most important task of the TTO should be commercialization of IPR and secret knowledge, as there is no better equipped place or better educated people to do that for the benefit of the PRO and the (domestic) economy.

TTOs competences should be further developed and TTOs themselves further financially supported.

6.   THE KT ACTIVITIES RESULTS: STATISTICS AND METHOD

In the following we present the results of the KT activities in Slovenia in the past decade. Metrics for collection of this data was not comparable in different periods due to different responsible bodies collecting the data and different understanding of what is actually important.

6.1   Incomparable metrics

Results on KT activities, collected during the periods of 2009-2012, 2013-14 and 2017-2019 are very diversified. One of the reasons of the diversification is the way in which the data were collected and the purpose of its collection.

For example, in the category of patents filed, data was not collected in period 2009-2012, in the period 2013-14 the number of patents filed wherever in the world was collected and in the period 2017-2019 the full report patents were sought for.

Only in the period 2009-2012 patents granted were collected and were divided between those granted in Slovenia (without full report) and elsewhere (also possible without full report, but more likely with one).

IP license and sales were collected in all three periods and R&D sales in period 2009-2012 and 2017-2019.

Number of created spinouts were collected in period 2009-2012 and 2013/2014 and not in the last period, as the Ministry for Science (somehow) concluded this was not a result of the work of the Technology Transfer Office.

Table 1: Overview results reported by the TTOs in the periods 2009-12 [15], 2013-14 [11] and 2017-2019* [16]

	Survey: 2009-2012 (36 months)	KTT: 2013/2014) (16.5 months)	KTT: 2017-2019 (24 months)
Patents filed to IPO with full report	/	/	24
Patents filed wherever	/	67	/
Patents granted in Slovenia	87	/	/
Patents granted with report (different patents in the same family count as many)	21		
IP License & Sales	826.417,00 €	86.500,00 €	726.172,00 €
R&D Sales	21.296.785,00 €		2.723.412,00 €
Spinouts	14	6	
Number of employed in SO companies younger than 5 years	18,4	/	/
New companies in collaboration with PROs thought TTOs	/	/	32

Number of employees in the spinouts created in the last 5 years were only collected in the period 2009-2012.

Number of new companies to be put into collaboration with the Public Research Organization was only collected in the period 2017-2019.

Numbers can be found in Table 1.

The overall results can be seen from Table 2, normalized to the length of 1 year.

Table 2: Overview results reported in the periods 2009-2012 [15], 2013-2014 [11] and 2017-2019* [16], normalized per duration of one year.

	Survey: 2009-2012	KTT: 2013/2014)	KTT: 2017-2019
Patents filed to IPO with full report	/	/	12
Patents filed wherever	/	49	/
Patents granted in Slovenia	29	/	/
Patents granted with report (different patents in the same family count as many)	7		/
IP License & Sales	275.472,33 €	62.909,09 €	363.086,00 €
R&D Sales	7.098.928,33 €	/	1.361.706,00 €
Spinouts	5	4	
Number of employed in SO companies younger than 5 years	6	/	/
New companies in collaboration with PROs thought TTOs	/	/	16

6.2   The period 2009-2012

The 2009-2012 numbers were a result of a SI-TT survey [15]. Based on the collected data of the three largest Slovenian public research organizations - institutes and three universities, an analysis of the results of work in the field of technology transfer in the period 2009-2012 has been prepared.

The logic at the time was that the granted patents are of importance, not the filings. The reason for this was an active pursue of the researchers at the time to file as many patent applications at the national Patent Office, as the filing itself sufficed to gain significant extra points according to the national evaluation at the Agency for Research and Development of Slovenia.

The Association SI-TT as an association of Knowledge transfer professionals was at the time also aware of the importance of other KT categories: R&D, licensing and IPR sales contracts, spinout creation. In their survey it went into as much detail as collecting data on actual employees in these companies.

On the other hand, the numbers in this survey were not monitored or cross-checked in any way. They were self-reported by the TTOs to the SI-TT questionnaire and no proof of actual achievement of the numbers was sought for or delivered, thus their accuracy might be limited. Also, the reported data are considered to be the data about the PRO activity as a whole, not about the share of activity in which the TTO was involved.

6.3   Project results 2013-2014

The 2013-2014 numbers are a result of a reporting, done to the Ministry of Economy and Development in autumn of 2014, within the first KTT project, financed by the Ministry.

The Ministry of Economy was financing the project KTT 2013-14 with national financing. It focused on the Licensing and Sales of IPR and on spinout creation. R&D contracts were at the time considered to be less indicative for a TTO activity (and new company creation was considered to be part of the TTO activity) [11].

Some monitoring was done by the Ministry of Economy to seek proof for delivered results, so the results can be considered as partially relevant as for measuring the activity of the TTO (not the PRO as a whole).

## 6.4   Project results 2017-2019

The 2017-2019 numbers are a result of a reporting, done every 6 months to the Ministry of Science, Education and Sports. The results were also presented at the 12th International Technology Transfer Conference [16].

The Ministry of Science sought to finance the KTT 2 project with money from the Structural fund, meaning that a local component with direct benefit for the companies of Slovenia had to be proven during the project.

The overall project goals for 5 years (until July 2022) include 40 patent applications at patent offices that perform full examination; 300,000.00 EUR of income from license agreements; 8,000,000.00 EUR income from contract and collaborative research agreements, and 40 new Slovenian companies served according to the public call [17a].

The consortium has already delivered the required results for the new companies served and the license agreements key performance indicators, and there are reasonably optimistic results achieved in the first two out of five years in terms of number of patent applications and contract and collaborative research relations (50% and 40% of the final mark achieved, respectively) [16].

The data is mainly accurate as an indication of the part of the PRO activity in which the TTO is involved (not the activity of the PRO as a whole). Also, the ministry of Science established a precise set of data and documented proofs to be submitted before confirming the results, thus they can be considered as mainly relevant.
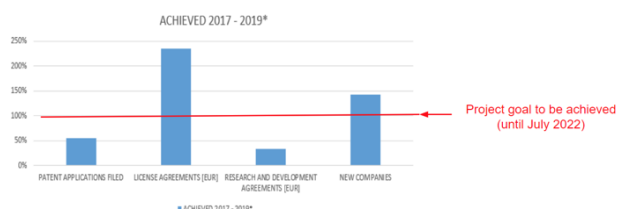
Figure 1: A comparison of 5-year goals and the 2-year performance of the KTT project.

The Ministry of Science in 2017-2019 focused on R&D contracts primarily with national legal subjects, on the new companies brought into collaboration and the national licensing deals. Spinout creation deemed to be out of the scope of the governmental support.

Nevertheless, it is possible that the majority of the reported (as requested) licensing deals are actually being done with unregistered spinout companies of the Public research organizations.

Also, since the Ministry is only monitoring the contracts and not their realization, it is not clear, how much of the reported amounts can actually be considered a PRO income (for incentive distribution).

A huge drop in R&D collaboration can be seen from the data. The KPI of both projects were predefined by the two Ministries. The difference in KPI definitions can be seen from Table 1.

To obtain comparable results in order to estimate the development of the TT profession in Slovenia, it is pertinent to use a similar metrics in every one of the time periods. However, some estimates can also be done when taking a look at the more granular level of data - how the results are distributed over the PROs in a particular year and in which particular fields.

6.5   Scientific output comparison

In an attempt to resolve the reason for the anomalies and drops in performance, an analysis of publicly available data on Research intensity and outputs was performed already in 2015, incorporating financing available to a PRO, its research staff in FTE, number of granted and valid patents (Domestic and internationally) and WoS PRO specific results.

The data was collected from yearly reports of the largest Research organizations in Slovenia: JSI, UL, UM, UP, KIS, KI, NIB and UNG, Thomson Reuters Database as of 1.10.2015, URSIL database as of 1.10.2015, ARRS webpage with financial data as of 1.10.2015, SciVal as of 1.9.2015 Web of Science as of 1.9.2015. The 8 institutions covered 79.07% of the ARRS budget at the time, meaning that 20.93% of the research institutions, financed by the ARRS were not covered by this survey. Number of students at the Universities was not considered as a relevant indicator, as the IPR generated by the students is not owned by the Universities. In addition, number of employees was also not considered, as the employments can range from a full FTE to just a few percent of work obligation, which cannot be treated equally. Also, in the category patents granted at least one university included patents granted to employees (and not the institution itself).

Results of the survey are shown in Table 3 below.

The results show a discrepancy between the amount of financing received for R&D activities from the Slovenian Agency, the number of FTE employed to perform the R&D work (teaching staff FTEs are not included) and the output in terms of number of valid and granted Slovenian patents, number of valid and granted foreign patents and number of publications. In this comparison, data on R&D contracts could not be obtained from public sources.

Table 3: 2015 Quality assessment of 8 Slovenian Research organizations made on the basis of the publicly available data.

ORGANIZATION (RO)	ARRS financing	SHARE OF FINANCING of projects / lines from ARRS funds from 8 Ros	number of employees of research FTE in JRO - group H as at 31.12.2013 *	SHARE – FTE	number of valid SLO patens as of September 1, 2015	number of granted SLO patents last 20 years	SHARE FROM QUALITY - SLO patents	number of valid foreign patents as of September 1, 2015	number of granted foreign patents in the last 20 years	QUALITY - FOREIGN patents	WoS publications - articles (2014, KI, UP 2013, NIB average of two quarters * 2) -no necessarily comparable source	SHARE from QUALITY - articles
UM	€9,796,995.78	8.9%	183	8.32%	27	65	15.86%	3	4	16.67%	550	16.92%
IJS	€32,035,245.37	29.1%	723	32.88%	44	122	28.62%	4	9	30.95%	808	24.85%
UL	€45,702,306.53	41.5%	830	37.75%	50	132	31.38%	3	8	26.19%	1230	37.83%
NIB	€3,950,023.57	3.6%	87	3.96%	1	5	1.03%	1	1	4.76%	118	3.63%
KI	€10,228,268.95	9.3%	192	8.73%	32	92	21.38%	5	19	19.05%	281	8.64%
KIS	€2,368,780.14	2.2%	50	2.27%	3	3	1.03%	0	1	2.38%	38	1.17%
UP	€4,061,256.28	3.7%	119	5.41%	0	0	0.00%	0	0	0.00%	196	6.03%
UNG	€1,866,639.01	1.7%	15	0.67%	1	3	0.69%	0	0	0.00%	30	0.92%
TOTAL	€110,009,515.63	100.00%	2199	100.00%	158	422		14	28		3251	

As the data covers 79,07% of all national research financing from the ARRS, it is indicative and helps us understand the distribution of knowledge transfer activities throughout the majority of the STEM oriented PROs in Slovenia. The discrepancies could assist us in understanding the year to year difference in performance as shown in Table 1 and Table 2. Further research should be done in this domain.

7.   FURTHER DEVELOPMENT

At the general level, primarily domestic, but also international R&D connections should be improved to allow for maximum development of the trademark of Slovenian science for industrial use.

The legislation should be adopted to allow not only for creation, but primarily for successful management of IPR as an investment in spinout companies.

Instruments that support investment and not merely paying for intellectual property rights should be further developed in Slovenia.

TTOs competences should be further developed and TTOs themselves further supported.

Projects funded from the ERDF funds, such as KTT 2017-2022, often have relatively complicated reporting, which represents an administrative work load for TT managers and results in a diminished amount of financing spent from the ERDF in the project as a whole. The Ministry of Science needs to establish a coherent financing over the years, which is not project based.

In the Slovenian case, the Proof of concept fund is not established, which prevents research entrepreneurs to develop their inventions further towards the market. Continuing support of the Ministry and their collaboration with the SID bank could lead to a breakthrough in this domain. The SID bank should continue with a steep pace the creation of the fund to be established by the end of the 2021.

There is a lack of support for spinouts. Start-ups can enter easily a technology park and perform a day-to-day business; in contrast, a spinout has to carry out many internal procedures within the PRO from which it originates in order to start operations. On the other hand, the scale-up phase is well supported (for example, by the national project SIO). Spinout support should become part of the Technology and Knowledge Transfer policy in Slovenia.

The Slovenian legislature (ZIDR) provides incentives for inventors, when the invention is licensed or sold (min. 20% of gross royalty, in practice around 33% of net royalty). There is a lack of recognition for Technology Transfer (TT) managers (compared to inventors). The Ministry of Science should make sure that the incentives for TT officers should become part of the legislation governing the incentives for researchers.

Professionalization is also sought for. For example, the Council for science and technology (SZT) should follow the lead of the European Commission and involve not only researchers and industrialists, but also technology transfer professionals into their developments of the policy inputs. As such, the current SZT lacks a very important component, and that is the knowledge and experience of the man or the woman in between the worlds. The European Commission has already rectified this in the past years, where the TT experts participate very successfully in several high-level Advisory Boards and Expert groups. The Slovenian government should follow that lead.

Last but not least, technology transfer needs stable funding, as a TTO is generally not able to finance itself – apart from the rare cases where industry buys high licenses (a large license can support a TTO for up to 10 years), and this is not applicable to Slovenia with its IP reluctant SMEs with lower than average EU27 technology absorption capacity.

In case when the TTO is supported by the government, it is important that there is good cooperation between the TTO and the government (not just administrative supervision but also content guidelines for future work, content analysis, KPI definition fine tuning, including the development of a toolbox for successful technology transfer as a collection of contracts, good practices and business models.

In essence, a TTO is an important part of the innovation chain and has to be recognized as such.

8. CONCLUSIONS

This paper was written to give an overview of the history/genesis of the current Slovenian technology and knowledge transfer system, unfolding several issues that will need to be addressed in the future to make the knowledge transfer and innovation system of Slovenia to become fully operational. The mistakes made during the short, but significant history od knowkledge and technology transfer in Slovenia, mustn't be lost or else the same mistakes will be repeated. The paper thus describes the effects of having project-based funding of TT with varying scopes and focuses:

i. The lack of continuity makes it hard to keep staff and develop competences over long time;

ii. Changing focus leads to changes in direction (what you measure is what you get) and the mixture of results of the TTOs in Slovenia in the past decade nicely shows the effect of the changing policy;

iii. It becomes hard to keep track of the overall development of TT in Slovenia, which needs to be improved in order to enable quality control.

iv. Exact and exactly measurable KPI should be determined to prevent the reporting manipulation of the support system and the PROs.

v. Constructive, systematic, sustainable, inter-connected and consistent solutions should be sought for, without excluding TTOs. They are players in the field of public research organizations support.

In other countries, the political systems have tended to fund the start-up phases of TT, but they have also had an expectation that PRO's would take over responsibility with time. This has not always happened. Even if the basic funding of the TTO office is secured by the government or PRO, the missing PoC link funding often has to continue on national/regional level for many years for TT to mature. Also, Seed funding for spin-outs is also a long-term need that may require political support.

The recommendations of the paper require further thoughts on the need of priorities for government intervention. These priorities will hopefully be set by the governmental/political structures in Slovenia through the new law on scientific research and innovation activity. The law is at the moment being coordinated interdepartmentally within the Slovenian government. However, the principles and the recommendations and the priorities should then also be followed by the PROs.

Last but not least, Technology transfer is a young discipline. There should be a sensible amount of healthy competition also in Technology transfer. However, this competition should remain cordial and motivational, and avoid any destructive steps, especially if for the purpose of self-promotion.

Having created a Scientific Section to address the issues of Technology and Knowledge transfer within the 13th International Technology Transfer Conference, clearly shows the opportunity for further joint research (nationally and worldwide, and beyond mere best-practice examples) on technology and knowledge transfer from a scientific point of view, influencing the entrepreneurship potentials and setbacks of the researchers and businesses.

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Patents on plasma treatments in agriculture

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ABSTRACT

Patents in the field of plasma agriculture are analyzed in this paper. The first patent application in this technological niche appeared in 1995 and disclosed a method for seed treatment using non-equilibrium gaseous plasma. Since then, over 60 patents were filled in different countries, representing about 7% of published scientific papers in journals indexed by the Web of Science. About half of the patent applications were submitted to the Russian office, followed by Chinese, US, and Korean offices. Five or six patent applications have been submitted annually in the past few years. No Slovenian application has been registered so far.

Keywords

Plasma, agriculture, patent, search

1. INTRODUCTION

Plasma agriculture is among the most promising fields of scientific research and industrial developments. It is an interdisciplinary niche where non-equilibrium thermodynamics meets farming and food industry. There are hundreds of research groups currently involved in developing plasma techniques to treat seeds, plants, crops, storage and packaging devices, food, and feedstock. Many are academic, and they are concentrated on chemical and biological modifications caused by plasma treatment. Some groups have studied the influence of plasma treatment on germination and growth of plants. Few groups have also performed field experiments and studied the role of plasma parameters on the amount and quality of crops. Indirect treatments are popular, too. In such cases, either water for spraying or watering plants is treated by gaseous plasma or soil is treated. The influence of plasma processing on the water-soaking capacity or microbiological picture is studied.

2. PLASMA SEED PROJECT

The project is focused on the development of methods for seed treatment and lasts about 3 years. The following partners are involved in developing a device suitable for treating seeds in the continuous mode: Interkorn Ltd. (Beltinci), Department of Surface Engineering, Jožef Stefan Institute (Ljubljana), Trac Ltd. (Šentjernej), Žipo Lenart, National Laboratory of Health, Environment and Food (Maribor), and Institute of Agriculture and Forestry (Maribor). The project coordinator, Interkorn Ltd., is the largest provider of seed coatings in Slovenia. It provides processing of seeds from separation to cleaning and deposition of various coatings. Processed seeds are further distributed among farms. Quality control and ecological production are among the company's priorities. The company produces and treats seeds of corn, wheat, barley, other cereals, and soybeans. The treatment of seeds is performed on an automated line, which allows for a high quality of processing and traceability of seed batches. It has almost 100 regular customers who provide feedback about harvesting and storage. The company has specialized in treating seeds to protect them against fungi (molds), worms, and birds to enable optimal harvesting. The unique coatings are adopted for use in the west Pannonia region, which has specific climate and soil conditions and ecosystem. The company also provides services for seeds' treatment before storage to minimize the proliferation of molds, which may produce toxins that are harmful to humans and animals. The scientific coordinator is Dr. Nina Recek, a researcher of the Department of Surface Engineering at Jozef Stefan Institute. Other project partners are involved in research

on plasma-seed interaction and development of different components for a prototype of the line, which will be used to treat various seeds in the continuous mode. The goal of plasma treatment is to disinfect seeds and improve water uptake and, thus, faster germination as compared to untreated seeds.

3. LITERATURE SURVEY
3.1 Scientific papers
Over 900 scientific papers have been published in journals ranked in the Web of Science. At the time of writing this document, 23 papers are highly cited in the field – received enough citations as of March/April 2020 to place them in the top 1% of their academic fields based on a highly cited threshold for the field and publication year. One paper is labeled as "hot paper" – such papers were published in the past two years and received enough citations in March/April 2020 to place them in the top 0.1% of papers in its academic fields. The majority of these papers deal with scientific aspects, but some also report experiments in the fields. The number of papers rewarded with "highly cited in the field" for the past decade is presented in Figure 1.
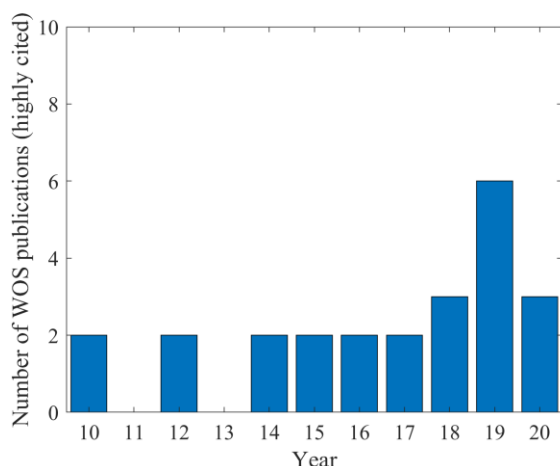
Figure 1: Number of highly cited papers in the field published in the last decade.

The number of scientific papers published in journals indexed by the Web of Science for the past decade is plotted in Figure 2. One can observe a graduate increase in the published papers. The number of papers published per year has tripled in the last decade, which indicates the scientific importance of the interdisciplinary field of plasma agriculture.
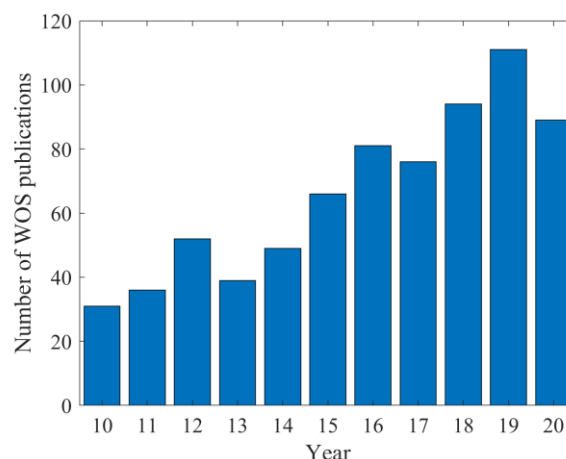
Figure 2: Number of scientific papers published in the past ten years in plasma agriculture.

3.2 Patent applications
While the number of scientific papers indicates the scientific importance of the subject, technological importance is revealed from the patents applied at various patent offices worldwide. The first patent in the field of plasma agriculture indexed in the ecpacenet database has the priority date 1995-07-05 [1]. The patent by Filippov, Bitjutskij, and Fedorov discloses a method for pre-sowing seed treatment. The method provides plasma treatment of seeds with low discharge intensity and pressure of inorganic gas, resulting in increased nutritive value of products and reduced power consumption. Since this pioneering work, numerous patents have appeared. Figure 3 represents the number of patents filed per year. The number is slowly increasing. By the time of writing this paper, as many as 67 patent applications appeared in the database. One of the last applications was also Russian [2]. Disclosed is a method for grain disinfection, which involves exposure of the treated grain to a stream of cold plasma at atmospheric pressure. Cold plasma flow is generated due to negative corona discharge between anode and cathode with pulsed voltage in air. Grains with the moisture content of 7-14% are placed on the anode surface and treated for 10 minutes. According to the authors [2], the invention provides a stable disinfecting effect when processing grain (for food and sowing) intended for storage.

Russian inventors are particularly active in filing patent applications in the field of plasma agriculture. Figure 4 reveals the number of patent applications submitted to patent offices in different countries. The Russian office received as many as 33 applications. Next on the graph is the Chinese office with 20 applications, followed by the US office (6 applications) and the Korean patent office (3 applications). Other patent offices received only one application each.
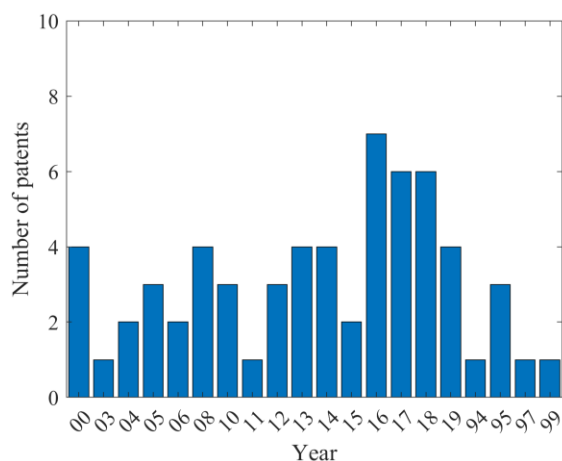
Figure 3: Number of patent applications registered in the Espacenet database.

Of particular importance are patents on the indirect treatment of seeds, usually treating a liquid by gaseous plasma and then soaking seeds in plasma-treated liquid. For example, RU2702594 (C1) [3] discloses a method of activating water or aqueous solutions. The method involves exposing a particular volume of treated water or aqueous solutions to plasma. Contactless activation is carried out. Water or aqueous solutions are exposed to a continuous electrodeless plasma flame created by a UHF-plasmatron, which generates a low-temperature plasma jet in a vapor-gas medium at atmospheric pressure. Device for contactless plasma activation of water or aqueous solutions contains a flame UHF-plasmatron with a capacitive coupling, which includes a magnetron and rectangular as well as coaxial waveguides. The coaxial waveguide is hermetically isolated from the rectangular waveguide by a radio-transparent quartz tube-insulator. The central conductor of the coaxial waveguide is a copper tube configured to supply plasma-forming gas and ends with a nozzle with a hole to form a directed jet of plasma-forming gas. The working part of flame UHF-plasmatron is placed through the seal into a sealed chamber containing a vessel with treated water or water solution fixed on a rod-elevator. The invention provides contactless plasma activation of water or aqueous solutions, enables the exclusion ingress of electrode material into the activated liquid, and provides a high degree of purity of treatment and safety.

A similar device useful not only for water treatment is disclosed by Hummel et al. in the patent application submitted to the US Patent Office [4]. Here, methods and systems for generating a plasma-activated liquid or gas and applying the plasma-activated liquid for agricultural use are disclosed. A system embodiment includes a hand-held device that can be pointed and directed at different target areas of a plant. A method embodiment includes generating a plasma discharge in a gas environment or a liquid environment and applying the gas or liquid to a plant.

Another method for plasma treatment of water is disclosed by Rothschild [5]. The invention generally concerns a machine that creates and infuses charged air products into a flowing water system. A plasma discharge is not in direct contact with the flowing water but is separated from the plasma by a void volume space. The resulting activated water may be used as an industrial wash, antibacterial wash, a medicinal drink, or can be used in agriculture, e.g., for irrigation of crops, plants, or seed treatment.

Nevertheless, another method for the treatment of liquids by gaseous plasma is disclosed by Chieh [6]. An agriculture plasma liquid apparatus includes an inlet pipe, an outlet pipe, an air inlet port, and a plasma liquid generating device. The diameter of the inlet and outlet pipes is rather large. The plasma liquid generating device is connected to the air inlet port to suck air from the air inlet port, communicates with the inlet pipe and the outlet pipe to import liquid flow from the inlet pipe and generate plasma particles into the liquid flow outputting through the output pipe. This solution is useful since many bubbles are formed within the innovative device, so the contact area between gaseous plasma and liquid is large compared to standard solutions.

A more powerful device for the treatment of water with gaseous plasma is disclosed by Lu et al. [7]. The utility model discloses a high-temperature thermal conductance water plasma generation system. Its structure includes high-temperature thermal conductance water plasma generator group, waterway system, and thermal energy system. The central part of the high-temperature thermal conductance water plasma generator is a high-temperature heat pipe, including an inner tube and urceolus. The high-temperature heat transfer medium is mounted between the inner tube and the urceolus at the bottom. The waterway system constitutes a water tank, filter, high-pressure unfamiliar water pump, solenoid valve, and hot water tank. The thermal energy system includes an oil tank, a high-pressure oil pump, an oil flow control valve, a fuel nozzle, and an electronic ignition wire that gradually connects. The high-temperature thermal conductance water plasma generation system causes water decomposition, so the water is transformed into a gaseous plasma rich in hydrogen and oxygen. The device is very efficient. According to inventors, more than 90% of water passing the device is converted. This device can extensively be used for engines, industry and civil boilers, agriculture, chemical industry, and even medicine, as claimed by the authors.

Rocke and Wandell disclose a simultaneous on-site production of hydrogen peroxide and nitrogen oxides from air and water in a low power flowing liquid film plasma discharge for use in agriculture [8]. A reactor system that includes a single reactor or a plurality of parallel reactors is disclosed. A method that includes: injecting a mixture including liquid water and gas into at least one electrically-conductive inlet capillary tube of a continuously flowing plasma reactor to generate a flowing liquid film region on one or more internal walls of the continuously flowing plasma reactor with a gas stream flowing through the flowing liquid film region, propagating a plasma discharge along the flowing liquid film region from at least one electrically conductive inlet capillary to an electrically conductive outlet capillary tube at an opposite end of the continuously flowing plasma reactor, dissociating the liquid water in the plasma discharge to form a plurality of dissociation products, producing hydrogen peroxide and nitrogen oxides from the plurality of dissociation products. Both nitrogen oxides and hydrogen peroxide are useful for the sterilization of agricultural products in an ecologically benign manner.

Go and Lim [9] presented an invention related to a plasma generator for agriculture and stockbreeding. The plasma generator comprises a pair of main bodies, disposed of in an upper portion and a lower portion with a predetermined gap between, a plurality of electrode rods, installed in a direction perpendicular to the pair of main bodies and evenly spaced, an electrode plate installed in a direction perpendicular to the pair of main bodies installed behind the plurality of electrode rods with a predetermined gap between, an electrode sheet disposed on the electrode plate spaced apart from the plurality of

electrode rods with a predetermined gap between, configured to generate plasma due to a reaction between a plurality of electrode rods and current, and an insulating plate interposed between the electrode sheet and an electrode terminal provided on the electrode plate to prevent moisture from being introduced into the electrode terminal. The plasma generator produces reactive gaseous species and radiation in the ultraviolet and vacuum ultraviolet range of wavelengths, which was found beneficial for sterilization or at least disinfection of different products.

Lee [10] invented a technique for sterilization of water using gaseous plasma technology. The invention relates to a water sterilization device for agriculture and fishery having a variable plasma device that reduces the costs of production by simplifying an existing plasma generating device. It also raises the productivity of agriculture and fishery and enables the use of seawater and freshwater for agriculture and fishery by properly sterilizing harmful bacteria existing in the seawater and freshwater by controlling the quantity of plasma through frequency variability. The water sterilization device for agriculture and fishery having a variable plasma device according to the present invention comprises a power supply device for supplying power necessary for the device, a water pump for receiving power from the power supply device and introducing water, a variable plasma generating device for sterilizing water being introduced from the water pump by generating plasma and controlling the strength of generated plasma by controlling the frequency of power supplied, a first connection pipe having one side intercommunicating with the water pump and the other side intercommunicating with the variable plasma generating device, a sterilized water storage tank for storing water sterilized and discharged by the variable plasma generating device, a second connection pipe having one side intercommunicating with the variable plasma generating device and the other side intercommunicating with the sterilized water storage tank, a pollutant and foam discharge device installed on the top of the sterilized water storage tank to discharge foam and ozone, and a sterilized water discharge hole installed on the bottom of the sterilized water storage tank to discharge sterilized water in the sterilized water storage tank.

Liu et al. disclosed a method for improving the germination of Stevia rebaudiana seeds. The method relates to a crop seed treatment technique in the technical field of agriculture. The method comprises the following steps: selecting and sterilizing seeds, preparing 6 to 8% aqueous solution of polyethylene glycol, soaking seeds into the prepared solution at the temperature between 20 and 30 °C for 24 to 48 hours, then filtering seeds, cleaning seeds by using clear water, and airing seeds for later sowing. It is generally recognized that molecules of the polyethylene glycol can change biological membrane structures of various cells in cell engineering, in a way that lipid molecules on a plasma membrane at a contact point of two cells are dispersed and recombined. These molecules can also change the osmotic regulation capability of plants, influence on plant physiology and are favorable for absorbing nutrition and inducing the activity of stimulation cells. The method can remarkably improve the capability of resisting adverse situations when the Stevia rebaudiana seeds are germinated so that these seeds still maintain a higher germination rate and germination energy in adverse situations.

As early as in 2007, Russian inventors disclosed a technique for treating fruit [12]. The processing and storage of fresh-cut vegetables, berries, fruits in agriculture, food-processing, and related branches of industry is disclosed. The method involves washing fruit and vegetable products with water preliminarily activated in one or two electrode chambers of one or more

diaphragm-type electrolysis units. Further removing water remained on the surface of products after the washing process by blowing with the use of gaseous plasma flow until complete removal of water is achieved. Plasma is produced in a medium of inorganic gas or a mixture of inorganic gases at a frequency of electromagnetic field of 4-40 MHz and at specific electromagnetic power of plasma discharge. Apparatus has at least one washing chamber, one drying chamber, one or more transportation mechanisms, one or more diaphragm-type electrolysis units with power sources, a plasma source with two electrodes, a plasma guide, a high-frequency generator, one or more reservoirs for inorganic gas, and vacuum oil-free pump. The effect of this method is prolonged shelf life of fruit and vegetable products.

The search for patents, as presented in this document, indicates that both direct and indirect plasma treatment result in a good finish of agricultural products. The indirect plasma treatment has a definitive advantage that treated material is preserved since the products are exposed to radicals only (not to powerful gaseous discharges). On the other hand, direct plasma treatment is faster since the concentration of reactive species within the plasma is, by definition, more substantial than in any medium treated by plasma. The users can choose between these two extremes or use a combination of direct and indirect treatment. In such a case, the liquid can be treated with a powerful discharge, while products are exposed to mild plasma conditions.
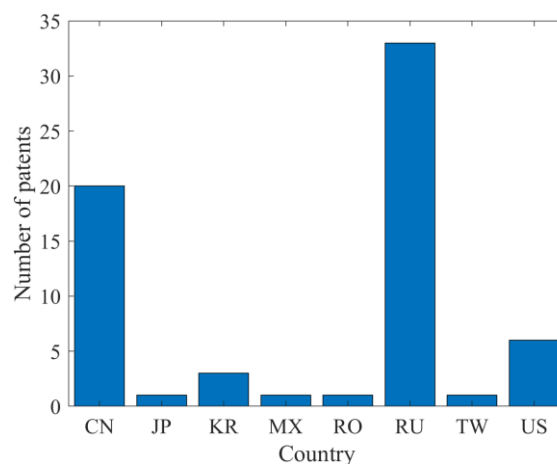
Figure 4: Number of patent applications registered in different countries.

4. CONCLUSIONS

Several innovative techniques have been protected with patent applications in the interdisciplinary field of plasma agriculture. The most innovative countries are China and Russia. The patent applications span from direct treatment of seeds, plants, or crops to indirect treatments using gaseous plasma to modify the chemical properties of liquids. Several techniques are applicable on a large scale, but the beneficial results in terms of improved germination, growth, or better quality or quantity of crops are rarely reported. Plasma agriculture, therefore, remains a technological challenge. Although the scientific literature reports better germination of seeds treated by gaseous plasma either directly or indirectly, the descriptions of patented solutions lack of quantitative reports. In most cases, patent literature does not mention any field experiments, so it is not easy to judge direct applicability. Another deficiency of patent literature is the lack of details about the exact treatment parameters. The patents disclose types of discharges used for

plasma generation but hardly mention the useful range of discharge parameters.

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Rare earth-based permanent magnets: A proposed way to the circular economy

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ABSTRACT

Critical raw materials, especially the rare earth metals like Dy, Nd, Sm, and recently also the transition metal Co are becoming more and more important to Europe's future energy independence, and offer the ability to be competitive in smart mobility and renewable energy innovation. The primary goal of the efforts from the Department for nanostructured materials from Jožef Stefan is to implement the state-of-the-art laboratory-developed & economically efficient technologies for the recycling and reprocessing of critical metals from end-of-life products. The aim is to integrate them into industrially relevant processes in order to reduce Slovenia and Europe's dependence on economically and strategically sensitive supplies and to increase their competitiveness on international markets.

This article depicts a strategic issue of the European Union in the field of technology transfer, which should benefit the research community and the economy. However, this issue is not being addressed at the proper level: the scientists and industry are working to solve the technical problems, but are not supported sufficiently on the political level.

Keywords

Critical raw materials, rare earth elements, permanent magnets, Nd-Fe-B, Sm-Co

POVZETEK

Kritične surovine, zlasti redke zemeljske kovine, kot so Dy Nd, Sm in v zadnjem času tudi prehodna kovina Co, postajajo vse pomembnejše za prihodnjo evropsko energetsko neodvisnost in ponujajo sposobnost konkurenčnosti na področju pametne mobilnosti in inovacij iz obnovljivih virov energije.

Primarni cilj prizadevanj Oddelka za nanostrukturne materiale Jožefa Stefana je uvajanje najsodobnejših laboratorijsko razvitih in ekonomsko učinkovitih tehnologij za recikliranje in predelavo kritičnih kovin iz izrabljenih izdelkov. Cilj je vključiti jih v industrijsko pomembne procese, da bi zmanjšali odvisnost Slovenije in Evrope od ekonomsko in strateško občutljivih zalog ter povečali njihovo konkurenčnost na mednarodnih trgih.

Članek prikazuje strateško vprašanje Evropske unije na področju prenosa tehnologije, ki bi moralo biti v korist raziskovalni skupnosti in gospodarstvu. Vendar se to vprašanje ne obravnava na ustrezni ravni: znanstveniki si skupaj z industrijo prizadevajo rešiti tehnične težave, vendar na politični ravni še niso dovolj podprti.

Ključne besede

Kritične surovine, redkozemeljski elementi, trajni magneti, Nd-Fe-B, Sm-Co

1. INTRODUCTION

EU plans for the transition to a low-carbon society and energy efficiency by 2050 (the so-called European Green Deal) [1] will require radical solutions, especially with the aim of reducing greenhouse gas emissions, which are projected to reduce by as much as 80%. The segments that will contribute the most are the development of green energy and electric mobility. The latter will require highly efficient electric motors to achieve this goal. The efficiencies of electric motors (mass versus efficiencies) based on permanent metal magnets of rare earth elements (such as $Nd_2Fe_{14}B$ and $SmCo_5$, Sm_2Co_{17}) both sintered and bonded are known to be higher than induction motors, which contributes mainly in terms of miniaturization of devices with preserved or even improved efficiencies. From this point of view, permanent magnets are a hot subject to further research with the aim of improving their state-of-the-art properties. However, rare earth metals based on rare earth metals are on the list of the most Critical Raw Materials (CRM) important for the EU, which will require their comprehensive treatment in the form of their complete use without and waste

and their efficient recycling of both systems using novel recycling processes that are being developed on the department.

2. CRITICAL RAW MATERIALS

2.1 EUs dependency on critical raw materials and their applications in permanent magnets

One of the major problems EU has been facing since 2011 is ensuring a sustainable access to Critical Raw Materials [2], in particular elements of the lanthanide group, i.e. rare earths. The group understands 15 + 2 elements, the most characteristic and useful of which are permanent magnets: Neodymium, Samarium, Dysprosium and Terbium with lately also Co, that is a transition metal. A key factor influencing that is their natural abundance and related production in only a few countries, such as China, Brazil, Russia, Australia and the Democratic Republic of Congo. Limited access and the political manipulations concerning the CRM issues are attributed to the way some of these countries use trade and tax policies to reserve their natural resources exclusively for their own use. China for the moment controls as much as 84% of the world's rare earth mineral production. Although the trade restrictions that have peaked in 2011 have declined at the moment, fear of a new material crisis still persists.
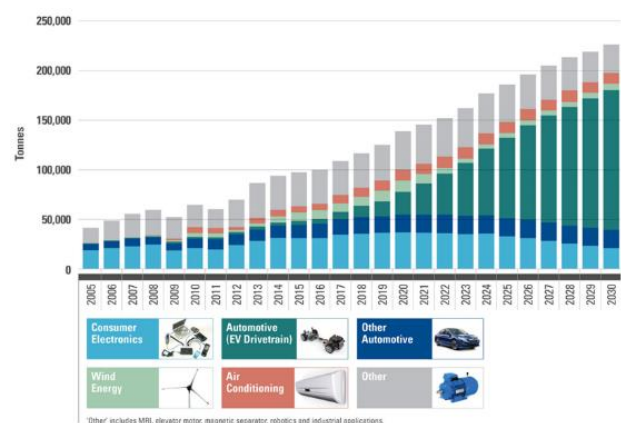
A Figure 1: Current consumptions of Nd-Fe-B PMs by application and future predictions [3]

A key component of the Europe Green Deal is to accelerate the "transition to sustainable and smart mobility", as transport accounts for a quarter of CO_2 emissions. That is why the electrification of the transport system is receiving large investments and research at the global level. Company Tesla, as the first mass producer of electric vehicles alone, is increasing production to 500,000 vehicles by the end of 2020 and with the expansion of its production plant in Shanghai and the opening of a new one in Berlin in the coming years reached as many as one million new e-vehicles on the market. Also, other major car manufacturers such as Toyota, Honda, Kia, Renault e.g. invest significantly in development and e-production. Volkswagen alone is expected to produce as many as 1.5 million e-vehicles by 2025. In 2011, the EU gave priority to rare earths as the most critical CRMs, but in the years since, it has focused mainly on permanent magnets made out of them based on two alloy systems, namely neodymium-iron-boron (Nd-Fe-B) and samarium-cobalt (Sm-Co). The latter systems are given the highest priority, as they are crucial in e-vehicles in their drive motors, servo controllers, starting motors and regenerative brake generators. The projected consumption and use of permanent magnets based on Nd-Fe-B and Sm-Co is shown in Figure 1. Today, the industry consumes 50,000 tons of these

magnets for powertrains in e-vehicles, and consumption is expected to grow to 150,000 tons in the next 10 years. Here, the EU is in a difficult position, as it has no active rare earth mines, so it has to import up to 90% of rare earth-based permanent magnets, while European producers of permanent magnets can be counted on the fingers of one hand. Here, Slovenia is strongly represented by two manufacturers of permanent magnets, namely Magneti Ljubljana d.d. and Kolektor Group d.d., which have managed to maintain a competitive advantage to this day, that gives Slovenia and enormous potential and advantage.

2.2 Novel solutions in Rare earths-based permanent magnets circular economy

2.2.1 The state of the art of the technology

From SICIRS it is evident that, diverse methodologies for recycling Nd-Fe-B magnets have been summarized in detail by many authors [4,5,6]. The recycling approaches can be broadly classified into physical/mechanical processing, pyrometallurgical and hydrometallurgical separation & recovery. Physical/mechanical processing, including resintering [7,8], hydrogenation disproportionation desorption and recombination [9-11], of sintered Nd-Fe-B magnet scrap will typically have a smaller environmental footprint compared to recycling routes, which rely on stripping of the REEs. The pyrometallurgical routes can be used to remelt the REE alloys and extract the different REE in the form of oxide, halide, fluoride or other metallic compound which can then be reduced to metallic form [12-17]. However, these pyrometallurgical processes operate at a temperature of around 750–950 °C and are thus energy intensive. Hydrometallurgical recycling processes designed for Nd-Fe-B magnets are promising due to the mild operating temperature, relatively simple equipment and the continuous separation ability [18, 19]. In hydrometallurgical processes, however, Nd-Fe-B magnets are completely dissolved with an acid. The roasting pretreatment at 900 °C is generally required. Iron, which is the major component of Nd-Fe-B magnets (60–70%) consumes large amount of acid, alkali and other precipitation agents that cannot be recycled in the whole process [5, 19]. REEs are concentrated by solvent extraction and then are precipitated with either oxalic or carbonic acid. The precipitate is further calcined at 950 °C to form REOs, which can then be returned to the initial manufacturing process for Nd-Fe-B magnets [20]. We also reviewed the patent documents using the queries below, from Patbase document system. Results were the following: The most populated field is the one including (($Nd_2Fe_{14}B$ or NdFeB or Nd-Fe-B) as earth particulate material)) in the title or abstract AND FT=(grain boundary*) anywhere in the text. This yielded 97 patent families. On the other hand, using earth particulate material)). Yielded some less, 74 families. On the other hand the search showed that (($Nd2Fe14B$ or NdFeB or Nd-Fe-B) and single crystal anodic etching is a rather unpopulated field with 0 patent families present at the moment and that our technology is not only operational, but worth exploring in the sense of novelty.

In the proposed method the $Nd_2Fe_{14}B$ grains are recovered by electrochemical etching of the bulk sintered Nd-Fe-B magnets or magnet scraps using an anodic oxidation process presented in Fig. 2 [21,22]. In this process the metallic Nd-rich phase in the grain boundaries is oxidized to Nd^{3+} as ions on the anode. The liquid electrolyte used in this process is formed of a non-aqueous solvent in order to prevent the $Nd_2Fe_{14}B$ grains from oxidation. This allows direct reuse of the collected $Nd_2Fe_{14}B$ grains for new magnet making.
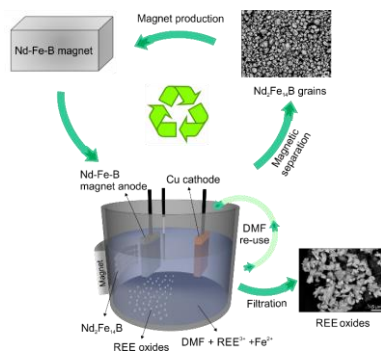
Figure 2: Selective electrochemical etching for recycling of Nd-Fe-B permanent magnets

2.2.2 The economics of the recycling

One of the purposes of the paper is show that although the magnets are needed in Europe, the fact that the rare-earth elements come mostly come from outside Europe presents an intriguing moment in the development of the technology transfer processes in Europe, in line with the recycling recommendations.

The economics of the process of recycling in the field of the rare earth magnet shows that investing into some local technology that would enable extraction from recycled components would benefit the environment and the countries of the EU that do not poses rare earth material sources. However, also such advanced recycling would still carry costs that result in 'virgin materials' being cheaper. Thus, considering the economics of the processes and the recommendations of the EU, we must conclude that the changes into a sustainable economy will remain impossible without legislative changes within the EU that are crucially needed to encourage this activity and contribute to the circular economy.

Thus, as a result of our research, we would like to propose some concrete measures to improve the position of the recycling processes of the rare earth metal components in the EU.

A novel recycling route for end of life (EoL) Nd–Fe–B magnets is thus proposed based on the electrochemical etching. Electrolyte can be recovered by distillation and re-used in a closed-loop thus minimizing safety risks and environmental impacts. Upon that the overall REEs mass balance from the initial magnet is 100% preserved that forms a circular economy. The total energy consumption of the magnet-manufacturing process using the proposed electrochemical recycling route is estimated to be ~2.99 kWh kg–1, which is much lower than hydrometalurgy (30.0-33.4 kWh/kg) and directly comparable to direct reuse (3.0 kWh/kg) [8], if we consider the conventional additive of the Nd–Pr hydride (4 wt.%), inclining to as feasible possible production, albeit very green and sustainable. We have shown that recycling process costs are actually a barrier in enlarging the usage of such processes industrially in the EU. Thus we propose a more targeted intervention that would tip the balance towards the recycling processes not only in regard to the rare earth materials, but all that are not applicable in significant enough amounts to be economically viable. The situation could greatly be improved if the EU could import the relevant waste from other regions of the world, which would enable cost reductions of the processes, based on the quantity. On the other hand, the EU could even – maybe – become self-sufficient in the supply of the rare earth materials. This is also a policy that would provide a significant and a wide-ranging impact in other European recycling technologies, dealing with economically negligible amounts of waste that do not prove economically sustainable for recycling.

2.2.3 The solutions to be used for sustainability

Persistent measures to achieve greater sustainability and independence from external suppliers, thus include, among other things, the recycling of industrial wastes and end-of-life products. Permanent magnets based on Nd-Fe-B and Sm-Co systems (as Co, as it is similar to rare earths subjected to major political and economic manipulations) due to the high content of these metals represent the most valuable secondary source of these raw materials. Currently, less than 1% of all rare earths used are recycled, mainly because they are dispersed in many applications, and are difficult to extract. A lot of labor force is therefore needed and the economic calculation does simply not add up.

Currently, the only way to recycle rare earth-based permanent magnets from waste streams of electrical and electronic equipment is by crushing and recycling using physical, chemical or pyrometallurgical pathways, which are costly, energy consuming and environmentally unfriendly. Upon that the developed novel feasible and green solutions for recycling REEs-based permanent magnets are of tremendous impact. The proposed technology for selective PMs leaching [22] and a related technology (EP 019 197 716.4) for complete electrochemical PMs leaching and REE recovery are in the patent procedure at EU Patent office. Efforts are also being made towards permanent magnets circular economy also on the national (ARRS L2-9213, L2-1829) with Magneti Ljubljana Ltd and Kolektor Group Ltd and international level via several European projects that encompasses the mentioned industrial partners in Slovenia and all over EU (ETN-DEMETER, H2020 SUSMAGPRO, ERA MIN II MAXYCLE, EIT RAW MATERIALS INSPIRES). Within H2020 proposal SUSMAGPRO TRLs of 7-9 are aimed via three pilot plants for recycling of EoL permanent magnets that are planned in Europe. Recently we got awarded the EIT RAW MATERIALS proposal on recycling REEs-based permanent magnets from white goods, where we collaborate also and also with Slovenian companies Domel Ltd, Gorenje Ltd, Surovina Ltd and Zeos Ltd.

3. CONCLUSIONS

Despite success stories, the challenge still persists when transferring the technologies form lab scale to functioning production lines, as the requests from the industry are strictly connected with the economic feasibility.

However, the proof of concept of the novel technology is shown on the lab scale reaching TRLs 3-4 and represents only an initiation that a technology could be feasible. Upon that much more investments would have to be made for "technology transfer" projects, to bridge the exact TRL gap between 5-7 like SUSAGPRO. In order for EU to become CO_2 zero efficient in to compete with the far East when it comes to be CRMs independent, the investments in the whole value chain on recycling of PMs have to be made. Slovenia for example has an extreme potential to act as a role model or as a feasible permanent magnet circular economy closed loop example, as it holds a geographical, professional and economical potential as to serve as a central location for the collection of waste magnets and their remanufacturing based on rare earths from the central and eastern parts of the European Union. The later has been recently successfully recognized by the EIT RAW materials scheme via funded INSPIRES project. The use of local

suppliers would significantly reduce carbon emissions and it is expected that in a few years Slovenia could produce 10 to 40 tons of Nd-Fe-B alloy magnets per year on the basis of recycling within the European SUSMAGPRO project. And the successful model could be later applied in different EU countries, using the recourse from EoL wind mills for example (like Scandinavian countries). However, this is not going to be possible without legislative changes within the EU that are crucially needed to encourage this activity and contribute to the circular economy, not to forget the most important thing the stimulations from the local governments and European Investment Bank.

This would strongly encourage local productions of rare earth secondary minerals and permanent magnets. Otherwise, the European rare earth industries i.e. permanent magnets will remain exposed to fluctuations in open market prices, making them very vulnerable and consequently uncompetitive.

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Real-time fluorescence lifetime acquisition system

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ABSTRACT

We have developed a novel method for measuring the fluorescence lifetime instead of or in addition to its intensity. We demonstrated an acquisition system that is extremely fast, compact and significantly less expensive than current approaches. We are seeking for partners among optical instrumentation manufacturers for licensing and technical cooperation agreements.

This article covers the analysis of technology transfer processes in correlation with expectations of newly developing biotech market. It concludes that technologies scaling project synergies and outreach are of crucial importance for the development of the technology for market purposes.

Keywords

Fluorescence lifetime; silicon photomultiplier; waveform sampling; knowledge transfer; innovation; patent search; role of market analysis, technology commercialization.

1. INTRODUCTION

This paper describes the application of high-energy physics technology for real-life applications. This is an area, which has always been considered to have a large potential, but too little has been realized. In particular in the detector area estimates show that there could be numerous unused technologies.

Based on the mature technology developed for high-energy physics, we developed a technology that targets primarily at medical, biomedical, biotechnology and pharmaceutical fields, all of which experience significant market growth in the current time period, in particular in the past ten years. The application areas include a detection of the presence of certain organic compounds, measurements of the properties of samples or tissue through the concentration of certain organic compounds, non-invasive determination of the chemical environment in the sample and non-invasive medical diagnostics and guided surgery.

In this article we will first touch upon the promising market capitalization. We will describe the technology at hand into more details, including the benefits, arising from it, the state-of-the-art and the technology scaling. Secondly, we will touch upon the patent databases searches which assisted us in estimating the technology potential, commercialization and IP protection strategy. Lastly, we will touch upon further technology development and market development plans.

1.1 Market evaluation

In the last several years, global market of fluorescence lifetime imaging microscopy developed smoothly, with an average growth rate of 4%. In 2016, global revenue of fluorescence lifetime (FL) imaging microscopy was nearly 155 MUSD; the actual production was about 545 units.

The major players in global Fluorescence Lifetime Imaging Microscopy market include Leica, Olympus, Zeiss, Becker & Hickl, HORIBA, PicoQuant, Bruker, Nikon, Lambert and Jenlab.

We expect this technology to enter the biotech market, which alone (but not limited to the FL imaging microscopy) is expected to hit 727b USD in 2025 [5], providing tangible benefits for society. Many emerging applications require sensors with a wide field of view, good spatial resolution and very fast acquisition times - a parameter envelope not yet reached by present research.

Our goals are to develop a device that uses a wide field illuminator (diffused laser) and a wide field detector, using a single laser pulse, capable of continuous sub millisecond frame rates. Global Fluorescence-Lifetime Imaging Microscopy market is projected to reach $ 1.8 Billion by 2020, with a GAGR of 4% from 2016, and Asia will have a big dynamic momentum on the market growth.

2. TECHNOLOGY DESCRIPTION

2.1 Background

Fluorescence is the emission of light by certain substances (fluorophores) after they are illuminated with light of specific excitation wavelengths. Measurements of the fluorescent light emitted by various samples are used in a very wide range of applications, such as imaging of cell structures, tracking of antibodies and DNA sequencing in biology, detection of cancer cells in medicine and quality control in pharmacy. Besides intensity, the fluorescence lifetime (FL) can also be measured, as pioneered in application of fluorescence lifetime imaging microscopy (FLIM). This has many advantages over the base method, such as independence from fluorophore concentration, reduced damage to the sample (photobleaching) and ability to measure properties of the microenvironment in which the fluorophore is located (pH, oxygenation…).

Currently, FL measurements require sophisticated and expensive instrumentation. Typically, the fluorescence lifetime is determined with time correlated single photon counting (TCSPC) method, which is intrinsically slow. Mature technological developments in the field of high energy physics (HEP) enable direct waveform sampling technology as important and a very cost-effective tool for fast FL applications. By measuring the photodetector signal resulting from complete fluorescence response, FL can be estimated even from a single excitation pulse.

Real-time Fluorescence Lifetime Acquisition System (RfLAS) was assembled from low cost, commercially available

components in order to demonstrate the feasibility of such approach. Calibrated FL standards with lifetimes in the range of 2 ns – 9 ns were used to test RfLAS accuracy and performance for different levels of available fluorescence light intensity and photodetector configurations. Using our prototype, we show that FL of all three fluorescence standards could be measured with an accuracy better than 10% from only a single pulse of excitation light, which improves below 1% level by averaging over only a few tens of pulses. Therefore, RfLAS demonstrates that FL can be acquired practically in real-time for a much lower price point than current state of the art.

The three critical components – the photodetector, waveform sampler and data processing algorithms – lend themselves perfectly for implementation in a single chip. These are also areas of expertise of the authors, and the institutes they are affiliated with. The envisioned integrated detector would push the performance and robustness beyond the present state, and more importantly, using CMOS technology at scale, would collapse the price per unit, opening possibilities to use FL obtained information in much wider areas as currently available.

2.2 State of the art

In TCSPC method, FL is determined from a histogram of measured time delays between excitation pulses and individual fluorescence photons, resulting from said excitations. If more than one photon is detected per pulse, the accuracy is degraded (pile-up effect), so the fluorescence signal has to be at a single photon level. The excitation pulse has to be repeated many times in order to obtain sufficient time delay histogram statistics, leading to long acquisition times and possible photo bleaching of the sample.

The acquisition times are even longer if imaging is required. In this case, laser excitation is scanned over the sample, and sufficient TCSPC statistics have to be accumulated for each scan position (image pixel). Alternative imaging approach is possible with single photon avalanche diode (SPAD) arrays, recently developed specifically for FL application with time-to-digital converters (TDC) implemented on a single chip. These devices have an intrinsic limiting factor, the sensitive area is somewhere between 1% and 20 % [1] as most of the space is used for electronics, and prototypes have a relatively small pixel count.

FL is also measured using frequency-domain technique, where it is derived from phase shift between modulated excitation illumination and resulting modulation in fluorescence signal, and gated detection, where FL is estimated from ratios of fluorescence signal at specific time gates.

Currently, FL measurements require sophisticated and expensive setups, and certain time to reconstruct the FL. In case of imaging, a few frames per second can be achieved at best for sufficient image resolutions [2].

2.3 Technology scaling

In our development plan, we will first build from the selected off the shelf components, a highly integrated multi-channel version of the device. It will be fully decoupled from laboratory equipment; therefore, it can be lent or sold to early adopters. These are crucial for us, we need early feedback, dissemination, and to validate and demonstrate the device in a real operational environment. An extremely important aspect is also presence on the market. Having a community of users, and a device that can be demonstrated in real operating environments will create the foundation for the third step.

Secondly, having built up the necessary experience, and deep understanding of the system, we will make an integrated scalable sensor, the real breakthrough in FL high speed imaging. The sensor will integrate efficiency optimized SiPMs, bump bonded to the electronics wafer, which could be produced in different technologies, with different performances, for different applications.

Taking in consideration mass production, these sensors can be made at a very competitive price. CMOS technology is also very affordable at scale, has a known roadmap and is very well supported. These factors provide a secure path to aggregate scalable solutions.

2.4 Project synergies and outreach

During the initial phases of the technology development, we were searching for cooperation with potential users and partners, focused on fast FL acquisition. We will be able to quickly form a consortium capable of advancing RfLAS. Laying the foundation in the dissemination program, we should build quickly a community of users to provide application test cases and feedback, and most importantly increment to TRL 5-7.

For additional dissemination, we intend to leverage one of the strong points of our technology, its simplicity. We will take an abundant amount of knowledge gained and develop an open source, open hardware, single channel FL acquisition toolkit, composed of hardware solutions based on off the shelf components, data acquisition software and library of end-user experience. The feedback and exposure will directly benefit the project, and increase the speed of development.

2.5 Technology application and demonstration cases

Measurement of FL is a still growing field of research with many applications not realized. A technique, improved in acquisition speed, and even more importantly, lower entry cost, has the potential to advance many fields of science and open new industrial applications. We have discussed concrete applications with potential users, including a pharmaceutical production company, high tech company developing monitoring and metrology technology for food industry and national health institute.

With just this batch of early adopters, RfLAS would improve development and monitoring of biopharmaceutical production. This includes an increase of the quality of food available to consumer and reduction of wasted food by measuring the ripeness of fruits and detecting presence of bacteria on food products; advance the accuracy and speed of diagnostics of histological samples; and contribute to a wide range of material science research.

3. ANALYSIS OF MARKET OPTIONS

3.1 Technology assessment

Supported by a group of specialists we performed a state of the art examination for the mentioned technology.

We found that technology has a significant advantage over the current state of the art. Some technologies touch on similar measurement methods and use language and definitions in patent claims to cover a very wide range of almost all measurement options, but do not cover the details of photodetector implementation. This is one of the significant improvements of our technology: we use silicon photomultipliers (for photodetectors), in connection with the

digitization of the signal from the photodetector using a chip and the principle of fast waveform detection.

There are also related patent applications and patents, which describe significantly slower, more complex devices or use alternative technology (TCSPC), which requires higher laser energy input to operate. The higher laser energy also results in photobleaching, which is in our technology avoided due to single photon regime of acquisition. The most related patent application, which also uses a silicon photomultiplier in conjunction with the use of a digitization chip and direct waveform sampling, does not describe a significant improvement in technology. These are namely the simultaneous capture of several sensors simultaneously, capturing the spectrum, which is an important analytical contribution in the submitted patent application of the presented device in the analysis and processing of fluorescent times.

3.2 Benefits and market placement

A silicon photomultiplier is a very fast photodetector, whose response to a single photon is faster than the fluorescence lifetime. Therefore, the shape of the electronic signal, i.e., the waveform, output by the silicon photomultiplier will follow the exponential decay of the fluorescence light resulting from a single pulse of excitation. If the resulting waveform is sampled with sufficient accuracy, the need for long accumulation of single-photon arrival times and large excitation light intensities can thus be avoided. Excitation light with low intensities reduces the risk of photo bleaching. Silicon photomultiplier photodetectors and waveform sampling chips developed for the needs of high-energy physics experiments have become low-cost, off-the-shelf components. Thus, the method allows a cost-effective way to measure the fluorescence lifetime and, at the same time, avoids lengthy data acquisition and photo bleaching of the sample.

The main advantages of the method proposed over TCCSP are cost-effective compared to common TCCSP technology, long accumulation of single-photon arrival times and large excitation light intensities of TCCSP are improved and excitation light with low intensities reduces the risk of photo bleaching.

The technology is in late early stage of development and is fully available for demonstration. It has been developed with the core funding of Slovenian Research Agency and also supported in part by ATTRACT Phase I. Due to the situation in the technology and market field, it was determined, that it is high relevance that its IPR status is arranged.

3.3 Database searches

We have prepared an overview of the state of the art with the help of the commercial patent database Derwent Innovation. In the review, we considered patent applications and patents filed anywhere in the world, and searched using the following key phrases: fluorescence lifetime, silicon photomultiplier, waveform sampling, and a specific content keyword that the authors of this contribution consider as a part of their secret knowhow and is not going to be revealed.

We tested different combinations of words and compared the obtained results with each other. We reviewed the results of the following search strings in more detail:

1.Fluorescence AND lifetime AND silicon AND photomultiplier AND waveform AND sampling AND specific content keyword (No records)

2.Fluorescence AND lifetime AND photomultiplier AND waveform AND sampling (6 records)

3.Fluorescence AND waveform AND photodetector (51 records)

4.Fluorescence AND waveform AND sampling AND photomultiplier (14 records)

The results obtained with the second, third and fourth search sets contain 71 results. Upon examination, 6 of the 51 hits turned out to be highly relevant and 2 relevant. Of the other 14, 4 were highly relevant and two relevant, and of the last six, 3 were highly relevant and 2 relevant. It turned out that the most relevant search was under point 4, where the largest share of relevant hits was. However, the search under point 3 is also important for finding market orientation.
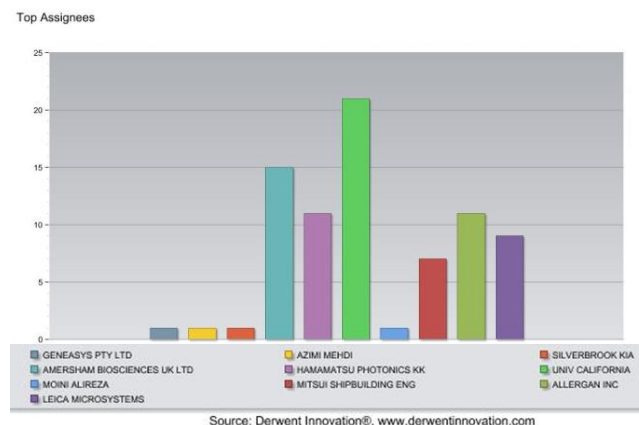
Figure 1: Top Assignees in the World in the field of fluorescence lifetime measurements

Even though we kept in mind that a proper Freedom-To-Operate analysis (FTO) can only be performed when the product is defined, the patent analysis also has given the authors insight into which companies have shown an interest in this type of technology. Top Assignees in the World can be found in Figure 1. Derwent Innovation overview of the field shows a current prevalence of US Universities and Japanese companies in the closest technology searches.

Due to the results of the review of the state of the art, we decided to prepare documentation for the disclosure of the official invention. it makes sense that intellectual property is properly registered with the JSI (it can also be used as a technical improvement / hidden knowledge) - also in terms of the possibility of rewarding inventors for inventions created during working hours.

3.4 Market assessment

The size of the market for measuring fluorescence time, according to data from companies engaged in market research, is currently estimated at over 250 mil. EUR at an estimated average annual growth, since 2016, somewhere around 4%. The advantage over the existing offer is mainly in the relatively favorable design / price of the technology (silicon photomultiplier), speed of data capture and processing, prevention of photobleaching and especially in the possibility of simultaneous capture of multiple wavelengths of light, obtaining important additional information for further processing.

Of course, the market analysis would be more significant and in particular more reliable, if we could identify the first specific application(s) to be addressed by the technology, and

then count the potential end users and multiply by the assumed price of the equipment to arrive at an accessible first market. This is an ongoing process which we hope to continue in the next steps.

We have already established contacts with companies, but without adequate protection of intellectual property, contacts cannot grow into more serious forms of conversations and exchange of technical information.

Following proper registration of intellectual property with the JSI, the marketing plan is expected to include: (i) the preparation and publication of a technology offering in commercial databases; (ii) contacting the main players from the list we created as part of internal market research; (iii) depending on the response from the main players, active marketing to other potential partners (through direct contact of potential partners, participation in international partnership events and active marketing within sectoral groups, a project of the European Commission).

3.5 Continuation of intellectual property protection

Given the high technological potential (according to the state of the art) and the high market potential, it makes sense to apply to the Office for the Protection of Intellectual Property, which conducts a full test, UK-IPO, which we also propose to find out within 6 months the invention is new and on an inventive level. Namely, we will receive an international opinion on the patentability of the technology (ISR - International Search Report) from a certified ISA (International Search Authority), on the basis of which we will be convinced of the novelty and inventive step of the proposed technology.

The selection of an office that performs a full test is also a precondition for co-financing the work of patent attorneys within the Technology Transfer project financed by Slovenian Ministry of Science and Sports.

Technology and market assessments proved the relevance and the need for patent application protection.

3.6 Technology commercialization

We are in the process of obtaining IP protection for the core aspects of our development, with patent applications currently filed in UK and European offices. We are in talks with two companies interested in technology, with one we are in the process of signing NDA. Other private entities expressed interest for the development of front ends and data display software. The multichannel instrument will support our commitment to advance as quickly as possible to step three of our development program, to enable the community and users to have on disposal a price competitive and robust instrument for their application.

4. FURTHER TECHNOLOGY, IP AND MARKET DEVELOPMENT PLANS

4.1 Envisioned risks

Our main target is the development program of highly integrated sensors, potentially having some degree of data processing on chip. Modelling, design, production, assembly and testing of such devices are, in a vast majority, also areas of expertise of the authors [6, 7], and the institutes they are affiliated with. We intend to prepare a simulation of such a device, to predict its performance and share the performance envelope with early adopters to shape its final form.

The physical aspect requires multiple R&D cycles which is slow and costly. To mitigate the failure in this task, we will start by assembling some of the ideas we already have on low cost CMOS fabs and unveil potential issues toward high integration. At each iteration, interested users shall be able to test our devices in their respective environments.

4.2 Liaison with student teams and socio-economic study

Our group are open for collaborations, and look forward to establish reliable partnership with users, partners and stakeholders. Our plan envisages their presence from the very beginning and will provide support in their future endeavors, by providing them with better and more advanced instruments. Of special interest are Master students, the next generation of STEM engineers, which will, one hopes, adopt our technology. It is very rewarding having the possibility to empower the younger generation, and give them tools to cover the fear of missing out new opportunities in such an early stage, searching for other possible applications of the developed chip, that may include PET, encrypted LIDAR, and other machine vision applications

5. CONCLUSIONS

The researchers come from a Slovenian public research organization. Their research involves experimental particle physics on large particle accelerators and development of complex detectors. They have analyzed their options with transferring the technology in question, performed market and technology assessment and decided upon an IP and market strategy. Future steps involve in particular wider interaction with potential customers and further development towards a product for the market.

Even though the process of the transfer is described in a historically relevant manner, the authors also acknowledge, that there have been many setbacks within the process itself. It is not that every step has been performed flawlessly, without mistake, setback, delay or disappointment. For example, it took a long time to arrange the internal take up of the technology at the public research organization, even longer to arrange for the dual ownership between the two primary owners, both public research organizations. We need to point out these facts, although we are, for non-disclosure issues not entitled to discuss the details here.

The partners are sought among optical instrumentation manufacturers. As a public research organization, the researchers are available for different sorts of collaboration: Potential partners are offered a license to the granted patent under licensing agreement. Technical cooperation for the development of a complete instrumentation device for measuring the fluorescence lifetime by this method is also considered a viable option.

The timing of technology development is suitable for inclusion in technological processes in the market. With the analysis of the market and patent saturation, we gained an overview of the state of the art and the possibilities for further market orientation. In our opinion, with the timely protection of intellectual property, we have achieved an optimal position for further marketing activities.

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Regulated toxicity-testing: Spinning out a company in a rapidly changing market

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ABSTRACT

Today, various chemicals and materials are introduced into our daily life. To guarantee their safety, number of tests have to be applied, ranging from simple testing on cell cultures (*in vitro*) to costly animal tests (*in vivo*). In case chemicals are planned to be delivered to a human body, many clinical tests are also required to be performed on humans. Logically, earlier stages of testing are used in selection, for example, of drug candidates or vaccines, or in early decision, for example, to remove dangerous materials from R&D pipelines as soon as possible. Unfortunately, the very expensive intermediate step – *in vivo* animal-based testing often provides wrong answers. Alternatives are being searched for and entire market is about to change with political decisions overtaking scientific and technological developments.

This article covers a relatively new field of how to deal with a situation arising from the fact that an associated novel IP is generated in public research institutions. It depicts how it becomes challenging for the institution and steps to be taken to spin the technology out into a company to a particular turbulent sector.

The article also touches upon the main dilemma on how to keep the novel technology solutions hidden if they need to be adopted by the regulators first. Related to this is also the question, how can one convince the committees at the research institutions as well as the investors that the technology in question actually do hold (enormous) business potential.

Keywords

Biotechnology, spin out, IP transfer, disease prediction, animal alternatives.

POVZETEK

Danes se v naše vsakdanje življenje uvaja različne kemikalije in materiale. Da bi zagotovili njihovo varnost, je treba uporabiti številne teste, od preprostih preskusov na celičnih kulturah (*in vitro*) do dragih testov na živalih (*in vivo*). Če je predvideno, da se kemikalije vnašajo v človeško telo, je treba na ljudeh opraviti tudi veliko kliničnih testov. Logično je, da se prejšnje faze testiranja uporabljajo pri izbiri, na primer pri oženju nabora kandidatov za zdravila ali cepiv, ali pri zgodnji odločitvi, na primer za čimprejšnjo odstranitev potencialno nevarnih snovi iz razvojnih aktivnosti. Žal zelo drag vmesni korak - testiranje na živalih in vivo pogosto daje napačne odgovore. Zato se iščejo alternative, ki bodo spremenile celotni trg, kar sicer nakazujejo že politične odločitve, ki prehitevajo znanstveni in tehnološki razvoj.

Ta članek zajema sorazmerno novo področje, kako se spoprijeti s situacijo, ki izhaja iz dejstva, da se v javnih raziskovalnih ustanovah ustvari povezan novi IP. Prikazuje, kako postaja omenjeni IP izziv za institucijo, in korake, ki jih je treba sprejeti, da se tehnologija pretvori v podjetje v nek turbulenten sektor.

Članek se loti tudi glavne dileme, kako naj nove tehnološke rešitve ostanejo skrite, če jih morajo regulatorji najprej sprejeti. S tem je povezano tudi vprašanje, kako lahko prepričamo odbore na raziskovalnih institucijah in tudi vlagatelje, da zadevna tehnologija dejansko ima (ogromen) poslovni potencial.

Ključne besede

Biotehnologija, spinout podjetje, prenos intelektualne lastnine, napovedovanje bolezni, nadomestki za živalska testiranja.

1. INTRODUCTION

1.1 The prior art of the technology

Currently, drug, vaccine and material development workflows heavily rely on expensive animal testing, used to reduce selection of possible candidates later on entering the preclinical and clinical testing phases that need to prove these candidates do not harm human health. Unfortunately, molecular driven disease mechanisms are very much different between test animals and humans [1], leading to almost catastrophic 95% probability of failure of, for example, drug candidates at the end of drug developments cycle [2].

This makes the later extremely cost inefficient with costs of 300 - 2000 MIO $ per drug development [3]. Other sectors, such as material safety testing, somewhat ignore this fact and stoically wait for the solution that more exposed and rich pharma sector can bring out.

To boost the launch of numerous new material and chemicals in a safe, hazard-free way, the material-related health adverse effects should be more reliably predicted [4,5]. Currently, the most promising alternatives involve test assays [6] and QSAR [7,8] models, but neither *in vitro* nor *in silico* tools can reliably predict *in vivo* adverse outcomes [9,10]. Particularly, the models unsuccessfully predict the systemic and chronic adverse effects [11].

The need of urgent development of more reliable prediction have been expressed by all the important policy- and decision-makers around the world (OECD, US EPA, NIH, EC, ECHA, etc.), which have highlighted the necessity of exploring the molecular mechanisms behind and identification of the key events in toxicity pathways associated.

During the last 5 years, 12 partners, joined within the SmartNanoTox European project, have worked pushed the mechanistic-prediction of toxicity-related diseases beyond the scientific frontiers. Within this consortium, our group of biophysicists at Jožef Stefan Institute in Ljubljana has led one

of the most distinguished breakthroughs in the field in the last decade – the first mechanistic explanation of the transition from acute to chronic inflammation. This discovery enabled us to predict a spectrum of inflammatory outcomes without animal tests for the first time [12].

1.2 The story behind the market and the opportunity

The only way to solve the lack of predictive testing that doesn't rely on animal tests is to develop living organ models (for testing purposes) that develop physiologically relevant responses to various drugs and other toxicants [13,6]. Several research groups and companies (Figure 1) are struggling to make such animal replacement models in a form of miniature and reliable organ copies.
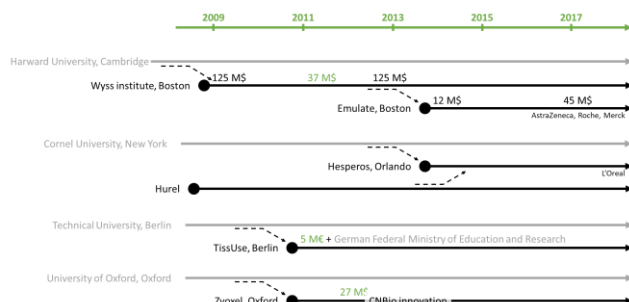
Figure 1: Small R&D institutes (black arrows), spun out from large universities (grey arrows), led the fields of *in vitro* model development. Some initial investments are shown with respect to the source – private (black) and public (green).
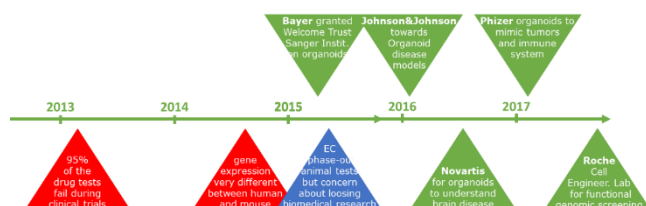

Figure 2: The important moments and decisions that boosted transition from animal-based testing into *in vitro* - or organoid – based testing and forced big pharmaceutical companies to get more involved into the *in vitro* model development

But, as expected this become a tedious, far from straightforward task full of trial-and-error steps. This makes the current developments look like being stuck and represent big challenge for regulatory bodies, which actually don't have clear plans on how to implement political decisions [14] (Figure 2) and public pressure (to eliminate animals from testing).

In terms of market size, toxicology testing market (Figure 3) currently values at around 20.000 MIO EUR per year [15]. Around of 10% of this market is driven by REACH EU legislation [16], which implies testing procedures for about thousands of substances that are produced annually with amounts greater than 1 ton per year. 2% of this REACH-associated segment includes acute & short-term repetitive dose exposure testing with 10,000 animal tests required per year. Value of this market is around 400 MIO EUR per year. Taking into account that most of the market need to be changed, this clearly represent a big opportunity for biotech companies that can bring new alternative solutions to the testing market. Currently, the testing market exhibit 12% annual growth. But is soon to reach its limits

in terms of testing capacity, that originate in limited number of animal tests that can be performed in the EU and other players around the world.

On the other hand, there is new material development sector with a fast growth of 20% per year that also requires extensive toxicology testing [17]. With 10.000 patents filed every year to protect various nanomaterials and their applications in addition to around 50,000 publications on the same subject, this sector will soon require much larger testing capacities. The only possible boost can thus come from new technologies and new players to guarantee material safety throughout new smart prediction approaches [12].
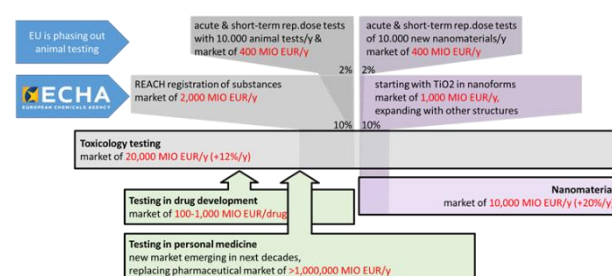
Figure 3: Target markets of acute & short-term repetitive dose toxicology testing in safety assessment of various substances and nanomaterials presented in the context of regulatory framework and political decisions.

To resume, the market is driving into a dramatic change:

- animal tests are considered as golden standard, but are phasing out;
- alternatives are lacking, imposing huge pressure on the regulatory bodies.

This opens new exciting opportunity for new knowledge-based companies, but at the same time impose great risk due to unpredictable development of regulatory framework.

The main contributions of the new companies in this field would cover exactly the market's greatest pains: the animal-free testing of drugs for human use and the prediction of the drug effects on the molecular level.

Not surprisingly, based on our new technology, which is registered as a secret know-how of the Jožef Stefan Institute, we decided to address this market need and participate in the product development and service provision in the new animal-free drug testing as explained above.

2. INITIAL STEPS TOWARD THE SPINOUT COMPANY

The initial steps we took were connected to shaping the idea into a market plan and creating a team to enable the creation of the market plan, sorting out the IP issues with possible other institutions and settling the IP relations within the research organization.

Interestingly, in the need for a business plan, expressed by any of our first investing contacts, we faced a lack of the expertise to create this business plan. Writing a business plan thus lead to complementing the existing team members. In our case, we have identified the need for getting involved someone with more economic background. This was a strenuous task for a group of scientists that have rarely think about nonscientific issues. But, when solved, another perspective enlightened the problem of

value creation leading us to much better vision of what the company can do and where it can be after 10 years. Recursively, the business plan have become much more solid while increasing the core team and focusing to its strengths.

While constructing financial projections for our business plan, we have "accidentally" discovered where the business models of the current service providers fail and where our scientific discoveries can really make a difference on a market (and in our budget). As said before, the toxicity testing, as we know today, requires many *in vitro* and *in vivo* tests. Even without clinical tests, all these tests cost lot of resources, making the business very resource-limited and, if you want to pay experts with a reasonably good salary, struggling with either low added value or being uncompetitive on the market. The problem is that it is required to run them all, but the results are not really being used in a smart ways or assembled in bigger picture. They are just there to be reported.

As discussed earlier, in the mean time, our scientific discoveries brought us several steps further, identifying how to use simple but well defined *in vitro* tests to predict disease development, that was till now possible only with much more expensive animal tests. This in turn release the business model from its limitations to human resources and make it more knowledge dependent (with higher added value). This will be beneficial for our company and the market, because the company business will be more competitive and the market prices will decrease at the same time.

Conceptualizing a new company in our case was a challenging task, yet alone in a field that is about to change dramatically and where the constraints are blurring rapidly with time.

The way that a company can be prepared to deal with such a challenge is stricktly by assembling together one big brain with out-of-the-box thinking ability. Inspired by many extraordinary business cases from the human history, we learnt the following lessons, while trying to set up our own company, Infinite-biotech:

- The core team need to dream about it, feel it by heart, and be ready to invest more than it can predict in the worst thought scenarios;

- Although there is always one that lead them all, the brainstorming is the real weapon of the team; the main leader needs others to challenge each other while searching for solutions that really makes the core idea;

- The core team members must complement each other in terms of expertise and at the same time be ready to listen to each other and adjust their ideas; nevertheless, they build entire story from scratch; so they must function as one big organism;

- Finding market opportunity is hard, but even harder is creating business out of it; the team have to search for their strengths enabling them to create high added value and be recognizable by the market;

To conclude, although everyone expects that you have the core team ready and you have already clarified all the business points ahead of writing the business plan itself, its actual the act of assembling the business plan that enables you to clarify of the details. It helps you to search for the missing expertise and complement the team members as well as to clarify many in particular business/finance related points of the very same business plan.

3. SPINNING OUT AND THE IP TRANSFER

Generally, a complex knowledge, required to elucidate basic mechanisms and further develop mechanisms-based testing or even disease prediction, as alternative toxicity testing concepts, logically arise from large publically financed projects that mostly run in well-equipped research laboratories in public research institutions.

The IP created has passed a well-defined procedure that, in our case at Jožef Stefan Institute, involves IP recognition by an expert panel followed by IP transfer to newly registered spin out company. IP must remain confidential during the processes and at the same time ambitious enough. This becomes challenging due to several reasons:

- procedures usually involve many different experts and some of them might have competing interests, but are involved in accordance with their elected position in the panels;

- protection of IP in a form of patents might be problematic because the patent application is disclosed to public sooner than the company might start making revenue to defend its IP, making it more vulnerable; The strategy of filing a patent and then preventing the disclosure by withdrawing the patent it in 18 months (and filing it again, in the same or in a modified form) has been disregarded. Patents might later on be filed, at this point in time the invention is protected as a secret know how;

- hiding IP in a form of secret knowhow might leave the impression that the inventions are not novel enough; many experts evaluating the proposal for IP recognition and company-associated business plans might therefore doubt about the potential of the idea;

- the use of university-internal panels to evaluate invention disclosures and IP can be considered of limited usefulness and it remains to be proven that the panel adds value in the eyes of the VC's.

The role of IP-transfer-dedicated department is thus even more important. In our case, both the Center for Technology Transfer and Innovation at the Jožef Stefan Institute and the Scientific Council of the Jožef Stefan Institute, were flexible and ambitious enough to recognize the dilemma above and support us in all possible (right) ways: the IP has been registered by the institute in a timely manner, the Scientific council confirmed the creation of the spinout company and the Center for technology transfer and innovation made way and glued together all the necessary pieces for the procedures to come together and obtain the general official support.

Last but not least, as mentioned before, the IP is often created within larger publically financed projects, likely to involve several partners. This inevitably exposed entire process of setting up a spin out company to a problem of shared IP, which can delay entire process substantially. While some universities almost hysterically claim their shares even when it is hard for them to prove their participation yet alone their contribution, this fortunately did not happen in our case.

Partners of the H2020 project SmartNanoTox easily realized that the core idea has originated from the work of our laboratory. However, in relation to multi-partner research projects and shared IP, it is important to distinguish between inventorship and the commercial rights. Inventorship is well-defined and one can contain inventorship even in larger projects. On the other hand the commercial rights can be shared, but the consortium

agreement should clearly state, that the partners will not block commercialization. However, in our particular case no partner claimed his share – despite the fact that the general trends were clearly defined already in the afore-mentioned H2020 project.

4. SEARCHING FOR THE FIRST INVESTMENT

As expected, the fact that our idea and technology is disruptive to the established market, adds to the complexity that we have experienced in their search for investors.

While transferring the IP might be enough to start making service-based revenue, it is actually far from sufficient to make revenue from products that allow a company to run into more stable and less human-work-dependent business model. Keep in mind that the research labs often focus on the basic mechanisms thus developing solutions up to a relatively low technological readiness level (TRL). Rarely, the TRL exceeds that of a proof-of-concept or a demonstrator yet alone that of validation of technology in a lab or real environment. Up to a prototype, which is really the one of the most important milestones of the company to enter the market, there is long way to go.

To speed up the required development cycle, a spin out company urgently needs an investment, which usually exceeds several MIO EUR. And despite the numerous venture capital funds (VC) and national agencies that all create an impression of straightforward access to financial sources, the investment into a business, whose potential is yet to be truly developed, is very difficult to find.

On a first sight, incubators might look the best option for spin out company. Nevertheless, they are expected to support startup at regional or national level. However, it turned out they are completely inappropriate choice for spin out companies arising from public-funded basic research due to extremely limited financial support that fails to meet the need for large investment after IP transfer. As stated previously, the TRL of the knowledge in a given situation rarely exceed the proof-of-concept making it far less attractive for direct financial investments.

During establishing our spin out company, we have learnt the two very important factors that influence the decision of an investor to invest into such story are:

- a proof that the entire business endeavor does not belong to a "green field" category;

- a proof that a company can start making revenue associated with the core technologies.

In business, a "green field" means an idea that can be written on a piece of paper with a dubious value that might hide lots of possible pitfalls and obstacles, far from being developed to a TRL high enough to start running even a small revenue. Despite its more or less clear message, we have noticed a very important difference in feedback of the scouts and VCs related to the IP origin. At the beginning, we approached them as a team with potentially powerful idea of the business and they rejects us almost instantaneously. Later on, when we approached them already as a legal entity with IP transfer in progress, their response has changed. Although they were aware of the origin of the IP – in both cases it originates from a large/renowned research institution, their attitude change simply because of the fact that there was an expert panel, which has already identified value of this IP before them. Passing this milestone has clearly brought us closer to reach the final investment.

Not surprisingly, ability of the company to start making revenue with its core knowhow is very important signal to investors. We noticed that this is particularly important for large VC funds. In addition, any effort of entering the market as soon as possible pays off with better business plan. In particular, it helps a company to identify the group of services and products that have higher added value and larger market potential. Further developments of spin out core technologies might thus be heavily influenced with the experiences gained through the first sales activities.

After exploring different possibilities, the best investor turned out to be a person ("angel") that is aware of the lack of solution and that can see the market niche your new company is trying to address. In many cases, he/she is the CEO of already another company. He/She is able to clearly see the potential of your knowledge and is willing to invest his/her resources (and/or attract others as well) and wait the minimum amount of time needed for the company to develop its core technologies for the future.

5. CASE SPECIFIC DATA AND THE IMPORTANT MILESTONES

The following details of our case timeline wants to illustrate the above and put all the discussion into a proper perspective:

- Market niche identification: 2017
- First idea of the company: July 2018
- Decision to protect IP as secret knowhow: September 2018
- First round to potential investors / contact type / contact location: December 2018 / scout, mentor / Switzerland
- 1st version of the business plan: February 2019
- First Financial plan and complementing the team: March 2019
- Second round to potential investors / contact type / contact location: June 2019 / intermediary / Germany
- Third round to potential investors / contact type / contact location: June 2019 / venture capital (VC) fund / Slovenia
- Final decision to make the company a spin out of Jožef Stefan Institute: October 2019
- 2nd version of the business plan: October 2019
- Start / End of the process of IP recognition (as secret knowhow): October 2019 / December 2019
- Approval of the scientific council of Jožef Stefan Institute: January 2020
- Fourth round to potential investors / contact type / contact location: November 2019 / angel related to venture capital (VC) fund / Austria
- Major breakthrough done on scientific side relevant for company business: September 2019 – January 2020
- Negotiation for IP transfer conditions and formal cooperation with date of signing the contracts: February 2020 – July 2020
- Fifth round to potential investors / contact(s) type / contact(s) location: March 2020 – June 2020 / venture capital (VC) funds & angels / Austria, Switzerland, Germany
- First demonstrator of the technology planned to use in a product: April 2020
- Sixth round to potential investors / contact type / contact location: April 2020 / angel, CEO, mentor / Slovenia
- First round to offer services: June 2020
- Complete marketing/sales plan for the company's services: September 2020

As can be noticed, from the market niche identification to a complete marketing/sales plan three years have passed. The main issues we encountered were twofold:

- In the field of registering the technology at the Public research organizations (PRO) the deadlines constantly

moved because we were not sure if the registration is necessary and for what reason; as it turns out, the registration itself is needed to enable the PRO to officially participate in the creation of the company in Slovenia; these clarifications took about a year to settle in with the team and the responsible at the research department;

- In the same field the time lag was also a consequence of a rigid PRO structure in the sense of the time urgency in which a typical spinout company finds itself; however, the procedures were carried out in the end in a timely manner; these procedures were ultimately carried out in less than two months;

- In the field of clarifying internationally on how to create a suitable team and how to attract with confidence a suitable amount of financing necessary to pursue with further technology development; these procedures took about two years; the main issue being that a researcher at a PRO is not in a position to devote a significant amount of time into the development of the market relations;

- With this in mind it needs to be said that an additional issue might be seen in the state of the mind of the researchers who believe that themselves are the only people who can properly present the technology and attract financial support.

In any case, the marketing and sales plan has been completed in September 2020. We plan to continue with the technology development and plan to deliver the services to the market in early 2021.

6. CONCLUSION

Scientific studies have clearly identified the need for a major change in the toxicity testing framework and the politics decides to realize this as fast as possible. This has created an exciting opportunity for business that can be started directly from basic research discoveries.

Because of the huge pressure to bring the future into reality faster than the new tech evolves, several milestones have to be met almost instantaneously: discoveries of the basic concepts, acceptance of the regulatory frameworks and establishment of the alternative testing market (and the trust in the same) that can replace the classical animal testing. Investors became reserved, simply because it is such a big step to the future. Despite the fact that the future is already here and a revolution of the testing market is inevitable.

In June 2019, I have been involved in an interesting discussion on tissue-on-chip technologies and the associated startup companies. The key dilemma associated with these small companies was: why they still get big investments if they can't and don't make big revenues. Yet. The answer given by the CEO of one of the first companies of this kind was marvelous: investors invest into teams that will be capable of reacting to the new market as soon as it will become approved (by the regulators).

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Status quo of computer-implemented inventions in Slovenia and EU

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ABSTRACT

In Slovenia there is no legal basis for computer-implemented inventions, and in the EU such inventions are not yet clearly defined. Over the last twenty years there have been many heated debates in the European arena concerning a single legal instrument, but a final solution remains elusive. In Slovenia and the EU, legal protection of computer-implemented inventions thus remains on thin ice: there are certain non-obvious combinations for obtaining a patent, but ultimately the decisive factor may as well be how the patent application is written. This status quo therefore necessitates an examination of this field: to arrive at a legal basis that would regulate the patenting of computer-implemented inventions it is necessary to identify and address the most critical points. This is the issue that this article deals with. It starts by presenting examples of computer-implemented inventions, followed by an overview of the state of play – the status quo concerning legal protection in Slovenia and the EU.

Keywords

Computer-implemented inventions, patent, copyright, status quo, Slovenia, EU.

1. INTRODUCTION

After Slovenia joined the European Union (EU), adopted the euro, and entered the Organisation for Economic Cooperation and Development (OECD), its integration into the European arena drastically improved, as did its international competitiveness. At present, information technology and digitalisation are highly developed, the country's rankings in a variety of international indices prove that Slovenia is an advanced and digitalised country. Other EU members are likewise considered advanced and digitalised, as the cutting-edge digital technologies they use make it possible to upend existing business models and create new ones, facilitate the development of new products and services, improve the efficiency and competitiveness of the economy, and contribute to socio-economic development in general [1]. The digitalisation of the entire society and economy underpinned by intensive use of information and communication technologies has significant growth potential and as such provides the groundwork for the long-term development and competitiveness of Slovenia, the EU, and Europe in general [1]. We live in an era where information technology may be considered one of the most important industries; consequently, management of industrial property and copyright, which are in the domain of intellectual property rights and are the subject of this article, are extraordinarily important.

Whereas the legal protection of intellectual property rights, as defined by the Convention Establishing the World Intellectual Property Organization (WIPO), is clearly and precisely defined in Slovenian and EU legal instruments, this does not apply to computer-implemented inventions [2]. A computer-implemented invention means any invention the performance of which involves the use of a computer, computer network, or other programmable apparatus, the invention having one or more features that are realised wholly or partly by means of a computer program or computer programs[1] [3]. Due to the recent shift in innovation towards things of a digital nature, computer-implemented inventions account for a large proportion of present-day inventions and creations, and as such represent an important segment of intellectual property [5]. Patents and all other intellectual property rights are the pillars of any innovation system and provide instrumental support in the development of technology and in the growth of national economies [6]. And although efforts to put in place appropriate legal instruments started over two decades ago, they ground to a halt in 2005, when, after a series of heated debates, the European Parliament voted down a proposal for a directive of the European Parliament and of the Council on the patentability of computer-implemented inventions, which the European Commission (EC) had issued in 2002 [7]. At least part of the reason why there is still no appropriate legal instrument is that such inventions are highly specific and demonstrating their technical contribution[2] and industrial applicability[3] may pose a significant challenge. But to a large extent, the reasons lie elsewhere – perhaps in the poor understanding of certain exemptions that apply in granting patent protection to computer-implemented inventions.

This status quo necessitates an analysis of this field and requires that the most critical points be identified and addressed in trying to create a legal basis for the patenting of computer-implemented inventions in Slovenia and the EU. This article presents computer-implemented inventions, the history thereof, and examples past and present. The focus is on the status quo in this field, in Slovenia and the EU, whereby we explore the possible ways of securing legal protection for computer-implemented inventions with the current legal instruments, in particular when such inventions can be patented and when they

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[1] A computer program is an algorithm written in a programming language (e.g. C++, JavaScript, PHP, Python, etc.) that can run on a computer [4].

[2] Technical contribution means a contribution to the state of the art in a field of technology that is new and not obvious to a person skilled in the art. It is assessed by consideration of the difference between the state of the art and the scope of the patent claim considered as a whole, which must comprise technical features, irrespective of whether or not these are accompanied by non-technical features [3].

[3] Industrial applicability assumes that an invention is applicable in industry if the subject of the invention can be produced or used in any economic activity, agriculture included [8].

can be copyrighted. Finally, we highlight the open issues that should inform future work, in particular in the context of how and where technology transfer offices (TTO) can help accelerate the adoption of such legal instruments and improve their clarity.

2. COMPUTER-IMPLEMENTED INVENTIONS

2.1 Theory and Practice

Computer-implemented inventions are defined as inventions the performance of which involves the use of a computer, computer network or other programmable apparatus, the invention having one or more features that are realised wholly or partly by means of a computer program or computer programs [3]. A computer-implemented invention can cover topics related directly to information and communications technology (ICT), e.g. compiling back-ups or data compression, or it can be indirectly related to ICT and only used to control other appliances or devices [9]. Although programs for computers are as such explicitly excluded from patentability (at least at the European Patent Office (EPO)), a product or a method that is of a technical nature, i.e. it produces a further (technical) effect beyond the normal functional interaction of a program and computer, may be patentable, even if the claimed subject matter defines or at least involves a computer program [9].

The first patent application for a computer-implemented invention in Europe was submitted in Great Britain in 1962. The application was made by British Petroleum CO. Ltd., and P. V. Slee and P. M. J. Harris. The patent for the invention *A computer arranged for the automatic solution of linear programming problems* was granted in 1966 [10]. The computer-implemented invention is described as a computer comprising quick-access storage, slow-access storage, and an arithmetic unit, arranged to automatically solve a linear programming problem by means of an iterative algorithm [10].
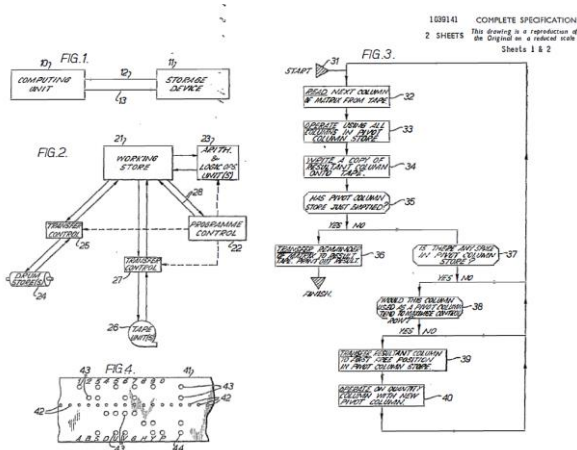
Figure 1: Drawing of patent application GB1039141A for the invention *A computer arranged for the automatic solution of linear programming problems*

One example of a computer-implemented invention that is widely used every day and was granted patent protection in Europe is the electronic anti-lock braking system (ABS). In 1969 ITT Teves (Continental) unveiled an electronically supported ABS system as a premium add-on feature of the Mercedes Bens S-class, and in 2004 electronically supported ABS systems became standard on all new cars in Europe [11]. Another example of a computer-implemented invention that will probably change our everyday in the near future are autonomous vehicles. However, in order for autonomous

vehicles to be recognised as computer-implemented invention, numerous experts will need to identify intellectual property issues related to autonomous vehicle technology, and to navigate the complex intellectual property landscape within this rapidly developing sector [12].

2.2 Status quo of Legal Framework: Slovenia

The Slovenian Industrial Property Act (ZIL-1-UPB3), which determines the types of industrial property rights and the procedures for granting and registering these rights, the legal protection of rights, and the representation of parties, stipulates in Article 10, which determines the subject matter of patent protection, that "*patents shall be granted for any inventions, in all fields of technology, which are new, involve an inventive step and are susceptible of industrial application*" [8]. Article 11, which determines exceptions to patent protection, stipulates that (1) "*Discoveries, scientific theories, mathematical methods, and other rules, schemes, methods and processes for performing mental acts as such shall not be considered inventions within the meaning of Article 10,* and that *(2) A patent shall not be granted for: (a) inventions, the exploitation of which would be contrary to public order or morality; (b) inventions of surgical or diagnostic methods or methods of treatment practised directly on the living human or animal body, with the exception of inventions relating to products, in particular substances or compositions for use in any of these methods.* [8]. This means the Slovenian Industrial Property Act does not deal with computer-implemented inventions.

Software[4] that does not provide a technical contribution can therefore be protected only by copyright, whereby ideas cannot be copyrighted. The appearance of a command line interface[5] or a graphical user interface[6], on the other hand, can be protected as a registered design. At the Slovenian Intellectual Property Office (URSIL) it is possible to get a patent for computer or mobile applications, but only under the condition that a technical contribution is demonstrated. One such example is a patent granted in 2012 for the invention *A mobile application and procedure for the processing of environmental information*, which solves technical problems in preventing the generation of waste, reducing the amount of generated waste, channelling waste into reuse, appropriate disposal of individual types of waste, reducing environmental pollution and reducing the demand for the production of new raw materials that subsequently pollute the environment as waste [13]. This was the first such patent granted in Slovenia. Another such example, also granted patent protection in 2012, is the invention *A system for automatic detection and monitoring of harmful insects*, which solves the problem of the time-consuming inspection of insect traps [14]. With the help of cameras in traps it detects and monitors harmful insects [14]. The third such example is the invention *A system and method for printing and delivering of publications such as newspapers on-demand*, which was granted patent protection in 2019 and is classified as a special purpose printing device and device combining printing and other functions [15]. The printing and delivery system consists of at least two internet connected units and a mobile application

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[4] Software is a group of computer programmes that constitute a whole in combination with hardware in a computer.

[5] A command line interface is an interface in the form of lines of text that shows a prompt on the screen into which a user enters a command and executes it with the enter button. If the command is valid, it is executed.

[6] A graphical user interface displays elements such as icons and other tools. It is an interface between the user and the software.

that transmits location data to the printing and delivery device, includes account management functionalities, and sends instructions for printing and billing [15].

2.3 Status quo of Legal Framework: EU

In 2002 the EC issued a proposal for a *Directive of the European Parliament and of the Council on the patentability of computer-implemented inventions.* After a series of heated debates among MEPs, the European Parliament rejected it in 2005 [3]. The adoption of this directive would have created a single set of rules for the patent protection of computer-implemented inventions in the member states. The European Patent Convention Stipulates in Article 52(2) (c) that programs for computers are not regarded as inventions [2]. Recognizing that the European Patent Convention (EPC)[7] established a European Patent Organisation (EPO), which is responsible to grant European patents. This is carried out by the EPO (supervised by the Administrative Council), which is not an agency or an organ of EU. It is an organ of the EPO, which has legal entity and it is an independent inter-governmental organisation[8] [16]. The status quo thus remains the same as in Slovenia. Software that does not demonstrate a technical contribution can only be protected by copyright, which does not protect ideas. The appearance of a command line or graphical interface can be protected as a registered design, whereas a patent for computer or mobile applications can be granted if a technical contribution is demonstrated. Under EPO rules, in the event of such, the software must be connected with the hardware.

3. COPYRIGHT AND COMPUTER PROGRAMS IN SLOVENIA AND EU

3.1 Copyright

Computer programs are defined both in Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs (the Directive) [17] and the Slovenian Copyright and Related Rights Act (the ZASP) [18]. EU member states protect computer programs by copyright the same way literary works are protected under the Bern Convention for the Protection of Literary and Artistic Works [19]. While a computer program is defined by these legal instruments as a program in any form of expression and is considered a written work, software does not enjoy copyright protection. Due to the requirement that copyright protection applies to the expression of a computer program in any form, algorithms and programming languages that involve ideas and principles do not enjoy copyright protection. Preparatory design work leading to the development of a computer program is considered a computer program provided that the nature of the preparatory work is such that a computer program can result from it at a later stage.

When a computer program can be patent protected or when it can enjoy copyright protection depends on what kind of problem it resolves. If a computer program resolves a business problem, it is protected by copyright. In the event it resolves a technical problem (and meets all other criteria for patent protection) it can be protected with a patent.

3.2 Employment and works made for hire

The ZASP stipulates that the employer or person ordering the work is entitled to all economic rights to a computer program if it is created by an employee in the execution of his duties or by an author under a contract for a work made for hire. Economic rights and other rights of the author to such a program are assigned to the employer or person ordering the work, exclusively and without limitations. In accordance with the applicable regulations, the employer or person ordering the work and the employee (author) may agree otherwise, which has also been confirmed by the Supreme Court of the Republic of Slovenia in judgement II Ips 552/2003 [20]. In practice, however, at least regarding computer programs created in the course of an employment relationship, the worker and employer tend not to agree otherwise in the employment contract. The Directive treats the transfer of economic rights to a created computer program the same way as the ZASP, but it deals only with computer programs created in the framework of an employment relationship, it does not regulate computer programs created under a contract for a work made for hire. There are significant differences between instances when a "classic" copyrighted work is created in an employment relationship, and when a computer program is created in an employment relationship.

The ZASP also accounts for instances when an employee creates a copyright work that is not a computer program, in the event of which it stipulates that economic and other rights of the author to this work are exclusively assigned to the employer for a period of ten years from the completion of the work (unless the parties agree otherwise in a contract). Upon the expiration of the term, the rights revert to the employee. However, the employer can claim a new exclusive assignment of these rights, for adequate remuneration. A worker who creates a computer program in the framework of an employment relationship is therefore in a disadvantaged position compared to workers who create other copyright work in the course of their employment.

Despite the copyright protection in place for computer programs, the Directive and the ZASP do not regulate the subject matter exclusively; they allow legal protection under other branches of law [21]. For computer programs, other branches include regulations on patent protection, trademarks, protection of competition, trade secrecy, etc. Due to this non-exclusivity, and the grey area between copyright and computer-implemented inventions, computer programs are therefore often protected as trade secrets and as know-how.

4. CONCLUSION

The status quo in the field of computer-implemented inventions, which are neither legally defined nor legally undefined in Slovenia and the EU, raises many open issues and provides opportunities for future work. In Slovenia it would make sense to examine at which stage TTOs can methodologically and substantively contribute to the examination and presentation of computer-implemented inventions at the level of the national patent office and to the examination of non-obvious combinations that constitute computer-implemented inventions under the ZIL-1-UPB3. At the level of the EU and Europe as a whole, it is necessary to examine how we may contribute to the creation of a legal basis that would ensure uniform patenting of computer-implemented inventions.

TTOs are tightly integrated into the work of organisations that produce inventions. First and foremost, we use our know-how to help researchers who create computer programs by verifying

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[7] The EPC is a multinational convention of which 38 member states participate in, including all 28 member states of the EU and other non EU member states [16].

[8] For the last 50 years, the EU's ambition to create a single, central court for the enforcement of European patents has been frustrated by the EPO's existence as an autonomous, international organisation outside the EU [16].

what kind of problem their program addresses and how a quality decision can consequently be made as to the protection of intellectual property (a copyright or patent).

All things considered, we believe that TTOs should at a minimum participate in public debates and present practical examples of researchers who develop computer programs at public organisations, thereby contributing to a constructive decision-making process on the future of the protection of computer programs. However, firstly TTOs have to recognise steps and phases where can TTOs provide methodological and practical support in processing and presentation of computer-implemented inventions at national and EU level.

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Strategic intellectual property management system for universities and scientific organizations for efficient technology transfer

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ABSTRACT

The technology transfer development is a strategic priority in the economies of many countries. For a successful and efficient technology transfer, a high-quality exchange process between science and industry must be established. In this publication author review the specifics of Intellectual Property management systems in higher education institutions. Universities and scientific organizations should strive not only to create patents with public funds and publish in top-rated journals, but also work efficiently with industrial partners to increase the commercialization level of their developments. For that purpose, it is necessary to create a specialized structure in the university – a technology transfer center – that could manage Strategic Intellectual Property by using specific documents that form unique ecosystem.

Keywords

Technology transfer, strategic intellectual property management, universities and scientific organizations.

1. INTRODUCTION

In modern world and Russian practice, the main developers of innovative technologies and suppliers of developments with the potential for commercialization are large universities, research centres and laboratories. Universities and research organizations are increasingly responding to the needs of the real sector of the economy for innovative developments by making changes to R&D plans. Developing towards a larger-scale participation of universities / research institutes in economic processes, offices and technology transfer centres contribute to building communications with other participants in research activities and subjects of the real sector of the economy, contribute to improving the quality of fundamental and applied research, and intensify the cooperation and integration interaction development. Based on fundamental scientific research, the results of the development of these institutions, having an applied focus, allow the companies acquiring them to form new strategic competitive advantages based on significant technological superiority [1]. Today, there is an aim on global and regional agenda to create the environment as well as the ways to make researches' results commercial, to make it possible having an income from the intellectual property. The universities should become the reliable providers of the specific intellectual products to meet the federal and industrial demand. In many strategies of scientific and technological development of countries, this aspect is qualitatively reflected – Russia [2], China [3], Germany [4], South Korea [5], USA [6]. It should also be considered the scientists' interest for publishing their researches' results and being fairly treated. The question of making the balance between scientists, universities and federal parties is not only to appear within one organization. Universities and educational organizations are actively engaged in creating new products, but there is often no systematic work on commercialization - there are questions about attracting industrial partners, setting up accounting for the result of intellectual activity and the amount of royalties pay out.

2. STRATEGIC INTELLECTUAL PROPERTY MANAGEMENT SYSTEM

These problems of technology transfer can be solved by Strategic Intellectual Property Management System (SIPMS), which helps to build the commercialization stage step by step. Speaking about the strategic priorities of such a system it should be working for the researches, university administration and industrial partners to make the mutually beneficial cooperation. This approach guarantees all the parties' interests to be considered and minimizes the risks to lose one's intellectual property. It can also help to build the researches' reputation, attract new employees, and, finally, meet the federal demand for using the knowledge for the national economy benefit.

There is a vital experience of such a system in Russia: National Association of Technology Transfer has a Project Group that organizes an intellectual property management system in higher education institutions [7]. The activities of this group are related both to the holding of events to popularize and involve in the work of the vice-rectors of universities responsible for innovations, as well as a wide range of experts in the field of technology transfer and all interested market participants, and to the implementation of a package of standard documents for the IP management in universities and research centres.

In preparing a set of National Association of Technology Transfer model documents, the Intellectual Property Policy for Universities and Research Organizations, adapted by WIPO and the Ministry of Education and Science of Russia, was used. Pilot implementation of the IP management system to the Lomonosov Moscow State University experience showed that IP management rules in the local regulations should be first consolidated. These regulations can be the Strategy and/or the Policy in the field of IP management. MSU version of such a document is the Provision on IP management, which latest revision was approved in 2018 [8].

Speaking of key strategic principles of the efficient functioning of the strategic system, implemented to the Lomonosov Moscow State University, legal certainty, fair income distribution, and stability could be mentioned. These principles are consolidated in the local regulations. The legal certainty

principle implies the right holder to have all the results of intellectual activity certificated, all the rights transactions to be confirmed by entering into a contract and fulfilling its conditions.

According to the fair income distribution principle, the university pays costs to get and renew the patent, including the international ones. The income of the commercial using the intellectual property is shared as following: The authors receive 25%, the faculty – 40%, the university – 35% of the reward. The amount of payments to the authors can be extended by the head of faculty, using the funds which the faculty got in the specified order [8].

An important aspect of successful technology transfer on the part of the authors is associated with the motivational part. [1] For example, Higher School of Economics — National Research University pays 30% of net contractual income [9], Saint Petersburg State University pays 50% of net contractual income for using intellectual property [10], Ural Federal University [11] named after the First President of Russia B. N. Yeltsin pays up to 50% of the royalty income.

The stability principle means that authors should remain confidential and report the university about the intellectual activity result before there will be any information published. The university recourse usage makes intellectual activity result as the university's property. Commission on university IP approves the key deal's conditions, as well as the patenting geography. Earlier, the IP management process in MSU was decentralized and implied several departments' parallel participation. Faculties were responsible for many matters in the field of IP management (including special legal, patent, accounting matters). However, not all the faculties could afford employees from the field needed. That is why there came an idea to reconstruct the IP management system. Moreover, it was necessary to do the rights inventory, analyse the demand for current intellectual activity result and prospective for the ones at the application stage [8].

The new IP management system is working in MSU since 2014 when the decision was taken on the pilot system implementation. Russian Federal Service for Intellectual Property (Rospatent) expertly supported the pilot implementation. The system is constantly developing, considering changing legislation, application practice, and special ministries and departments' recommendations. For example, the Ministry of Economic Development of Russian Federation developed in 2014 [12] and finalized the Recommendations on results of intellectual activity (RIA) management [13]. In 2018, WIPO and the Ministry of Science and Higher Education approved the Policy in the field of intellectual property for universities and research centres [14].

The main chain of a system implemented in MSU is Centre of Technology Transfer. The main goals of technology transfer centres are to promote the development of cooperation chains between science and business, attract investment for the innovative projects implementation and the creation of consortia, commercialize the results of scientific and technical activities, meet transfer innovative developments to industry and the market [16]. Centre of Technology Transfer of Lomonosov Moscow State University is a "one-step" facility for both internal university work and processing external suggestions and external demand. It is staffed with employees in the field of intellectual property management (patenting, licensing, business development and legal issues) with various competencies that allow assistance in the promotion,

development and practical application of the Moscow University developments in industry.

Strategic IP management system implementation helped MSU get significant results in two important rankings:

- National University Ranking (Innovations unit). There were 849 scores (8th place) in 2017, 805 scores (5th place) in 2018, and 774 scores (4th place) in 2019 [15].

- Invention Activity University Ranking (scores are summed). There were 57,9 scores (1st place) in 2017, 58,9 scores (1st place) in 2018, and 63,6 scores (1st place) in 2019 [17].

There are about 900 items in the overall MSU IP portfolio. There are also more than 30 valid license contracts made by MSU. At the same time, the income from RIA rights disposal multiply.increased. As a result of successful SIPMS implementation, the following information can be given:

11 licenses were issued with fixed payments for the current period and royalties for future periods;

legal support of transactions with industrial partners were undertaken;

119 notifications on disclosure of intellectual activity results were processed;

42 applications for inventions/utility models were submitted to Rospatent, 2 of them for international protection;

2 applications for industrial designs were submitted;

3 applications for University trademarks were submitted;

30 computer programs and databases submitted for registration;

received 55 patents for inventions/utility models;

received 37 certificates for computer programs and databases;

received 2 trademark certificates;

received 2 patents for breeding achievements [18].

There are also IP commission and Intangible Assets commission in the IP management architecture. The main chain of the system, NATT, is participating at all the stages of life cycle. At the first stage of the research, the Association approves the work conditions, announces the RIA creation, forms a document on its legal protection, and participates in making a request and applying for a patent. As all the actions mentioned above are made by one department, the amount of patent applications has raised up to 100 a year. That is 80% more that it was in 2014. After the grant of the patent, there is still commercial work to do. Be that we mean making additional research, communicating with appraisers, internal and external experts. As well as looking for partners, approving terms of the deals on RIA rights disposal, and controlling over university and developers treatment [8].

In conclusion, it can be noted that MSU has successfully implemented SIPMS, as evidenced by the results. It should be noted that such a system is effective for establishing systemic interaction between main participants in technology transfer, helps to set up a system work on commercialization and consolidate innovative offers for industrial partners. The presence of such system in technology transfer centres helps to work systematically even in the face of external challenges. The main SIPMS value is to reduce uncertainty, regulate liability and establish a standard business process. The presence of the same template for the industrial partner technological request makes it possible to create an innovative development catalog more effectively. Taking into account the professional

competence of each university and its structural organization, SIPMS is easy to adapt and change. NATT specialists are currently implementing SIPMS at Sechenov University and D.Mendeleev University of Chemical Technology of Russia [8]. Using this experience, we can talk in the future about the possibility of scaling it in order to form the maturity of universities to introduce their developments into national and global industry.

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Strategic research and innovation partnerships as enablers of technology transfer

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ABSTRACT

Paper address the question of knowledge -transfer activities in the case of two (business and research-led) SRIP. SRIP-Strategic research and innovation partnerships is the form of collaboration between business sector, public research organizations (PROs) and other stakeholders introduced by Slovenian Smart Specialization Strategy. In the paper, we try to find similarities and differences in their positions, perceptions and approaches toward technology transfer, as well as challenges of this process on the level of SRIP as an instrument and on the level of Slovenian innovation system.

Keywords

Technology transfer, Smart Specialization Strategy of Slovenia, SRIP Strateško razvojna inovacijska partnerstva- Strategic development innovation partnership.

1. INTRODUCTION

With adoption of Smart Specialization Strategy of Slovenia (S4) in the end of 2015 (GODC, 2015a), a new form of collaboration between business sector, public research organizations (PROs) and other stakeholders was introduced. So-called Strategic research and innovation partnerships (known as SRIPs, GODC, 2015b) were established in all nine priority areas of S4, following a public call, issued by the Ministry of Economic Development and Technology in December 2016 (MEDT, 2016).

The 3 priority pillars of the Smart Specialisation (a) Digital, b) Circular and c. (S)Industry 4.0 have nine areas of application:

(i.)   Smart cities and communities;
(ii.)   Smart buildings and homes, including wood chain;
(iii.)   Networks for transition into circular economy;
(iv.)   Sustainable food production;
(v.)   Sustainable tourism;
(vi.)   Factories of the future;
(vii.)   Health-medicine;
(viii.)   Mobility;
(ix.)   Development of materials as products.

The idea of the policy makers was to support the formation of a platform, similar to clusters, in each of the priority areas, based as a long-term public –private partnership. The members of SRIPs are to identify value chains within selected priorities (deepen the relatively general priorities) through providing fora for continuous entrepreneurial discovery process (EDP). SRIPs should provide an environment for cooperation in joint R&D projects of various type and enable innovation activity eventually leading to market penetration in S4 priority areas. The objective is to focus and coordinate both private and public investment in R&D and innovation, share capacities, both human and material, with the objective to raise competitiveness and value added in selected sector.

One of the tasks of SRIPs, as specified in documentation explaining the S4, is exchange of knowledge and experience as well as knowledge transfer (SVRK, 2015b). SRIPs should enable flow of knowledge among the members, from the PROs to business sector as well as among the business partners themselves (for example, from large to small and medium size enterprises). They should also enable the transfer of knowledge among the same stakeholders.

The implementation of this expectation of the policy makers, which was spelled out in the public call for the establishment of SRIPs, is the subject matter of our short paper. SRIPs were established in the fall of 2017 and their first mid- term evaluation/ monitoring was performed in 2019 (FDV, 2019).

The monitoring looked at the issues, specified in the public call:

- Implementation of the objectives in Action plans

- Progress in promotion of joint development and services, especially in cooperation and development of joint RRI initiatives to develop and market higher value-added integrated products and services;

- Introduction of horizontal enabling technologies within vertical value-added chains

- Implemented market manifestations, resulting from joint activities.

Mid-term monitoring of the SRIPs resulted in the report to the funders, where the successes as well as some of the problems in functioning of the SRIPs were identified. The main conclusion of the monitoring phase was that the SRIPs are a good instrument to support RIS3 implementation and that most of them have achieved an impressive level of cooperation among their members from different spheres (large and small companies, public research institutions and in some cases, also communities/ municipalities).

Since transfer of knowledge was not considered the primary task in the initial phase of working of SRIPs, the mid-term monitoring had not focused on this issue. Still, we believe it is important to examine how they approach this topic, if at all. To learn more about the position of SRIPs with regard to technology transfer, we designed a small questionnaire for two very different SRIPs: one is primarily business- dominated and the other with more pronounced impact of the public research organizations. Their views on the role of SRIPs as agents for technology transfer are presented in the next segment.

2. INDUSTRY-LED SRIP AND TECHNOLOGY TRANSFER

First, we wished to learn if the SRIP coordination office deals with the questions, relating to technology transfer, especially in view of relatively limited human resources. The answer revealed that the technology issues are mostly addressed at the level of Council of Experts, where new developments in their priority field are discussed, especially in the areas of interest to their members. The office itself has no capability to assist in the actual technology transfer deals; they do however monitor technology developments at global level and pass relevant information to the members. They see their role mostly in establishment of initial contacts between different members, where the office identifies potential for cooperation. Beyond this phase, they currently do not act.

The issue of transfer of technology is in the opinion of the office an important one for their members, but the SRIP can only help in raising the awareness and the promotion of the protection of intellectual property rights, sharing information on cases of successful transfer of knowledge to the market, but not with the actual process of transfer.

Explicitly, the members have not requested services or assistance with transfer of knowledge. They do take part in the events, organized by the Office, where experience and knowledge on the topic of various members is presented. The Office has also organized a set of workshops with one of the leading Slovenian expert on intellectual property rights protection. The workshops had sufficient attendance, but not exceptional, suggesting that the topic is not the most problematic in their industry.

The Office of SRIP sees itself primarily as an intermediary: their role is to monitor the trends in global industry, be well informed of the development plans and needs of their members and act as a matchmaker for the exchange of ideas and formation of joint R&D projects. Up to now, they have not identified specific barriers to transfer of knowledge or technology. They do, however, observe inactivity among PROs, especially research institutes in searching the contacts with industry. Here, researchers from the universities, especially younger ones, are more eager to cooperate with business. On the other hand, the research institutes wait to be approached by the industry and, often reluctantly, respond.

3. RESEARCH-LED SRIP AND TECHNOLOGY TRANSFER

The same set of questions as for industry- led SRIP, were directed to research-led SRIP. Regarding the question, related to technology transfer, we received an answer that coordinating office of SRIP is not dealing with knowledge transfer activities. They don't have sufficient human and financial resources for this sort of services. However, PRO hosting the research-led SRIP has its own Technology transfer office (TTO), providing the services connected with knowledge transfer for their researchers. Yet, these services are available only for the PRO researchers and their customers.

From the side of research-led SRIP members, technology transfer is currently not recognized as a very important topic. Currently main cooperation form between SRIP business members and research organization are joint R&D projects, where intellectual property rights (foreground, background and side-ground) are agreed in advance and they are part of cooperation agreement signed before the project starts. In these projects, in most cases, industrial property rights become property of business partners. This is often the standard condition for cooperation between PRO and business entities in such projects, explained by the fact that the business partners contribute most of the co-financing. So far, research-led SRIP had no case of direct technology transfer, where the coordinating office would be directly involved.

As technology transfer is not recognized as a crucial topic/activity of the SRIP, SRIP coordination office does not detect special needs or requests from the side of SRIP members. Therefore, activities of SRIP coordination office are oriented mainly toward awareness raising and trainings of members through special events and thematic workshops. Research-led SRIP coordination office sees the opportunity for a more active role of SRIP in the technology transfer only if the main stakeholders would request such service, as SRIP itself at the moment has no planned resources for technology transfer.

Research-led SRIP coordination office also detects some obstacles, which prevent transfer of knowledge and technology. In the first place, they point to a relatively complicated and long lasting procedures for knowledge transfer, which demand specific and high professional knowledge in different areas. Secondly, as procedures are mainly focused on financial part of transfer (i.e. licenses or patents costs), this is not found as highly stimulating, especially for Spin-out companies. Third: legally very complicated procedures for knowledge transfer in most PRO, especially universities, requiring a long list of approvals, discourages the process. The SRIP sees solution in changing the current, very restrictive legislation. In order to simplify and standardize these procedures, SRIP suggests preparing Toolbox for SME members in order to help and support them in such procedures.

4. DISCUSSION AND CONCLUSION

With both types of SRIPs, we can find some similarities and common issues: to the first question on the engagement of the SRIP coordination offices in transfer of technology, both pointed out the lack of human resources with specific knowledge and competencies in the field of technology transfer. This is the main reason why they cannot play the role of technology broker. However, this issue does not seem to represent significant problem as this role is also not expected from their members. From the side of SRIP members, the role of SRIP office is not seen in the field of TTO.

Secondly, policy maker, at the time of establishing SRIPs, listed a long range of tasks for the SRIP offices, obviously with the expectations that the SRIP member will be prepared to finance all these tasks. Common rule of 50% public co-financing of the SRIP office activities does not allow them to strengthen the technology transfer activities. On the other side, there is no specific need expressed by the members for SRIP offices to enter the field of technology transfer, which requires a very specific and high professional knowledge. Often, this knowledge and resources already exists at the PRO and universities in the form of existing Technology transfer offices. Most business enterprises, with experience in joint R&D projects, have their in-house capabilities to address the issues of intellectual property rights. The question arises as to what is the situation in SMEs and whether in the case of their more active involvement in joint projects they would benefit from the assistance of the coordination office of SRIP. Here, we see the opportunity for strengthening technology transfer service from the side of SRIP members, coming from the public research community. They should invest more energy into informing SRIP business partners regarding their own R&D work and potentials, of course if they are motivated to more actively transfer their knowledge and technologies. Also, the services in

the area of technology transfer, which were developed with public money within PROs, could be offered to SMEs as well.

As we see, the issues identified in the previous studies (Bučar and Rojec, 2019) on knowledge/ technology transfer have not been addressed by SRIPs either. These issues are actually long-term challenge for Slovenian innovation system, which cannot be solved by one, single, time-limited action. The issue requires several systemic changes in different areas, from bridging the gap in understanding the objectives of R&D for PRO and those of business entities. One of the solutions is a permanent long-term, sufficient and clear support of the government to the instruments like SRIP and TTO's.

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The awareness on environmental protection issues as reflected through the inventions

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ABSTRACT

The present study aimed to get the insight into specific environmental issues associated with key enabling technologies and to identify the environmental protection related niche areas of the highest potential for growth to which the future technology transfer activities should focus on. Analyses of environmental related inventions in terms of absolute numbers and their shares within the technology fields of electronics, materials, biotechnology and power sources were based on the annual data for the last decade. The shares of environmentally oriented inventions at the fields of electronics, materials, biotechnology and fusion power over the last decade remained as low as 1%, 5%, 9% and 2%, respectively, indicating low market demand for environmental applications. On the contrary the shares of inventions related to green power sources increased from 54% to 60% over the last decade, most probably due to intragovernmental actions on reduction of carbon dioxide emissions that took place over the last decades. Similar actions should be implemented promptly in order to support the innovativeness and technology transfer related to management of electronic and material waste in the following decades.

Keywords

Technology transfer, environmental protection, key enabling technologies, electronic waste, recycling, recovery, metals, rare earths, batteries, fossil fuel, fusion, nuclear, green power generation.

1. INTRODUCTION

Key Enabling Technologies (KETs) – a group of six technologies: micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies – increase industrial innovation to address societal challenges and creating advanced and sustainable economies [1]. In addition to having the highest potential for growth at the global markets the KETs have several applications related to the environmental protection, but there are also certain environmental issues associated with KETs at various fields.

Information technology is important for the growth of any country, but with the sudden development of new TV sets, smartphones, computers and their relatively short lifespan, the accumulation of waste electronics is increasing. Waste electrical and electronic equipment contains toxic substances that may leach into the ground and emissions that may escape into the air when disposed. Direct environmental impacts are the release of acids, toxic substances and heavy metals and carcinogenic chemicals [2].

In developed countries, formal sectors for e-waste management are being established, which take care of manual disassembly followed by semi-automated separation of various materials from which further attempts are made to recover metals using "state of the art" methods in smelters and refineries. In underdeveloped countries, equipment disassembly and separation of materials is manual, and the recovery of metals is made by heating, burning, and acid leaching of e-waste scrap in small workshops causing additional damage to environment [2].

Many batteries still contain heavy metals such as mercury, lead, cadmium, and nickel, which can contaminate the environment and pose a potential threat to human health. Batteries represent a complete waste of a potential and cheap raw material, when improperly disposed. In addition, battery recycling is not feasible from economic point of view. However, nanotechnologies could provide more economical battery recycling in the future [3].

Nanotechnologies are also used in radioactive waste clean-up in water, direct seawater desalination and disinfection by using nanochannels and nanopores, oil and water separation, detection of pollutants, carbon dioxide fixation, artificial photosynthesis, photocatalytic degradation of organic pollutants in waste waters, superhydrophobic and intelligent construction materials etc. [3].

In biotechnology, biological treatment plants are well known for removal of organic impurities in solid, liquid and gaseous form and removal of heavy metals from waste materials. An important application of environmental biotechnology are also biosensors enabling biomonitoring, including monitoring of biodegradability, toxicity, mutagenicity, concentration of hazardous substances, and monitoring of concentration and pathogenicity of microorganisms in wastes and in the environment [4].

Photonics have enormous potential of reducing the greenhouse and non-greenhouse gas emissions by reducing the electricity consumption from traditional energy sources [5]. Photonics have already significantly contributed to climate protection by applications such as energy saving light bulbs and LED lighting, photovoltaics and communication via fibre optic networks. Other environment protection related applications of photonics are at the moment in the beginning of their growth trajectory and include early detection of forest fires, laser-supported metal recycling and optical communication in 5G mobile networks [5].

In best case scenario, the introduction of automation will have a positive impact on the environment: greenhouse and non-greenhouse gas emissions will be reduced as well as the use of natural resources. However, automation will lead to increased electricity consumption, so the impact of increased automation on the environment depends primarily on how society will cope with the replacement of "dirty" energy sources. In worst case scenario, automation at the expense of increased electricity consumption would lead to increased greenhouse and toxic gas

emissions and increased consumption of natural resources, increased consumption of rare materials for building electronic equipment and increased electronic waste [6].

In addition to the growing need for recycling, recovery and regeneration due to lack of natural resources there is also a growing need associated with the electric power generation [7]. In particular, the source of electricity will determine the extent of damage that power generation will cause to the environment. Primary energy sources such as crude oils, coal and natural gas exhibit the highest amounts of greenhouse and toxic gases and should be reduced on behalf of the increased use of nuclear [8] and presumably fusion [9], hydro power and especially green power sources such as geothermal, wind, solar and bio energy [7].

Environmental protection related inventions will benefit the society and benefiting the society should be the main and only morally acceptable focus of public as well as private entities.

In this study, we examined the emergence of patent documents related to environmental protection at the fields of electronics, materials, biotechnology and power sources. We hypothesized: (i) that environmental applications should account for about half of all innovations now days; (ii) that the share environmental applications had grown sharply over the past decade.

The aim of this study was to search for the guidelines for future technology transfer based on the occurrence of environmental related inventions at the mentioned main fields of technologies and identifying the environmental protection related niche areas of the highest potential for growth to which the future technology transfer activities should focus on.

2. METHODOLOGY

The results of this study are based on comparison of the occurrence of patent documents between the general key enabling technology (KET) areas and its sub-areas related to environmental protection applications (e.g. area of "electronics" compared to its subarea "electronic waste") within the priority period from 2008 until 2018. Since the content of patent applications is normally confidential for the first 18 months after the priority date, the priority period 2008-2018 is quite well reflecting the known prior art of the last decade (June/July 2010 to June/July 2020). This paper was written in August 2020.

Keywords denoting different areas and subareas within KETs were selected based on the known literature considering the widest possible coverage of technology fields: The keyword (*electronic*) was selected to cover electronics, micro- and nano-electronics; the keyword (*material*) was selected to cover materials and advanced materials as well as micro- and nano- materials and consequently a certain range of nanotechnologies; the keyword (*bio*) was used to cover biotechnology.

Various combinations of keywords referring to metals, rare earths and batteries were selected rather than those referring to advanced production and photonics. According to the literature the natural resources such as metals and rare earth elements and magnets are often a limiting factor of advanced production, electronics and photonics sectors. For the purpose of this study batteries were classified among the materials although in reality the field of batteries is rather interdisciplinary representing the intersection between electronics, materials, chemistry, advanced production, photonics and energy conservation.

Fusion as the potential new power source and traditional power sources such as nuclear and fossil fuel were compared to green power sources such as hydro, wind, solar, geothermal and bioenergy.

The analyses was performed using PatBase [10] in August 2020. The exact keywords and combinations with basic Boolean operators and symbols are listed under the PatBase queries in Table 1. The PatBase search was set to search within titles, abstracts and claims (TAC) which are usually available in English language after publication by majority of national patent offices. Priority date (PRD) field was set to search within a certain year. In Table 1 the PRD was set to year 2018 for all the queries and the results were further analysed by PatBase analyticsv2 providing the numbers of filed, granted and published patent families, top five assignees and top five jurisdictions. Ten separate searches for data on the number of patent families without further analysis with PatBase Analytics v2 were performed for each of the priority years from 2008 to 2018 and graphically presented on Figure 1 and Figure 2. The calculations in Table 2 are based on the same dataset as Figures 1 and 2. Tables and Figures were prepared by Microsoft Excell software. Whenever average values were calculated the corresponding standard deviations are presented next to the average values (e.g. average value ± standard deviation).

There were 651.578 patent families for the query "TAC=(*material* and PRD=2018:2018)". PatBase analyticsv2 is capable of analysing up to 250.000 patent families at once. In order to maintain the comparability of results and for the reasons described in the previous paragraphs of this section, only the areas of metals, rare earths and batteries and their corresponding environmental protection related subareas were included into the analysis.

3. RESULTS

The patent families (Table 1 and 2, Figures 1 and 2) having priority filing dates in 2018 were published in summer 2020 and therefore represent the latest known prior art in the time this paper was written. Approximately half of the patent families filed in 2018 were granted by at least one jurisdiction and each of them was published by approximately five different jurisdictions. The term "invention(s)" will be used in the following text referring to the filed, granted and published patent families at the fields of Electronics, Materials / Chemistry, Biotechnology and Power Sources.

Table 1: Number of filed, granted and published inventions (patent families) and top five assignees and jurisdictions based on the specific PatBase queries denoting wide areas (white background) and environment protection related sub-areas (shadowed background) within the technology fields.*

Technology Fields	Areas and Sub-Areas	PatBase query	Patent families filed	Patent families granted	Patent families published	Top five assignees	Top five jurisdiction
Electronics	Electronics	TAC=(*electronic*) and PRD=2018:2018	174.737	88.457	577.376	Samsung Electronics Co. Ltd GuangDong Oppo Mobile Lenovo Group Ltd Qualcomm Inc Apple Inc.	China P. Rep. USPTO WIPO Japan EPO
	Electronic waste	TAC=(*electronic* AND *waste*) and PRD=2018:2018	2.332	1.170	12.229	Ford global technologies Alibaba Group holding Ltd. Beijing Qihoo Tech Co. Ltd Netease Hangzhou Networl Co. Ltd Univ. Shanghai 2ND Polytechnic	China P. Rep. WIPO USPTO EPO Japan
Materials	Metal	TAC=(*metal*) and PRD=2018:2018	218.502	108.249	757.025	Taiwan Semiconductor MFG Co. Ltd Samsung Electronics Co. Ltd Intel Corp; LG Chemical Ltd. BOE Technology Group Co. Ltd	China P. Rep. USPTO WIPO Japan EPO
	Metal recycling	TAC=(*metal* AND (recover* OR recycl*)) and PRD=2018:2018	9.587	4.285	54.242	Exxon Mobil Corp. Univ. Kunming Science and Tech Univ. Central South UOP LLC BASF SE	China P. Rep. WIPO USPTO EPO Japan
	Battery	TAC=(batter*) and PRD=2018:2018	145.739	82.062	331.599	LG Chemical Ningde Contem… Sonoef Hefei Tech Hefei Guoxuan Bosch Gmbh	China P. Rep. USPTO WIPO Japan South Korea
	Battery recycling	TAC=(batter* and (recycl* or regenerat*)) and PRD=2018:2018	2.484	1.087	9.221	Toshiba KK Bosch Gmbh Toyota Jidosha KK Honda Motor Co. Ltd Toyota Motor Corp.	China P. Rep., USPTO WIPO Japan EPO
	Rare Earths	TAC=(rare AND earth* AND (magnet* OR element*)) and PRD=2018:2018	2.971	985	13.769	TDK Corp. Nichia Corp Hitachi Metals China Petroleum Univ Jiangxi Scientific	China P. Rep. USPTO WIPO Japan EPO
	Rare Earths recovery	TAC=(rare AND earth* AND (magnet* OR element*) AND recover*) and PRD=2018:2018	164	60	1.223	Sabic Global Technologies BV Exxon Mobil Corp. Univ Jiangxi SCI and Technology Inner Mongolia Jarud Banner Luan Commissariat A Lenergie Atomique	China P. Rep. WIPO USPTO EPO Canada
Biotechnology	Biotechnology	TAC=(bio*) and PRD=2018:2018	99.862	37.244	497.744	IBM Samsung Electronics Co. Ltd Univ. California Univ. Jiangnan Univ. South China Tech.	China P. Rep. WIPO USPTO EPO Japan
	Bio waste treatment	TAC=(biotreat* OR Biodegrad* OR bioaugment* OR biosens* OR biomonitor*) and PRD=2018:2018	7.208	2.566	42.793	Univ. Jinan Univ. Tianjin Univ. California Univ. South China Tech. Univ. Zhejiang	China P. Rep. WIPO USPTO EPO South Korea
Power sources	Fossil Fuel	TAC=(power AND (crude* OR coal OR gas OR fossil)) and PRD=2018:2018	27.824	15.535	110.970	Tokyo Electron Ltd. Applied Materials Inc. Toyota Jidosha KK United Technologes Ltd. Huaneng Clean Energy RES Inst.	China P. Rep. USPTO WIPO EPO Japan
	Nuclear	TAC=(nuclear AND power) and PRD=2018:2018	3.214	1.739	11.245	China General Nuclear Power China General Nuclear Power ENG Cnnc Nuclear Power MAN Co. Ltd. Jiangsu Nuclear Power Corp. China Nuclear Power Design Co. Ltd.	China P. Rep. WIPO USPTO South Korea Japan
	Fusion	TAC=(fusion AND power) and PRD=2018:2018	1.512	708	17.226	State Grid Corp. China Hewlett Packard Development Co. Siemens AG Saint Gobain SA Corning Inc.	China P. Rep. WIPO USPTO EPO Japan
	Green	TAC=(power AND (hydro* OR wind OR solar OR geothermal OR bio*)) and PRD=2018:2018	48.465	27.245	167.115	State Grid Corp. China Beijing Hanergy Photovoltaic Invest Beijing Boyang Dingrong PV Tech Beijing Goldwind Science and Hanergy Mobile Energy Holding	China P. Rep. WIPO USPTO EPO Japan

* PatBase queries were based on the keywords to be searched in titles, abstracts and claims (TAC) across the patents and patent applications having priority date in 2018 (PRD=2018:2018). Analyses were performed using PatBase in August 2020. Priority patent applications are published after 18 months from the priority date. The represented data therefore reflects the present known state of the art.

There is a correlation between number of filed, granted and published patent families within the categories of Table 1. Average ratio of number of granted and filed patent families was $0,46 \pm 0,08$ and the average ratio of number of published and filed patent families was 5 ± 2. The results in the following

Table 2 and Figures 1 and 2 are based on the filed patent family data.

The queries referring to technology field of Materials have jointly contributed the highest number of inventions filed in 2018 followed by the fields of Electronics, Biotechnology and

Power. The situation is different when comparing environmental protection subareas within the general technology fields. The highest number of environmental related inventions is the subarea Green followed by Metal recycling, Bio waste treatment, Battery recycling, Electronic Waste and Rare Earths recovery subareas representing the descending order of Power, Materials, Biotechnology and Electronics fields in terms of the number of inventions (Table 1). A similar order in the number of inventions by field has been observed over the past decade (Figures 1 and 2) with the exception in the field of Batteries and Biotechnology. In 2008 fewer Battery related priority patent applications were filed as compared to Biotechnology, but from 2015 onwards the field of Batteries exceeded the field of Biotechnology by the number of inventions due to presumed exponential growth (R2 = 0,98) of Battery related inventions (Figure 1). However, in general the number of inventions within all areas has been growing over the priority years 2008 – 2018 (Figures 1 and 2, Table 2). Moreover, the number of inventions in general areas of technology as well as the number environmental related inventions were growing proportionally resulting in similar proportions of environmental related inventions within the general areas in 2008 and 2018 (Table 2).

The proportion of environmental related inventions within the general fields of Electronics, Materials and Biotechnology was low, ranging from 1% up to 10%, throughout the whole priority filing period 2008-2018. The said proportions have slightly increased over time except the proportions of Bio waste treatment related inventions, which dropped from 10% to 7% from 2008 to 2018, respectively. On the contrary, the proportion of Green Power within the field of different Power sources was higher than 50% in 2008 and increased to 60% in 2018 (Table 2, Figure 2).

Top five assignees are presented for each of the areas listed in Table 1. Some of them are active in more than one area at the same time: Samsung Electronics in areas of Electronics, Metals and Biotechnology; LG Chemical in areas of Metals and Rare Earths; Exxon Mobil Corp. and Univ. Jiangxi Scientific in area of Rare Earths and Rare Earth recovery; Toyota Jidosha KK in area of Battery recycling and Fossil fuels; University of California in Biotechnology and Bio waste treatment and State Grid Corp. China in areas of Fusion and Green Power Sources. The top assignees listed under the general areas usually differ from the ones listed under the environmental protection related subareas (Table 1).

In general, based on the number of published inventions the top five jurisdictions were China, America, Europe and Japan appearing in descending order. South Korea is classified among top five jurisdictions in the areas of Batteries and Bio waste treatment and Nuclear Power sources displacing European, Japan and European jurisdictions from the top five jurisdictions at the said areas, respectively. Canada displaced Japan among the top five jurisdictions at the field of Rare Earths recovery.
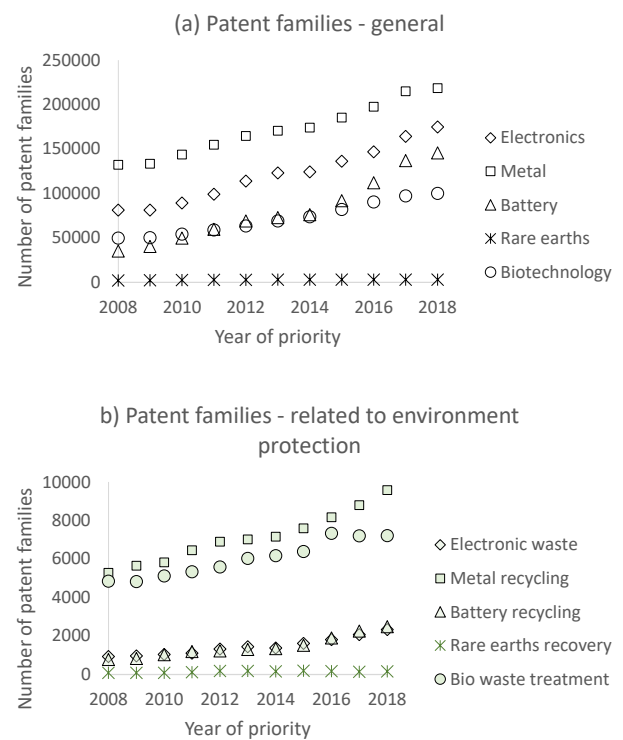
Figure 1: Number of inventions (patent families) with priority dates ranging from 2008 to 2018 referring to: (a) general areas of Electronics, Materials - including metal, rare earths and batteries - and Biotechnology; (b) environment protection related sub-areas of electronic waste, recycling or regeneration of materials - metal, rare earths and batteries - and bio waste treatment.*
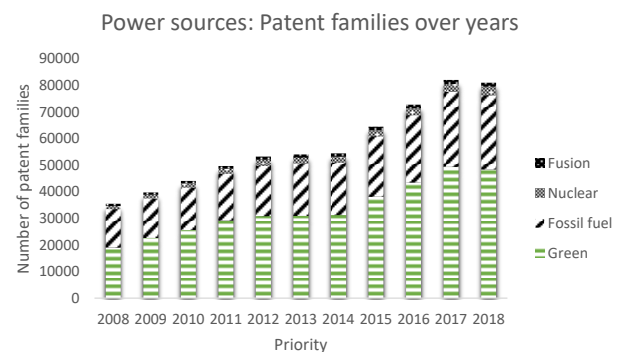
Figure 2: Number of inventions (patent families) with priority dates ranging from 2008 to 2018 referring to different power sources: fusion; nuclear; fossil fuel including crude oil, coal and gas; and green including hydro, wind, solar, geothermal and bioenergy sources.

Analyses were performed in August 2020 using PatBase [10] and PatBase queries listed in Table 1.

Table 2: Absolute numbers of general and environmental related inventions (patent families) filed in 2008, 2018 [Nr.] and the proportions [%] of environmental related inventions (patent families) filed in 2008 and 2018 and the 10-year average (Avrg) proportion with corresponding standard deviation (stdev).*

Environmental related subareas		General areas		Number and percentage of environmental related patent families in priority years							
				2008			2018			2008-2018	
				[Nr.]		[%]	[Nr.]		[%]	Avrg	Stdev
Eletronic waste	:	Electronics	=	928	: 81266 =	1,1%	2332	: 174737 =	1,3%	1,2% ±	0,1%
Metal recycling	:	Metal	=	5284	: 132352 =	4,0%	9587	: 218502 =	4,4%	4,1% ±	0,1%
Battery recycling	:	Battery	=	776	: 35109 =	2,2%	2484	: 145739 =	1,7%	1,8% ±	0,2%
Rare Earths recovery	:	Rare Earths	=	88	: 2123 =	4,1%	164	: 2971 =	5,5%	5,0% ±	1,0%
Bio waste treatment	:	Biotechnology	=	4850	: 49774 =	9,7%	7208	: 99862 =	7,2%	8,6% ±	0,9%
Green Power	:	Power	=	19023	: 35513 =	54%	48465	: 81015 =	60%	58% ±	2%

*data on the number of patent families for individual filing years 2008-2018 are represented at the Figures 1 and 2. The PatBase queries referring to the keywords shown in Table 1 were combined with the priority dates (PRDs) ranging from 2008 to 2018 reflecting the known prior art from 2010 to 2020.

4. DISCUSSION

The results indicate that the shares of environmental applications account for less than 10% of all innovations in the fields of electronics, materials and biotechnology now days and there was no sharp growth of the shares of environmental applications observed over the past decade in these fields (Table 2 and Figure 1), which is not consistent with any of our introductory hypotheses. On the other hand, in the field of power sources the environmental applications account for more than half of all inventions, while their share grew from 54% to 60% over the past decade, which is consistent with the hypotheses.

A possible explanation for extremely low share (approximately 1%) of inventions in the field of "electronic waste" within the wider field of "electronics" could be due to inappropriate methodological approach - choosing too secular keyword for the analysis (as explained latter this was not the case). Electronic waste is indeed a mix of different materials and its recycling is therefore closely linked to the recycling of various materials including metals, rare earths and batteries [2]. Interestingly, Samsung Electronics did not only appear among the top five assignees in the field of its core business (electronics), but also in the field of metals, which is not surprising, since Samsung is investing in the development of metals (e.g. semiconductors), which are an integral part of electronic devices they are producing [11].

However, the proportions of inventions related to recycling, recovery and regeneration of metals, rare earths and batteries were low as well, amounting approximately 4%, 5% and 2%, respectively. And the top five assignees in the general areas of electronics, metals, rare earths and batteries were mostly different to those associated to the subareas related to recycling, regeneration and recovery of these products.

With electrification of transport and growing demand for natural resources, the need for batteries and battery recycling is growing sharply, which explains the presumed exponential growth in terms of the number of inventions in this area. It is not surprising that representatives of automotive industry and/or auto parts suppliers Toyota, Honda and Bosch are among the top five assignees in the subarea of battery recycling. It seems that national programs need to become involved to support the recycling of products, otherwise these activities would not be economically feasible for large corporations. For example,

Toshiba, Panasonic and Sharp funded an Electronic Manufacturers Recycling Management Company (MRM) in 2007 and Toshiba as the top assignee in the field of batteries is also a partner of the Rechargeable Battery Recycling Corporation (RBRC) under the national U.S. Call2RecycleTM program dedicated to recycling of batteries [12].

Surprisingly, two large IT corporations Samsung and IBM appeared in the general area of Biotechnology, most probably due to their activities in healthcare and life sciences, such as computational biology [13] and pharmaceuticals [14]. However, the Bio waste treatment subarea was dominated by universities. Universities of California and South China appeared among top five assignees in both, general Biotechnology area and Bio waste treatment subarea as well. In addition to the absence of large corporations at the subarea of "Bio waste treatment", the average proportion of "Bio waste treatment" related inventions has decreased from 10% to 7% over the last decade.

Technology transfer in the field of environmental solutions is often unsuccessful because, as evidenced by the low proportions of environmental inventions in this study, market interest in environmental technologies is low. As a result, a negative feedback loop arises: (i) Environmental solutions are not a priority to companies, since they present financial loss rather than profit to them. For example, the introduction of recycling of products in parallel with the production would drastically affect the price of products and consequently the competitiveness; (ii) Public research organizations, which are supposed to be a driver of innovation and the well-being of society are trying desperately with the commercialization, but they sooner or later stop with patenting of environmental solutions due to the low probability that these technologies will be licensed out to companies. Therefore, it would be illusory to expect that the corporations mentioned in this study - in other words the largest producers of waste and pollution - will begin to change their attitude towards the environment on their own [15].

As mentioned in the introduction, photovoltaics and other photonic applications will contribute to reduced electricity consumption and consequently lower greenhouse gas emission [5]. On the other hand, advanced production will increase the consumption of electricity and presumably increase the greenhouse gas emission [6]. Switch to green power sources is therefore extremely important [7]. However, it is necessary to

understand that the power generation from green sources is less reliable due to low capacity potential and dependency of momentary environmental parameters. Therefore, complete transition to green sources is most probably not possible and the need for reliable power sources, such as fossil fuels and nuclear power will remain [8].

Fusion power will be able to replace environmentally harmful energy production with fossil fuels in the future, if successful [9], but decades will pass by then. This is also evident from the number of inventions related to fossil and nuclear power sources, wherein a number of inventions related to less environmentally friendly fossil fuel was approximately nine times higher as compared to cleaner nuclear and fusion power sources. However, the major concept of the vast majority of fossil fuel inventions was related to carbon dioxide according to PatBase Analyticsv2 [10], indicating that research and development in this area is mainly concerned with optimizing fuel use towards lower carbon dioxide emissions, which is admirable.

Even more favorable trends were observed in the field of green power at which the share of inventions was high and has grown from about 54% to 60% in the last decade. These data are encouraging in terms of reducing the global warming, environmental pollution and health hazard originating from "dirty" power sources, which gives optimistic forecast for the future.

A kind of "push" obviously exists at the energetics sector that forces states, governments and consequently all kinds of private and public entities including the players of innovation ecosystem to deal with environmental issues. This might be not only due to a lack of natural resources, but also due to clear rules at international and intergovernmental level, which oblige countries to respect the environment globally. The 1997 Kyoto Protocol, which has been in force since 2005 and replaced by the Paris Agreement in 2015 [16] seems to play a key role encouraging innovation towards the use of green energy sources by reducing the carbon dioxide emission [7].

Despite the fact that some countries do not respect the Kyoto Protocol and later Paris Agreement, it still is a good practice as it has - by insisting on solving climate problems at the international and intergovernmental level - created markets for green power sources around the world. Even China for example, which has often been declared a non-Kyoto country, is active producer of the equipment related to exploitation of green power sources – most probably due to the existence of global market as well as due to its own awareness on the environmental issues in the last decades [17]. Environmental issues associated with the "dirty" power sources are decades old and have been consequently addressed more in detail by the relevant authorities as compared to newer environmental threats (e.g. electronic waste, batteries, rare earths, metals etc.).

The establishment of the UN E-Waste Coalition and the introduction of the Platform for Accelerating the Circular Economy (PACE) [18] will hopefully lead to at least as effective international protocols in the field of electronics and waste material recycling as were established in the field of power sources. Measures that would encourage companies to protect the environment should therefore apply to all companies and all countries in order to maintain healthy competition between them. Once such a global pressure will be established, new markets will appear committing the private and public entities to become innovative also at the field of environment protection.

Technology transfer within the innovation ecosystem is a part of the solution, but unfortunately it works well in case of clear demand for breakthrough technologies at the market. In the field of alternative energy sources, intergovernmental agreements have emerged over the decades, creating such a demand for technologies enabling the exploitation of alternative power sources. This can be observed by the high number and shares of inventions in the field of green power sources.

However, the need in the market has yet to be created for technologies dealing with recycling of waste electronics and waste materials. And it is illusory to expect that this demand will arise on its own without adequate political support to put pressure on manufacturers globally. The task of the innovation ecosystem stakeholders is therefore to properly present these problems to the interested public, through which the pressure to the policy makers will be exerted. In fact, it would be great, if the solution in the field of electronic waste and waste materials management would be even more efficient and implemented faster than in few decades.

5. CONCLUSIONS

Although the number of inventions has generally increased over the past decade, the share of environmentally oriented inventions has not changed at the fields of electronics, materials and biotechnology, and has remained on average as low as 1%, 5% and 9%, respectively.

Large corporations leading at the areas of electronics, materials and biotechnology are not as innovative and active at the subareas related to the recycling of their own products, therefore they should refocus and invest into the environmental protection. In order to do so, legal basis, programs and incentives for non-profit recycling at national, international and global levels are beneficial.

On the contrary, the situation is more optimistic in the field of electric power generation, wherein the share of inventions related to green power sources grew from 54% to 60% in the last decade suggesting that technology transfer works well in case of clear demand at the market. In the field of alternative energy sources, intergovernmental agreements have emerged over the decades, creating such a demand for technologies related to exploitation of green power sources.

The players of innovation ecosystem should therefore convince and support the interested public to exert the pressure to the policy makers in order to create a market demand for the technologies dealing with recycling of wastes, especially electronic and material waste through establishment of intergovernmental agreements on the global scale.

6. AKNOWLEDGEMENTS

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Transfer of knowledge and skills in STEM: Exploring and promoting digital analysis skills - Testing optimal conditions of X-ray irradiation

Prenos znanja in veščin na področju STEM: Raziskovanje in promocija digitalnih veščin: Testiranje optimalnih pogojev rentgenskega obsevanja

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ABSTRACT
In this paper, we describe the transfer of knowledge and skills between the High school and University system in establishing of a digital environment for analytics in physics experiments. ICT skills are essential in establishing the potential for automated or digital analysis in the observation of physics experiments. We have proven that this claim is valid in the case of X-ray detection on a imaging phantom. We photographed an irradiated imaging phantom under different initial conditions and tried to compare results with each other in terms of different output parameters as optimal voltage used and signal to noise ratio. With the help of independently created automated Python software for the RGB analysis of the images and using analytical tools as Root and Logger Pro programmes, we showed that collaboration between the two educational systems is crucial for the transfer of knowledge and skills.

Keywords
Digital technologies, digital skills, data analysis, STEM, X-ray detection, imaging, observation

POVZETEK
V tem prispevku opisujemo prenos znanja in veščin med gimnazijo in univerzitetnim sistemom pri vzpostavitvi digitalnega okolja za analitiko v fizikalnih eksperimentih. IKT spretnosti so bistvenega pomena pri ugotavljanju možnosti avtomatizirane ali digitalne analize pri opazovanju fizikalnih eksperimentov. Dokazali smo, da ta trditev velja v primeru rentgenskega zaznavanja na slikovnem fantomu. Fotografirali smo obsevan fantom za slikanje v različnih začetnih pogojih in poskušali med seboj primerjati rezultate glede na različne izhodne parametre kot sta optimalna uporabljena napetost in razmerje signal / šum. S pomočjo neodvisno ustvarjene avtomatizirane programske opreme Pyton za RGB analizo slik in z uporabo analitičnih orodij kot sta programa Root in Logger Pro smo pokazali ključno soodvisnost med obema sistemoma izobraževanja za namen prenosa znanja in spretnosti.

Ključne besede
Digitalna technologija, digitalne veščine, analiza podatkov, STEM, rentgensko zaznavanje, slikanje, opazovanje

1. INTRODUCTION
In today's world, knowing digital approaches is increasingly crucial. On the other hand, the relationship between the various branches of science - chemistry, physics, computer science - even in the education system itself is still in its infancy. Interdisciplinarity and cross-curricular integration depend on individual initiatives. Particularly noteworthy is the link between information technology and science education to motivate young people to STEM content. In this context, digital skills are crucial for establishing closer links between science and education. We presented one of the options in our paper.

In this paper, we describe an experiment done in collaboration between the International Baccalaureate at the Gimnazija Bežigrad and the Faculty of Physics and Mathematics of the University of Ljubljana. The aim of this experiment was twofold: firstly, to explore how changing the voltage affects different image quality properties in X-ray Imaging phantom detection; secondly, to explore how and to explore digital tools necessary to execute the experiment as a regular study and collaboration tool. The experiment and its data analysis allows for an exploration of digital tools in STEM experiments and can represent a good basis for further collaboration between the institutions.

The crucial element of this work was to establish a collaboration that would enable the realization of the goal. The goal of this research was to prove the correlation between the voltage applied to the X-ray apparatus and the image quality of the recorded picture. We were also exploring the impact of the distance between the fluorescent screen and the phantom irradiated by the x-ray apparatus on the intensity of the light measured.

The experiment conducted is based on the theory of X-rays. The rays are produced by an apparatus, where a certain voltage is applied to a X-ray tube that accelerates the electrons towards the molybdenum's anode. The x-ray beams are the result of the interaction of electrons with matter. They are shielded by a collimator so that can only exit the sources at a certain spatial angle.

The detection of X-rays was achieved by taking a picture of a fluorescent screen [1], which emitted fluorescent green light when hit by x-rays, with a camera. The acquisitions had to be taken in complete darkness with a long exposure time to enable enough light to accumulate on the sensor.

After the data was converted to numerical form, a double error function was fitted on the 2D response image. The parameters, which I received as an output, were then used in the analysis.

2. METHODS
The experiment was performed at the University of Ljubljana, Faculty of Mathematics and Physics. I used the experimental equipment for the X-ray exercise of the subject Laboratory experiments V [2].

The detection of the x-ray particles was double-phased. The apparatus used to produce x-rays was "Didaktiksysteme 554811" [3]. The first part of the experiment was acquiring data in the form of captured photos, whereas the processes and techniques employed further on my research are analytical and systematical.

However, there is a second segment of activities embedded in this paper. It presents a proposal for technology transfer between different parts/sectors of the educational system. In particular, the paper proposes to enhance the capabilities of high schools by giving them access to digital tools that can only be found on the university level, but which could potentially be utilized by high school students.

2.1 Transfer of knowledge from one to the other educational environment

It has soon become clear that without digital tools the observation of the processes taking place in the imaging phantom and the setup as a whole would be impossible on the level of accuracy requested to draw reliable conclusions.

Thus the second aim of the study was to use existing and to develop missing digital tools to enable RGB analysis of the images taken.

These tools were developed with the assistance of the experts from the University of Ljubljana, Faculty of Mathematics and Physics and Jožef Stefan Institute.

The main purpose of the collaboration was to enable quick, accurate and reliable analysis.

On the other hand, the process at hand demanded that a knowledge transfer in terms of technologies used and skills that enable analysis, to be transferred from one educational environment to the other, to enable analysis of the data themselves.

2.1.1 Transfer of knowledge and skills in STEM
During the measurements it soon became obvious that the scope of analysis is too broad and too extensive to allow for a usual approach of analysing single data sets with simple analytics tools as Excel or Logger Pro analysis, which are usually used in the high school environment.

Thus in a constructive dialogue with my IB Physics teacher it was decided to seek for further assistance with the experts at the Faculty of Matematics and Physics and Jožef Stefan Institute.

They proposed to collaborate on creating suitable analytics tools that would be useful for the concrete analysis, but would also be further used in the IB process, if necessary. The digital skills in question included in particular:

-   Python script-image color processing,
-   Root script-intensity analysis and
-   image splitting.

The relevant digital skills to be transferred from a University to a High School environment proved to be crucial for the execution of the research at hand.

To understand how the process of knowledge transfer happens from a University to a High School environment, we need to start with more background information on how collaboration between high school and faculty commenced and where in the process the knowledge transfer occurred.

2.1.2 Process of transfer
Since 2017 in Slovenia there is a systematic approach, the project SKOZ [4], trying to connect students from high schools to mentors at the Public research organizations. Although this particular connection has been established via personal means, it

is significant, that the researchers involved take part in the initiative SKOZ.

The project itself will end at the end of 2020, during which time, together with schools from the Western Cohesion Region, research partners and business partners, established a solid and functioning network of organizations that encourage the most talented students with projects. Jožef Stefan Institute took part in the initiative, supporting more than 40 students so far.

The purpose of SKOZ was to connect students with mentors and experts for the transfer of knowledge, in order to allow specific subjects from a supportive environment to deal with the field of work in specific research of the students.

Gimnazija Bežigrad was not the recipients of the funds of the tender announced in August 2017 by the Ministry of Education, Science and Sport. Even though it was not actively involved, it still aimed at supporting and encouraging collaboration of the experts with talented students.

In line with the idea of the project, in which the experts of the Jožef Stefan Institute actively collaborated and understood its purpose, also other more personal initiatives as this one were absorbed.

Thus on the point where digital skills transfer of knowledge was established as a break through element, which will enable this study to be carried out, although via personal contacts, the collaboration has been established between the IB Gimnazija Bežigrad student and the experts from Jožef Stefan Institute and Faculty of Mathematics and Physics.

The transfer of knowledge resulted in the setup of the processes required for the data analysis, as described below.

2.2 Analysis of data
2.2.1 Python script- image color processing
The photos taken by the camera were then transferred to a computer, where further analysis was carried out. The captures were analyzed using a Python script that determines a specific RGB light composure of a certain pixel on a straight line, whose direction and extremes are provided by the user. The result of the image color processing is a graph of light intensity in the correlation with coordinate of the pixel explored. The base code was found on the internet [5] and was then changed so that it suited my experiment's needs.

2.2.2 Root script- intensity analysis and image splitting
ROOT [6] was in this experiment used in two parts of analysis. Firstly, the picture of the phantom had to be split up in several smaller pictures, which were only showing one hole in the phantom at a time. This step was required to enable easier management with the original data. Other processes in the analysis were then run on large amount of very similarly structured photos, which enabled the code to be less complicated.
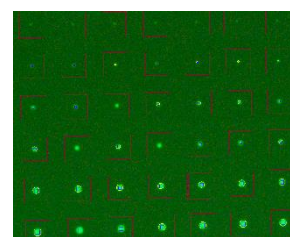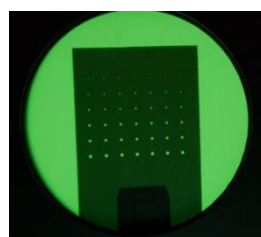

Figure 1. Irradiated phantom   **Figure 2. Image splitting**

Secondly, the color analysis done in ROOT analysis framework is similar to the one in Python. However, in this case the options for the analysis are much wider. A light composition analysis investigation can be done over the x-, y- axis and over the whole

picture. To achieve the highest accuracy of the outputting values the analysis over the whole picture was done. The program tried to fit an error function [7] on the 2D response. Borders of such a signal is usually treated as a Gaussian function [8], so when a number of signals are treated together as one signal, convolution of the point response with the image shape makes the borders take form of an error function. The fitting of an error function was in my case used all around the given circular 2D signal (Fig.6).
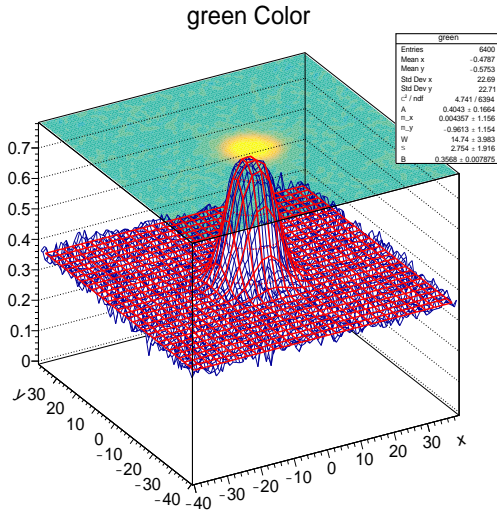
Figure 3. 2D histogram of a captured photo

The outputs that determined the double error function were:

-A, the height of the signal,
-W, the width of the signal,
-B, the height of the background,
-∂, the width on the half of the height of the graph od derivative of the error function

2.2.3 LoggerPro analysis
The data acquired from the analysis by the code in Python and ROOT can be transferred to LoggerPro by importing the data as a text file with different columns. After the data is appropriately represented, we can identify the average height of the signal and the average width of the border by using cursor coordinates displayed by LoggerPro. The data gathered was then presented in the table to show the correlation. Graphs were drawn to explore different dependences.

3. RESULTS
The images captured using the phantom with holes and the above described setup (Fig.3), were analyzed using the described digital tools.

Our goal was to determine the sharpness of the holes' images. The results acquired from the exploration were firstly in the form of pictures (see example in Fig.7). After the analysis using the developed Python programming tools the results had a numerical form, since they represented an average width of the signal and the average height. Both obtained values are an important test of the sharpness of the picture border and the quality of the photo.

After the ROOT script was run on a set of little pictures, as presented above, the code tried to find the best fit for the mentioned double error function. The parameters that root used to find the best correlation, were then exported to a .txt file, where they could be used for further analysis.

On the pictures captured with the lower input voltage the smallest holes of the size of 0.5mm were really hard to see and the analysis of light intensity on those was not returning consistent results.

That is why I decided to perform the research only on the remaining 6 different sizes of gaps (0.8mm, 1mm, 1.4mm, 1.6mm and 2mm).
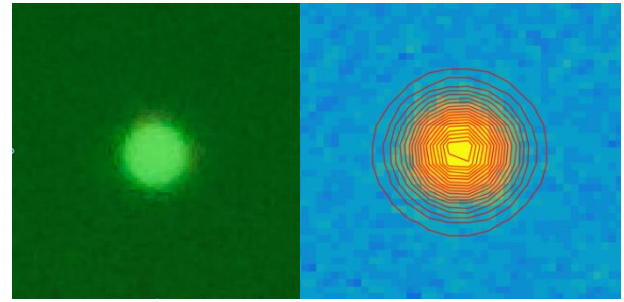

Figure 4. Example of analyzed material   (left)

Figure 5. Python color intensity test   (right)

The voltages used in this experiment are displayed in the table below:

Table 1. Accelerating voltages used on the X-ray apparatus

Trial no.	1	2	3	4	5	6
Voltage [kV]	35	32	29	26	23	20

The aim of this experiment was to explore how changing the voltage affects different image quality properties.

3.1 Resolution dependence on the voltage
σ is a parameter of the error function that essentially tells us how steep the border between the peak of the signal and background of the measurement is. It represents the width of a derivative function of the error function. The width of the derivative is a statistical value that tells us how well the border of the picture was captured, the quality of the image can be described.
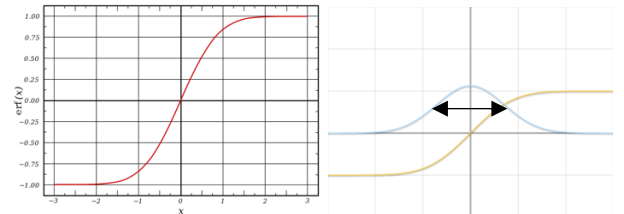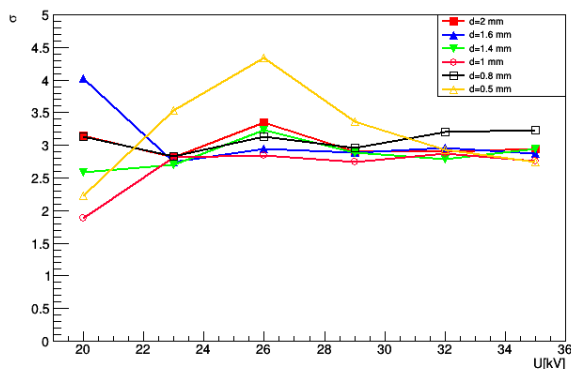

Figure 6. Error function   (left)

Figure 7. Average width of the derivative function of the error function   (right)

The data that was processed with the mentioned codes resulted in the graph, where the *sigma*-value does not increase or decrease with the variation of voltage. There was no found correlation since the changes in the values with different voltages are probably a result of a statistical error. The data gathered and averaged is collected in the table and the graph below.

Table 2. σ's average values for different gap diameters and voltages

Diameter of the hole [mm] / Voltage [kV]	2	1.6	1.4	1	0.8	0.5
35	3.07	3.43	3.47	3.38	3.63	3.72
32	3.03	3.45	3.46	3.46	3.60	6.04
29	3.00	3.44	3.47	3.41	3.11	3.54
26	3.21	3.66	3.70	3.49	3.68	2.97
23	2.92	3.33	3.48	3.17	3.28	3.55
20	3.93	4.39	4.46	8.93	10.17	4.01

Graph 1. σ 's correlation with voltage

We can clearly see that the differences between the values are not the consequence of the variation of voltage.

4. DISCUSSION
4.1 Usefulness of the Transfer of knowledge

As the baseline, I need to reconfirm the thesis that none of this work would be possible without the collaboration between Gimnazija Bežigrad and Jožef Stefan Institute alongside with the Faculty of Mathematics and Physics. The knowledge transferred in the field of digital skills and analysis were of the utmost importance for the design and execution of the experiment.

The role of the project SKOZ was previously explained and can here be reconfirmed that it has created, at least for this particular setup of people, technologies and skills needed, an awareness of a need for collaboration and transfer of knowledge between the different educational systems.

The creation of digital skills in a different environment and a transfer of knowledge and promotion of digital analytics has been subject to personal experience and efforts, which I am thankful for. This, however, also sheds a ray of light onto the future possible transfer of knowledge and skills between the two educational systems.

4.2 Accuracy of the established digital tools

The ROOT and Python analysis scripts I ran on captured photos often did not give very accurate output, because the starting parameters were not set correctly. Even though I worked on improving the code to the point, where the efficiency and reliability was relatively high, there were still some cases where the code using the described models did not converge with the initial parameters provided. Especially the part of the experiment, where the Root script was finding optimum double error function to fit on the given data, was problematic, since a small difference in the way function was structured had major impact on the output parameters.

To conclude, the experiment could of course be performed more efficiently, professionally, accurately, the errors could be minimized. However, I believe that with given time, resources and my non-existing previous experience with such machinery, the experiment was performed optimally, and the results are quite relevant as they show how and to what degree digital skills are important in analysis of data obtained in physics experiments.

Moreover, not only is the transfer of knowledge important between the industry and public research organizations. It is pertinent that the transfer of knowledge is supported between the educational systems to allow for an optimal human resources development for the future industrial needs.

5. CONCLUSION

Ultimately, the results could not have been obtained without using digital skills. STEM collaboration between high school and experts with highly developed digital skills is of utmost importance in order to firstly promote digital skills at a relatively early age of students, and secondly, to enable the students to learn them and use them in real-experimental setups, measurements and analysis.

The conclusion is, that transfer of knowledge is very important in the STEM field and that young people can obtain many options and opportunities with such transfer of knowledge, which would otherwise would not be achievable for them – and is not time financially or consuming for the university system at all. Only through transfer of knowledge and skills between the two educational systems optimal solutions can be found.

6. ACKNOWLEDGMENTS

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DODATEK / APPENDIX

INTRODUCTION AND AIM OF THE CONFERENCE

Conference topic: How to maximize the impact of technology transfer funnel at TTOs?

Subtopics:

Assisting enterprises in order to better use the RTD results from public research organizations

How to approach enterprises? The perspectives of TTOs, researchers and enterprises. The value proposition of early stage technologies for enterprises.

Creation of an efficient national Proof-of-Concept (PoC) funding system.

Helping spin-offs to succeed.

Improving the knowledge base of technology transfer experts.

Objectives of the Conference

The main aim of the Conference is to promote knowledge exchange between academia and industry, in order to strengthen the cooperation and transfer of innovations from research labs into industrial exploitation. The Conference goal is also further strengthening the knowledge base and experiences of technology transfer professionals at public research organisations.

In the past events, we hosted more than 2500 participants, including investors, inventors, researchers, students, technology commercialization and intellectual property experts, start-up funders, industrial development experts etc. We have successfully organized eleven competitions to award the team with their technology and business proposition with the biggest commercial potential, which led to successful start-ups and licensing contracts. Biannually we organise Research2Business (R2B) pre-scheduled meetings in order to give the participants additional opportunity to meet and discuss possible cooperation. Researchers presenting their work being financed by Slovenian Research Agency (ARRS) is another channel for enterprises to get familiar with recent discoveries and development opportunities.

Conference prize for the best innovations in 2020

The main objective of the special prize for innovation is to encourage commercialization of inventive/innovative technologies developed at public research organizations and to promote cooperation between research organizations and industry. One of the main objectives is also promoting the entrepreneurship possibilities and good practices in the public research organizations. Researchers are preparing business models for their technologies and present them to an international panel of experts in a pitch competition. They need support in many aspects of their path from research to industrial application. The researchers and their team need assistance, knowledge and tools to develop business models, find appropriate partners, form a team, and secure financial resources to bridge the gap from publicly funded research to the market, either in their own start-up (spin-out) company or by licensing out their technology. How shall they do it and how can we help them?

The Conference pitch competitions in the last eleven years resulted in spin-out company creation or licensing case development in at least one case per competition each year. In many cases, young researchers that participated in pitch competition in the past years, have been involved for the first time in an organized and structured process of development business model around their technology and preparation of the targeted (pitch) presentation about their planned venture to investors and technology commercialization experts.

WIPO IP Enterprise Trophy

The aim of the WIPO IP Enterprise Trophy is to stimulate Slovenian enterprises to intensify their cooperation with public research organisations. We wish to expose as a good practice those enterprises that are constantly and methodologically using the IP system in their business activities.

WIPO Medal for Inventors

The goal of the WIPO Medal for Inventors is to award inventive and innovative activity of Slovenian public researchers and to recognize their contribution to national wealth and development.

Research2Business meetings

In the course of the conference, pre-scheduled Research2Business (R2B) meetings will take place, allowing the representatives of companies and research institutions to discuss possible development solutions, inventions and commercially interesting technologies. Such meetings present an excellent basis for possible future research cooperation and business synergies.

Opportunities arising from publicly funded research projects / presentations of successful scientific projects

Researchers will be presenting their work that is being financed by Slovenian Research Agency.

Key stakeholders

The conference involves different key stakeholders in the process, public research organizations as knowledge providers, technology parks as infrastructure providers, business accelerators, intellectual property offices, IP attorneys, agencies, consultants, capital (venture capital companies, agencies, business angels), SMEs, international enterprises, private innovators, and others.

Target audience and benefits

Target audience of the conference are researchers, students and post-graduate students with entrepreneurial ambitions, representatives of industry, established and future entrepreneurs, innovators and also representatives from governmental institutions and policy-making organizations.

Introduction to the International Technology Transfer Conference

The International Technology Transfer Conference (ITTC) is organized by the **Jožef Stefan Institute** (Center for Technology Transfer and Innovation) for the 13th year in a row. The first ITTC was organized in 2008. The ITTC has, through the years, been presented in different formats and it is currently organized as part of the International multiconference Information Society (IS2020), organized by the Jožef Stefan Institute.

The Center for Technology Transfer and Innovation at the Jožef Stefan Institute is the coordinator of the project KTT (2017-2022), coordinator of Enterprise Europe Network Slovenia, and is a financially independent unit. The CTT is presently involved in 4 projects, having recently been involved in three additional ones. The Conference has been organized with the support of partners from the KTT project (2017-2022).

The previous project KTT, from 2013 through 2014, was the first project within which technology transfer in Slovenia was systematically funded from national funds. There were 6 partners involved, but the project only lasted for 17 months.

The current KTT project, 2017-2022, comprises 8 partners, all public research organizations (PROs), represented by their respective technology transfer offices (TTOs), namely, 4 leading institutes and 4 renowned universities.

The project's mission is twofold: the strengthening of links and increasing the cooperation of PROs and industry and the strengthening the competences of TTOs, researchers and enterprises. Most (80%+) of the finances go to human resource financing.

Support of Slovenian Industry

The goal of the KTT project is to support the industry in Slovenia, rather than an outflow of knowledge abroad or great profit for PROs. Collaboration between PROs and SMEs in Slovenia should be strengthened. However, Slovenian companies prefer contract and collaborative cooperation to buying licenses and patent rights. Also, a relatively low added value per employee and a low profit margin are not stimulating the research-industry collaboration.

Investing into Intellectual Property Rights

Despite the above stated it is important to invest in patents and other forms of intellectual property (IP). Investments in intellectual property increase licensing opportunities and the IP position of the Slovenian knowledge worldwide.

Research2Business meetings

One-to-one research-to-business pre-scheduled (virtual) meetings allow the representatives of companies and research institutions to discuss possible development solutions, inventions and commercially interesting technologies. Such meetings present an excellent basis for possible future research cooperation and business synergies. The meetings focus on applications, solutions and expertise in natural sciences like electronics, IT, robotics, new materials, environment, physics, chemistry and biochemistry. Companies and researchers book meetings also with technology transfer experts from the Center of technology transfer and innovation. The meetings are held virtually through b2match platform.

The Research-to-business meetings at the Conference were co-organized in collaboration with the Enterprise Europe Network partners.

Strengthening the Competences of TTOs

The goal of the KTT project is to establish technology transfer centers in Slovenia as integral parts of PROs, which shall, first and foremost, strive to serve the interests of the researcher and the PRO. The TTOs shall assist the researcher throughout the entire procedure of the industry-research cooperation, by raising competences and educating, taking care of legal and administrative issues, and promote research achievements among the industry. Lastly, TTOs shall support the cooperation already established by research groups.

ACKNOWLEDGEMENTS

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Dr. Jeff Skinner, Executive Director of Institute of Innovation and Entrepreneurship, London Business School,

Dr. Jon Wulff Petersen, director, Technology Transfer, Plougmann Vingtoft,

Niko Schlamberger, President of Slovenian Society INFORMATIKA,

Doc. Dr. Tamara Besednjak Valič, Faculty of Information Studies in Novo Mesto,

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Our special thanks go to the **EVALUATION COMMISSION MEMBERS**:

Andreja Satran, Managing Director, ABC Accelerator,

Dr. Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School,

Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft,

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Jon Wulff Petersen, TTO Ltd., Denmark,

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Day 1

OVERVIEW OF THE PROGRAMME

8 October 2020 (virtual teleconference)

08.30 – 09.00	**Registration**
09.00 – 09.15	**Welcome address** Dr. Simona Kustec, Minister, Ministry of Education, Science and Sport Prof. Dr. Jadran Lenarčič, Director, Jožef Stefan Institute Dr. Špela Stres, MBA, LLM, Head of the Center for Technology Transfer and Innovation, Jožef Stefan Institute
09.15 – 10.00	**Keynote speech: Does the relation between the technology transfer and business education system influence the transfer efficiency?** Dr. Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School, UK **Keynote speech: How to maximize the impact of technology transfer funnel at TTOs?** Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft, Denmark
10.00 – 12.00	**Best innovation with commercial potential: Pitch competition**
12.00 – 13.00	Lunch break
13.00 – 13.20	**Award announcement: Best innovation with commercial potential** **Award announcement: WIPO IP Enterprise Trophy**
13.20 – 15.20	**Paper presentations: scientific papers on technology transfer and intellectual property** **Round table on IPR management in industry:** Mag. Mladen Vukmir, Vukmir and Associates, Zagreb, expert in IPR management, patent attorney Mr. Gverino Ratoša, innovation in automotive industry, Hidria d. o. o. Mr. Drago Lemut, Director, company Le-Tehnika d. o. o. Prof. Dr. Alexsandre Marin, Director TTO, University POLITEHNICA of Bucharest; EEN member, EU IPR Helpdesk Ambassador
15:20 – 16.50	**Opportunities arising from publicly funded research projects / presentations of successful scientific projects** **Award announcement**: WIPO Medal for Inventors
16.50-	Closing
Parallel session: 9:00 – 13:00	**Besearch2Business meetings (B2R meetings)**

WELCOME ADDRESSES

Honorable Speakers:

Dr. Simona Kustec, Minister
Ministry of Education, Science and Sport

Prof. Dr. Jadran Lenarčič, Director
Jožef Stefan Institute

Dr. Špela Stres, MBA, LMM, Head of the Center for Technology Transfer and Innovation,
Jožef Stefan Institute

KEYNOTE SPEECHES

Honorable Speakers:

Dr. Jeff Skinner, Executive Director,

Institute of Innovation and Entrepreneurship, London Business School, UK

Does the relation between the technology transfer and business education system influence the transfer efficiency?

Dr. Jon Wulff Petersen, Director,

Technology Transfer, Plougmann Vingtoft, Denmark

How to maximize the impact of technology transfer funnel at TTOs?

Does the relation between the technology transfer and business education system influence the transfer efficiency?

Keynote speech by Dr Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School, UK

The summary written by: Tomaž Justin, Miha Pitako, Robert Blatnik, Center for technology transfer and innovation, Jožef Stefan Institute

Dr Jeff Skinner shared the business and research practice of how multiple relations between the technology transfer and business education system can influence the transfer efficiency. The question of "Can the relationship between the technical universities improve and benefit technology transfer from connecting with business schools and how?" arose as a focal point of where and how technology and business meet and evolve together seeing that technology transfer should be complemented with a great business strategy. People from science, technology, engineering and mathematics (STEM) usually have useful tech knowledge and ideas but those ideas lack support by people who could and would want to commercialize the idea.

The efficiency of technology transfer can be improved if we help researchers to learn how to sell their knowledge and how to combine their talents with the entrepreneurs' ones both exploiting existing business education systems and opportunities. Researchers have to go on a business and commercial journey from their laboratories to the world. They have to be empowered to effectively and efficiently search for the right application, with the right team and business model around the technology they invented.

This is where business schools can complement the journey of the invention or innovation to the market as they can provide people with knowledge and skills of entrepreneurial methodology, offer existing business courses accessible to researchers, provide access to MBA students who love to work on cool stuff and have already established "entrepreneurial clubs" for networking and exchange of ideas.

How can we combine these talents effectively? Researchers should mix and form teams with those who have business know-how and entrepreneurial spirit. In trying to combine these talents effectively we tried different approaches in order to form teams out of mixing people with different technical talents and people with business know-how. Researchers may join existing MBA courses to understand how business "think" and enable them to form teams with MBA students that may last beyond the course. As it turns out the sooner an idea can generate a critical mass of people supporting it the more likely it is to have market success. With bringing new venture ideas to the MBAs, they may be able to test different business models for technology commercialisation regardless, none of them is tailored to technology transfer exclusively. Business people should understand the business aspect of the technology transfer.

By bringing people together into a single space to share ideas we are trying to establish a "cohort feel" to enable ideas support with people helping each other in different areas of expertise in order to enable freedom over scheduling and duration of the project as technology transfer projects may take months if not years to come to fruition.

The other option is to inject technology transfer projects into MBA courses that may bring useful ideas on how to commercialize the innovations or inventions. Technology Transfer

Offices (TTOs) select promising projects that are elaborated almost as a consultancy project. We can argue if we do like that technology transfer opportunities are written up as teaching cases.

We may want to venture out of the classroom with enabling co-curricular activities organized by the school's staff. It is even better that students form semi-structured opportunities to mingle. At London Business School we are organizing hackathons, launchpads, team-forming workshops, competitions and challenges in order to achieve inter-sectoral mingling. By doing so we established several effective semi-structured educational opportunities for researchers to become better sellers.

On one hand, after joining some forms of business education, some of the researchers may be even more curious about the efficient process of commercialization. On the other hand, Business Schools have assets that TTOs can use. For example, entrepreneurship courses to learn and team-build or MBA students who crave tech opportunities with some social capital in the business world that can enable the technology project to reach the market.

But business education for researchers to become better sellers will always be a bit ad hoc and focused on the individual rather than project development. As it turns out the technology transfer projects are often about personal skills training. This is making it much more difficult to demonstrate the impact of the business education system on the transfer efficiency in short term.

There is no steady state for technology transfer offices. This is why one should not overthink things but just do something, act on them. TTOs have to constantly think of new ways of engaging.

To conclude: TTOs at STEM and business schools should enable and support mingling and networking within formal or informal mixing of different student's 'clubs. Be it medical clubs, media clubs, management clubs and others that can provide an environment in order to enable team formation of differently skilled people to gather around an idea as quickly as possible.

The quicker an idea gathers a team the more likely it is to succeed.

How to maximize the impact of technology transfer funnel at TTOs?

Keynote speech by Dr Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft, Denmark

The summary written by: Tomaž Justin, Miha Pitako, Robert Blatnik, Center for technology transfer and innovation, Jožef Stefan Institute

Dr Jon Wulff Petersen, pointed out that technology transfer is a contact sport demanding a team effort with work that has to be organized systematically by clear concepts and rules whilst working with academia. This leads to the need of combining individual and team approaches.

Technology transfer offices (TTOs) connect academic, scientific and research institutions with the industry and interact with various groups of people with different competences and roles, ranging from researchers, patent specialists, external project pilots, external mentors, seed investors and so on. The key is to form a team very early on, even around immature ideas.

Since technology transfer is not an individual challenge, technology transfer requires a system thinking where organizational knowledge build-up is a key. Acknowledging the fact that we will always be short on resources, early funding such as proof of concept and seed capital has to be spent wisely. It is very important for technology transfer offices, apart from the skilled individuals, to have systems, processes and tools in the TTOs to overcome eventual lack of resources. This lack of resources is a challenge that requires clever systems and embedded processes such as the "Triangle method", project and decision-making questionnaires, templates and other tools. The technology transfer system with a technology transfer office has to be robust enough to tackle good staff members leaving the successful TTO and joining the industry. On the other hand, when a TTO is on the rise one has to think of how to plug new people into TTOs as the TTO gets successful.

The "Triangle method" is an important vehicle system that follows the case of technology evaluation for technology transfer all the way through the process. It is a way of organizing questions for which you want answers to when you have new technology. Some questions are more important than others and some are showstoppers. The TTO triangle method links six segments where specific value is added to them for the technology evaluation. The segments we observe in the TTO Triangle are: Application, Market, Competition, Human resources, Development time and cost and Intellectual property rights and regulatory.

The TTO Triangle method is also an effective communication tool towards the team, to be used in explaining to the team, researchers and other colleagues or the outside world about the new technology. It can be used as well as a portfolio management system and as a tool for introducing new staff members into the system.

An additional tool is the NABC - Needs, Approach, Benefits, Competition - which was developed at Stanford University and is broadly used in Scandinavia along grading and comparing inventions. The NABC is preferably using a simple system, like 10-point scale, which can also be used to provide new insights. It helps us understand what are we missing or what do we have to improve.

The TTO Triangle method and NABC can be useful communication tools for creating team spirit and energy in the process. Communication assures progress, creates transparency, commitment and back up for the technology transfer system and the TTO.

A lot of work in technology transfer offices runs in circles – from analysing ideas to business development where we can be successful or the idea goes bad. Transparency in communication with participants within the process of technology transfer is imperative for when or if the invention is given back to the researchers at a certain stage of the evaluation or transfer process. The "giving-back" should be a positive learning process for the whole team, in particular for the researchers who should know the criteria and the decision-making foundation in advance.

It is helpful for the TTO staff to be outgoing, to understand technology and have great social skills. The TTOs staff should be mindful not to get too far ahead of the research team they are trying to help. The feeling of ownership should remain with the R&D team. The R&D team should be encouraged and not frontrunner by the TTO stuff.

To maximize the impact of technology transfer funnel at TTOs, stakeholders have to build a local technology transfer ecosystem that will work with local, near-by resources. Early stage technology transfer does not work well on long distances. Inventors have to connect with management professionals and do bottom-up market analysis rather than top-down one.

BEST INNOVATION WITH COMMERCIAL POTENTIAL: PITCH COMPETITION

From 10:00 to 12:00

Moderator:

Robert Blatnik, Senior Technology Manager | Spinnovator, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission:

Andreja Satran, Managing Director, ABC Accelerator

Dr. Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School

Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft

Robert Al, Head of Business development, TU/e Innovation lab, Eindhoven University of Technology (proxy member: Mark Cox, Knowledge Valorisation Officer, TU/e Innovation lab, Eindhoven University of Technology)

Presentation of six (6) selected business model proposals from public research labs to the technology transfer experts.

Course of the competition

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

The 12th annual competition for the best innovation in 2020 at public research organizations (PROs) aims at stimulating the researchers from public research organizations to develop business models for commercialization of their inventions. The competition was initiated with a public call, which was open to authors of inventive technologies with a proposed business model for commercialization. Eligible applicants for the call are individuals, employed at PROs, which are developing innovative scientific-research ideas into a viable business model. Possible business models are either licensing the technology to industrial partners or commercialization in a spinout company. The teams have prepared their application and pitch presentation following the guidelines, which were introduced by the Organizer of the Conference at the dedicated preparatory webinar which was organized for the teams. The webinar consisted of three one-hour parts. The researchers learned the guidelines on how to prepare their pitch presentation. In a series of three webinars we went through the process of preparing a pitch of their invention and business model to a potential investor or a partner in a future venture; either licensing the technology to an industrial partner or via commercializing of the technology in their own spin-out company. We have discussed which are the stronger points in the specific business model of participants and how to prepare an effective and appealing presentation for the intended audience of their pitch. The guidelines for preparing a pitch included the following elements: Cover / Introduction slide (name & compelling tagline); Deal (what you are selling, to whom, for what price); Market & segmentation (target customer, market size, trends); Customer value proposition and why now; Product (the solution); Financials; Impact; Competitive advantage; Team & founder's/inventor's dream; Summary / three key points to remember. The written description of the proposed invention/innovation included the following chapters: Title of the idea with a brief commercial tagline; Summary; The Science; The Opportunity (problem and solution); The Plan (Development stage and Business model); The Team; Impact.

The teams and their applications with the proposed business models were evaluated by an international panel of experts which constituted the evaluation commission. The members of the evaluation commission are the following experts: Andreja Satran, Managing Director, ABC Accelerator, Dr. Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School, Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft, and Robert Al, Head of Business development, TU/e Innovation lab, Eindhoven University of Technology and his proxy member: Mark Cox, Knowledge Valorisation Officer, TU/e Innovation lab, Eindhoven University of Technology.

The experts evaluated the proposals in two phases. The 1st phase was the evaluation of written descriptions and the 2nd phase was the evaluation of the five-minute pitch at the Conference. The evaluation experts used the predetermined evaluation criteria which were already defined in the public call. The Criteria for evaluation are divided into six lots, which together account for total of 19 criteria. The criteria are presented in the table 1; each of the 19 criteria brings at the most 10 points. After the pitch the experts exchanged their views and opinions and selected the winner(s). The Criteria is presented in the Table 1.

The traditional pitch competition, which this year had its 12th anniversary, stimulated six innovative and entrepreneurial research teams to prepare their pitch and apply for competition. Members of the teams have participated in three preparatory workshops to develop their pitch

and receive comments for improvements of their presentations. The workshop was organized by Center for Technology Transfer and Innovation as part of the KTT project, financed by Slovenian Ministry of education, science and sport. The teams are entirely or partly employed at the Slovenian PROs, Jožef Stefan Institute, National Institute of Chemistry, National Institute of Biology and University of Ljubljana.

Criteria lots	Criteria
1. Overall	Degree to which project aligns with market need
	Project's IPR situation
2. Product/application advantage	Unique benefits
	Meets customer needs better
	Value for money
3. Market attractiveness	Market size
	Market growth
	Favourable trends
4. Competitive situation	Degree of entry barriers
	Level of competitiveness
	Manufacturing / processing synergies
5. Technology maturity	Technical gap
	Complexity
	Technical uncertainty
6. Risk versus return	Expected profitability (e.g. NPV)
	Return (e.g. IRR)
	Payback period
	Certainty of return / profit estimates
	Low cost & fast to do

Table 1: Criteria for evaluating the applications (source: Jon Wulff Petersen, TTO A/S, Denmark)

Abstracts of the Competing Teams and their Technologies

Contact-based, leaching-free antimicrobial textile

Authors/inventors: Marija Vukomanović, Srečo Škapin, Danilo Suvorov

PRO: Jožef Stefan Institute, Ljubljana, Slovenia

Abstract:

Antimicrobial textile market is currently valued at around 10.48 billion USD with predicted growth rate close to 9.8% for the period from 2020 to 2026. The development of new fabrics is promoting the market growth. Further up-scaling of the production is particularly expected to support the healthcare industry's requirement for masks and other medical textiles amid the spread of the COVID-19 pandemic.

Besides being efficient against microbes, antimicrobial component inside textile has to meet important additional criteria regarding: (i) toxicity, (ii) allergenicity, (iii) irritation and (iii) sensitization. These are the most challenging criteria in selecting adequate antimicrobial component. Silver is frequently used antimicrobial present in many products (i.e. AlphaSan®, Silpure®, Silvadur™, SmartSilver®, Silvérion 2400). Integrated inside textile in form of ions or (nano)particles it is leached to provide antimicrobial activity. Lately there have been a lot of concerns about safety of this technology. Sweden's national agency for chemical inspection has ruled silver as health risk (for human genetic material, reproduction, and embryonic development). Regulations in USA and Australia limit application of antimicrobial silver, particular in healing procedures. Still there is a high demand for discovery and implementation of the novel strategies able to replace existing, potentially toxic antimicrobial technologies. The last opens wide highways for innovation and progress in this area.

Our team is designing innovative antimicrobial technologies for more than 10 years. We are holding EU patent on contact-based, non-leaching gold-based technology with proven efficacy in replacing antimicrobial silver (illustrated in Fig.1). Our next challenge is to formulate product prototype that will place our technology closer to the market.
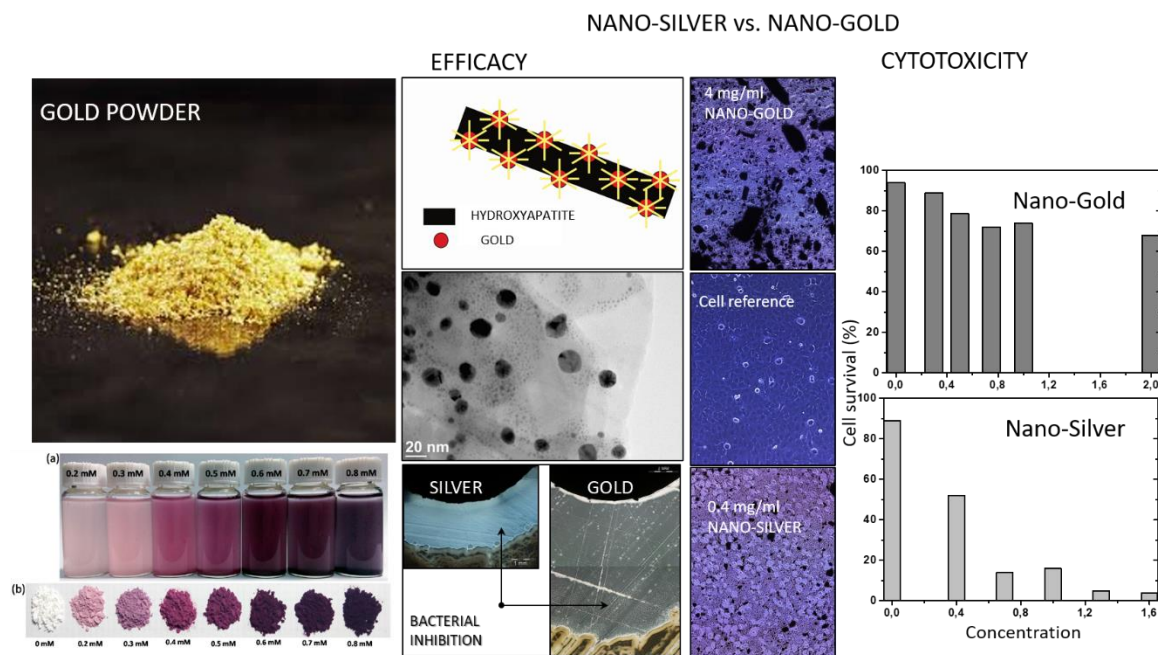
Figure 1: Current state of the invention: gold powder its efficacy and cytotoxicity in direct comparison to nano-silver. Doctoral dissertation, M. Vukomanovic, 2012.

DiTeR: Dynamic thermal line rating software

Authors/inventors: Gregor Kosec, Jure Slak

PRO: Jožef Stefan Institute, Ljubljana, Slovenia

Abstract:

One of the important aspects of transmission lines is overheating and thus the transmission capacity of the transmission network is often limited by the maximum allowed temperature of the conductor. Traditionally, the static capacity of the line is conservatively set for unfavourable weather conditions, i.e. hot sunny windless days. A more sophisticated approach is to dynamically determine the capacity considering the weather conditions or the weather forecast, which results in a considerable increase of the transmission capacity of the line. Based on experiences from theoretical studies and technology transfers, we developed a software package DiTeR that enables forecasting of thermal rating of power lines. The implemented software package has achieved high reliability and industrial level of use (TRL 9), thus representing a product that can be marketed on an international level. With DiTeR, any transmission system operator can much better utilize its power transmission network. Additionally, DiTeR increases the reliability of the transmission network and offers support for decision making in forecasts of extreme events. Currently, it is in operational use by the Slovenian transmission operator ELES that monitors 27 transmission lines with it.

Figure 1: The image shows an overhead powerline that collapsed due to extreme icing. This event triggered the creation of software for thermal management which evolved into DiTeR. Eles d.o.o., February 2014.

Single step production of Bio-based methacrylic acid for plastic and coating industries

Authors/inventors: Ashish Bohre, Miha Grilc, Blaž Likozar, Peter Venturini, Martin Ocepek and Miha Steinbücher.

PRO: National Institute of Chemistry, Ljubljana, Slovenia

Industrial partner: Helios Tblus d. o. o., Slovenia

Abstract:

Methacrylic acid (MAA) is an industrially important monomer, widely used to produce organic glass (poly-methyl methacrylate), acrylic fibres, plastics, and paints. Currently, the majority of MAA in the industries are produced through acetone-cyanohydrin process. This unsustainable method relies on expensive and extremely toxic feedstocks and corrosive concentrated acids. Besides the use of harmful substrates, low atom economy, poor product selectivity and the net emission of greenhouse gases are other drawbacks, associated with the industrial process, while the production is based exclusively on a non-renewable fossil-based resource. We have invented an efficient and sustainable catalytic route for the production of MAA. MAA is sourced from inexpensive and abundant lignocellulosic biomass derived feedstocks thus addressing one of the major issues associated with the utilization of depleting fossil fuel based feedstocks. Our technology provides industrially-relevant yield and selectivity, with more than 90 % of purity of MAA in a single step process. The archived MAA yield is higher compared to the previously reported method that utilized noble metal catalyst and alkaline base as a co-catalyst. Our catalytic process enables to replace the current multiple-step and energy-intensive industrial process of the MAA production in a single step from petroleum-based chemicals with the bio-based feedstock under relatively mild operating conditions.
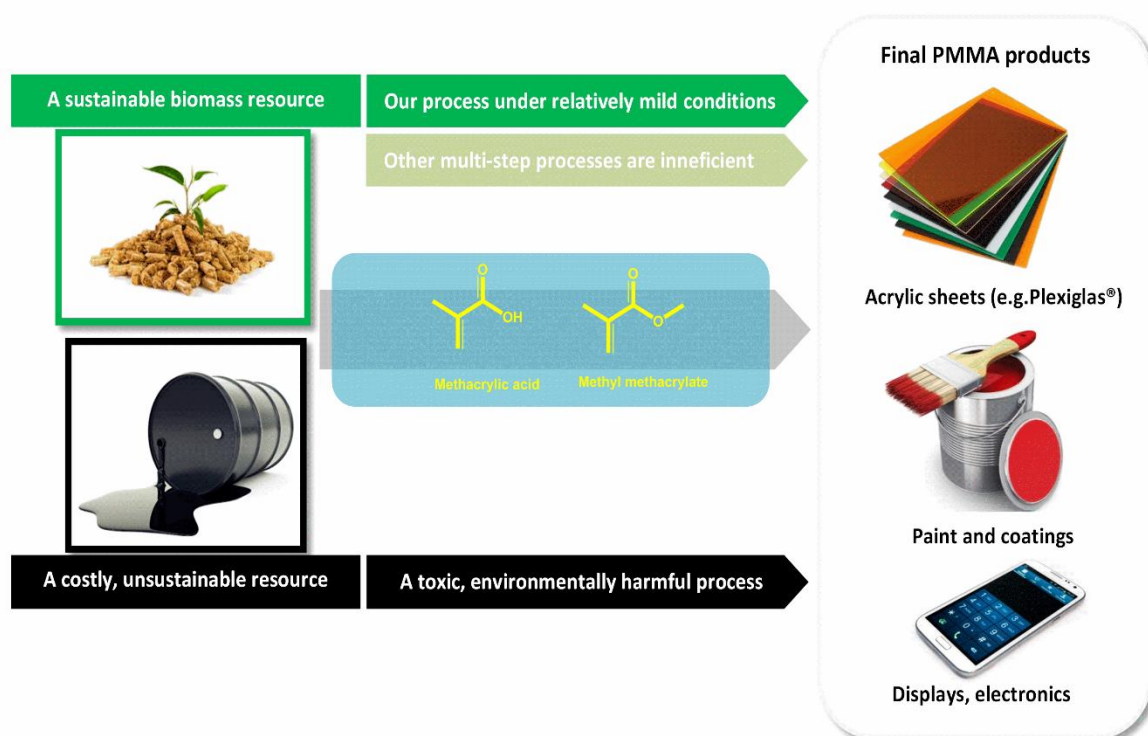
Figure 1: Single step production of Bio-based methacrylic acid for plastic and coating industries. Ashish Bohre, Miha Grilc, Blaž Likozar, Peter Venturini, Martin Ocepek and Miha Steinbücher, 2020.

A scalable method for eco-benign destruction of waterborne microorganisms

Authors/inventors: Gregor Primc, Arijana Filipić, Rok Zaplotnik, David Dobnik, Ion Gutierrez Aguirre, Matevž Dular, Martin Petkovšek, Miran Mozetič

PRO: Jožef Stefan Institute, Ljubljana, Slovenia; National Institute of Biology, Ljubljana, Slovenia; University of Ljubljana, Slovenia, Faculty of Mechanical Engineering, Ljubljana, Slovenia

Abstract:

Water scarcity is one of the biggest problems we are facing today so there is a global need for a stable supply of safe, pathogen-free water. Contaminated waters come from various sources including hospitals, farms and irrigation systems. These waters are guided through water-treatment systems; however, they usually do not inactivate viruses. Currently, chlorination, or similar chemical methods, are used for water disinfection, what represents potential environmental hazard. Chlorinated water released to the environment can cause adverse changes to many useful, but chlorine susceptible microbes. Treatment by ultraviolet radiation or ozone is only feasible for the disinfection of small quantities of contaminated water and efficient decontamination is limited by water turbidity. Our innovative technology presents an eco-friendly way for inactivation of waterborne microorganisms, particularly viruses, with low operation costs. The first phase is penetrating the market of small irrigation systems, such as hydroponics, second phase is a device for cleaning the heavily virus-contaminated water from clinics and the third phase, if successful with previous two phases, are large users, such as wastewater treatment plants and urban water systems with a large purification device. Globally, there are roughly one million potential small users and several thousand large users. Our technology exploits synergistic effects of two technologies (plasma and cavitation). The efficiency of its decontamination potential has been proved in laboratories, and the patent application to EPO has been submitted in October 2020.
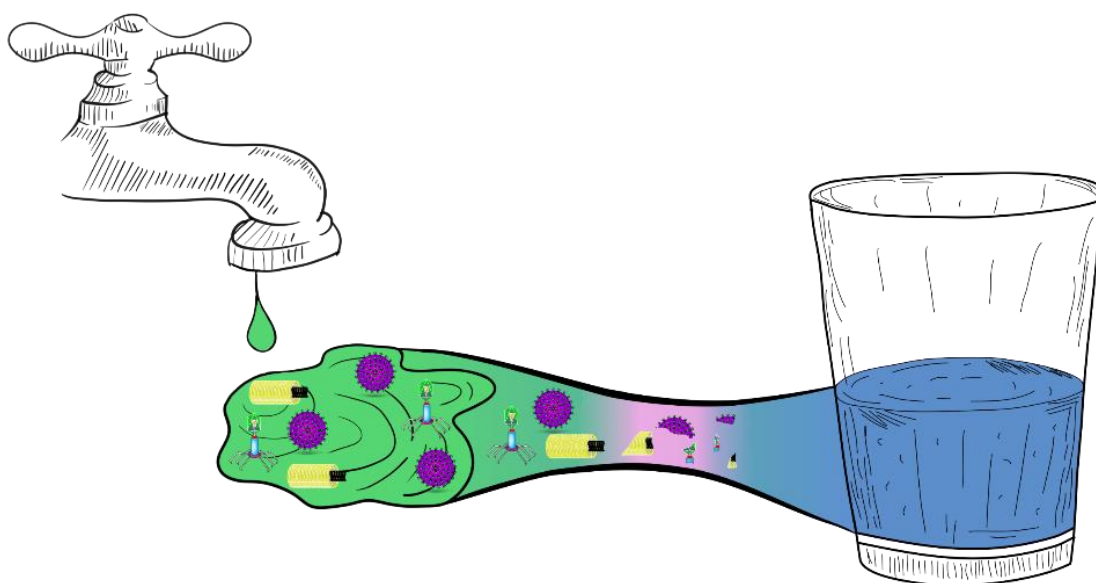
Figure 1: Abstract illustration on cleaning virus-contaminated water with synergistic effect of plasma and cavitation. Author: Gregor Primc (2020).

Enhanced cross-differential dynamic microscopy. A DLS-like particle characterization technique for cost-effective and accurate analysis of complex systems

Authors/inventors: Andrej Petelin, Natan Osterman, Luka Cmok

PROs: Jožef Stefan Institute, Ljubljana, Slovenia; University of Ljubljana, Slovenia

Abstract:

Enhanced cross-differential dynamic microscopy (C-DDM) is a cost-effective tool for the analysis of the soft matter dynamics in biosciences and biopharmaceuticals, paints, inks and coatings, nanomaterials, foods and drinks, pharmaceuticals and drug delivery, and academic research. The sensitivity of the method promises to be comparable to current commercial tools, like Dynamic Light Scattering (DLS), with added benefits of the multi-angle characterization for the analysis of complex systems, so it covers a broader range of use compared to DLS. The market size for DLS devices in European academic research is estimated to 15000 potential customers and 100 devices sold per year. C-DDM will be marketed as a complementary tool for studying the more complex system, or replacing more standard DLS applications. So, all current customers of DLS are potential buyers of C-DDM. Globally, in the long term, adding industrial customers into play, an estimated 1M revenue is viable, which is enough for a small-size sustainable business. We are a team of three, capable of completing the first phase of the development plan, that is, bringing the first device to the market in a year or two, and raising funds for further development. Team members have a good track record in applied research and have plans to improve the device in the future and to apply the technology for liquid crystal characterization and particle characterization tools for industrial research. For this, we will have to be successful in drafting the research projects and obtaining human resources (students). After finishing the research and development stage within three to five years, the team will assess the market and technology state and decide on future directives (licensing, spin-off).

A New Paradigm on Plastic Waste »PLASTICS - the Problem or the Solution«

Authors/inventors: Andrej Trkov, Luka Snoj, Stane Merše, Blaž Likozar, Johannes T. van Elteren

PRO: Jožef Stefan Institute, Ljubljana, Slovenia; National Institute of Chemistry, Ljubljana, Slovenia

Abstract:

Plastic waste is a big problem for the environment. Significant reduction of plastic use by replacement with more sustainable materials, circular economy and change of our behaviour is the key priority. However, plastics are hard to replace for some specific purposes, but eventually all plastic products become waste.

The objective is planet-friendly production of essential Eco-plastics and final disposal of unrecyclable plastic by burial as a form of long-term carbon storage.

Current practice of dealing with waste plastic is recycling (not all plastic is recyclable), disposal by incineration (CO_2 emissions, hazardous combustion by-products), chemical reforming (e.g. synthetic fuels, etc.) and bio-degradation (possible micro-plastic residuals).

A new paradigm is proposed, promoting the synthesis of Eco-plastics from CO_2 from the air and hydrogen from water by electrolysis (or otherwise), polymerization into plastic resins for industrial use, collecting and compacting plastic products when they become waste, and disposing them as a way of long-term carbon storage, thus returning some of the carbon from fossil sources back into the ground.

The key point is the availability of cheap electricity. Renewable sources of energy like the sun or the wind are strongly fluctuating. They result in surplus energy at peak hours and must have backup at production minima, which can be provided by the nuclear without a CO_2 burden on the environment. Plastic production from electricity production peaks would make good use of this energy and help to stabilise the energy grids.

Based on the experience of the team, our role in the scheme is to develop and optimize the system for the synthesis of plastic resins on a small scale. The know-how would be offered to external partners for application on industrial scale. Likewise, we would seek partners for the back-end of the process on super-compacting, canning and disposal of waste plastic.

Award announcement: Best innovation with commercial potential

From 13:00 to 13:10

Moderator:

Robert Blatnik, Senior Technology Manager | Spinnovator, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission:

Andreja Satran, Managing Director, ABC Accelerator

Dr. Jeff Skinner, Executive Director, Institute of Innovation and Entrepreneurship, London Business School

Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft

Robert Al, Head of Business development, TU/e Innovation lab, Eindhoven University of Technology (proxy member: Mark Cox, Knowledge Valorisation Officer, TU/e Innovation lab, Eindhoven University of Technology)

ANNOUNCEMENT OF THE WINNER

The evaluation commission weighed all the criteria in the evaluation process and selected the winning teams.

The second award of 500 Euro goes to the team members:

Marija Vukomanovič, Srečo Škapin and Danilo Suvorov, coming from the Jožef Stefan Institute, for their technology:

Contact-based, leaching-free antimicrobial textile »Silver-free, wearable germ protection«.

The first award of 2000 Euro goes to the team members:

Gregor Primc, Arijana Filipić, Rok Zaplotnik, Miran Mozetič, Ion Gutierrez-Aguirre, David Dobnik, Matevž Dular and Martin Petkovšek coming from Jožef Stefan Institute, National Institute of Biology and University of Ljubljana.

In the opinion of the experts, the presented technologies of both teams bring value to society, have great potential to be brought to first customers and to be industrially scaled up. The qualified and passionate teams have key skills and knowledge for successful further development of the application which will bring value to the customers.

Congratulations!

Award announcement: WIPO IP Enterprise Trophy

From 13:10 to 13:20

Moderator:

Marjeta Trobec, Spinout and Promotion Specialist, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Jeff Skinner, London School of Business

Jon Wulff Petersen, TTO Ltd., Denmark

Alojz Barlič, Slovenian intellectual property office (SIPO)

ANNOUNCEMENT OF THE WINNER WIPO IP Enterprise Trophy

By celebrating the achievements of inventors, creators and innovative companies around the world, the World Intellectual Property Organisation Awards aim to help foster a culture in which innovation and creativity are encouraged and appreciated at every level of society.

The WIPO IP Enterprise Trophy is awarding enterprises for their good practice to constantly and methodologically using the IP system in their business activities. Among the applications, the jury has decided to award Razvojni center eNeM Novi Materiali d. o. o. .

Justification: Razvojni center eNeM Novi Materiali is actively cooperating with several public-research organisations. In the last ten years they have been developing new products based on public-research transfer. Those products also have suitable IP protection. The applicant has persuaded with the outstanding use of the IP system and activities to build public respect for IP via different public campaigns, mostly environment oriented and based on the newly developed products. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff.

Congratulations!

Award announcement: WIPO Medal for Inventors

From 15:20 to 15:30

Moderator:

Marjeta Trobec, Spinout and Promotion Specialist, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Jeff Skinner, London School of Business

Jon Wulff Petersen, TTO Ltd., Denmark

Alojz Barlič, Slovenian intellectual property office (SIPO)

ANNOUNCEMENT OF THE WINNER WIPO IP Enterprise Trophy

The WIPO Medal for Inventors is awarding Slovenian public researchers for their contribution to national wealth and development.

The "WIPO Medal for Inventors" goes to Prof. Dr. Alenka Vesel.

In the last decade she has gained several international patents, she is a cofounder of company Plasmadis and her IP has resulted in different products and services being brought to the market.

Congratulations!

Research2Business meetings (R2B meetings)

Robert Premk, Center for Technology Transfer and Innovation, Jožef Stefan Institute

About

Traditional biannual Research2Business (R2B) meetings promote and encourage cooperation among researchers and/or representatives from research institutions and companies on the international level. Main focus is transfer of developed or in development technologies and techniques from research institutions in business processes of the companies, while searching for opportunities to develop new solutions for challenges the companies are facing in the business-as-usual activities, or to look for partners for different topics and calls.

Course of event

Distinguishing feature of Research2Business meetings in the frame of 13th International Technology Transfer Conference was the completely virtual form of the meetings through the b2match platform. In the registration period between May and October 2020, 134 participants from universities, R&D institutions, companies, start-ups, associations submitted their interest to participate at the meetings. They were from 14 different countries: Austria, Bulgaria, Croatia, Ireland, Italy, Lithuania, North Macedonia, Morocco, Romania, Serbia, Slovenia, Spain, Turkey and United Kingdom.

Two sessions of meetings were organized between 9 AM and 1 PM (CEST), where scheduled duration of each meetings was 20 minutes. In total 51 meetings were held, where registered participants could attend the meetings from their office with their computer, laptop or other devices with camera, microphone and connection to the internet.

In both sessions more than 13 hours of conversations were held, with average length of each meeting at around 15 minutes. The meeting with the longest duration lasted for 23 minutes and 39 seconds.

Although the format of this year edition of meetings was virtual instead of physical one, the participation exceeded expectations and attendance from previous years, while statistics and feedback already confirms that this type of meetings can provide excellent opportunity for individualized and thorough conversation between representatives of research and/or business community.

Day 2

CONFERENCE CEREMONY

Overview of the Conference Ceremony

9 October 2020

Jožef Stefan Institute, Ljubljana, Slovenia

Location: Main Lecture room at the Jožef Stefan Institute (A-building)

11:30 – 11:35	Musical performance
11:35 – 11:40	**Welcome speech** Prof. Dr. Jadran Lenarčič Director of Jožef Stefan Institute
11:40 – 11:50	**Opening speech** Dr. Jure Gašparič, State Secretary of Ministry of Education, Science and Sport
11:50 – 11:55	**Greetings** Prof. Dr. Mojca Ciglarič Chair of the Programme Committee of IS2020 Dean of Faculty of Computer and Information Science

11:55 – 12:10	**Awards of IS2020**
	Prof. Dr. Mojca Ciglarič, IS Programme Chair
	Prof. Dr. Matjaž Gams, IS Organization Chair
	Prof. Dr. Stane Pejovnik, Slovenia Academy of Engineering
	Prof. Dr. Nikolaj Zimic, AMC Slovenia President
	Prof. Dr. Sašo Džeroski, SLAIS President
	Dr. Mark Pleško , President of Slovenian Academy of Engineering
	Niko Schlamberger, President of Slovenian Society Informatika
	
	Robert Blatnik, M. Sc., Member of 13. ITTC Organizing Committee:
	   - Award for the best innovation with commercial potential in 2020
	   - WIPO IP Enterprise Trophy
	   - WIPO Medal for Inventors

12:10 – 12:15	Musical performance

Overview of the Conference Ceremony

13. ITTC Award Speech

Robert Blatnik, Center for Technology Transfer and Innovation, Jožef Stefan Institute
Marjeta Trobec, Center for Technology Transfer and Innovation, Jožef Stefan Institute

The award for "The best Innovation with commercial potential from a public research organisation in 2020 with the award fund of 2.500 Euro goes to two teams:

500 Euro award goes to the team members:

Marija Vukomanovič, Srečo Škapin and Danilo Suvorov, coming from the Jožef Stefan Institute, for their technology:

Contact-based, leaching-free antimicrobial textile »Silver-free, wearable germ protection«.

2000 Euro award goes to the team members:

Gregor Primc, Arijana Filipić, Rok Zaplotnik, Miran Mozetič, Ion Gutierrez-Aguirre, David Dobnik, Matevž Dular and Martin Petkovšek coming from Jožef Stefan Institute, National Institute of Biology and University of Ljubljana.

The presented technologies of both teams bring value to society, have a great potential to be brought to first customers and to be industrially scaled up. The qualified and passionate teams have key skills and knowledge for successful further development of the application which will bring value to the customers. We congratulate the awarded team and invite the team representatives to accept the award.

By celebrating the achievements of inventors, creators and innovative companies around the world, the WIPO Awards aim to help foster a culture in which innovation and creativity are encouraged and appreciated at every level of society.

The evaluation committee for the WIPO Awards consisted of Dr. Jeff Skinner, Dr. Jon Wulff Petersen and Mr. Alojz Barlič from the Slovenian Intellectual Property Office.

The WIPO Medal for Inventors is awarding Slovenian public researchers for their contribution to national wealth and development.

The "WIPO Medal for Inventors" goes to Prof. Dr. Alenka Vesel.

In the last decade she has gained several international patents, she is a cofounder of company Plasmadis and her IP has resulted in different products and services being brought to the market.

The WIPO IP Enterprise Trophy is awarding enterprises for their good practice to constantly and methodologically using the IP system in their business activities. Among the applications, **the jury has decided to award Razvojni center eNeM Novi Materiali d. o. o. .**

Razvojni center eNeM Novi Materiali is actively cooperating with more than 5 public-research organisations. In the last ten years they have developed several new products that have IP protection and are based on public-research transfer. They have persuaded also with the outstanding use of the IP system and activities to build public respect for IP.

Congratulations to all of the awardees!

INFORMACIJSKA DRUŽBA – IS 2020

INFORMATION SOCIETY – IS 2020

Ljudje in okolje
People and Environment

Uredili / Edited by

Janez Malačič, Tomaž Ogrin, Matjaž Gams

7. oktober 2020 / 7 October 2020
Ljubljana, Slovenia

PREDGOVOR

Konferenca je sestavljena iz dveh:
- demografske, predsednik prof. dr. Janez Malačič, letos trinajstič
- okoljske, predsednik mag. Tomaž Ogrin, letos drugič.

V letu pandemije se je zaostrila tako zdravstvena kot demografska scena. V 2020 bo umrlo nekaj nad milijon ljudi zaradi kovida, zbolelo jih bo nekajkrat več. V primerjavi s 130 milijoni rojenimi in 60 milijoni umrlimi se en milijon zdi zanemarljiv. Hkrati je razlika med rojenimi in umrlimi vsako leto manjša, a se bo zaradi časovnega zamika rast svetovnega prebivalstva nadaljevala še dolgo po izenačenju rojstev in smrti.

Za Slovenijo sta med najbolj perečimi tematikami begunska problematika in skoraj pol stoletja premajhna rodnost Slovenije, ki preti z dolgoročnimi uničujočimi posledicami. Demografske odločitve bodo pomembno krojile kakovost življenja ljudi v prihodnjih desetletjih tako v Sloveniji kot Evropi. Če Japoncev s sedanjo rodnostjo po napovedih leta 3000 ne bo več, bodo Slovenci s sedanjo rodnostjo izumrli čez nekaj 100 let.

Podobno travmatične so napovedi glede okolja. Medtem ko zavedanje o pomenu okolja narašča, mirno gradimo nova in nova veletrgovska središča na najboljši kmetijski zemlji, pa smo jo v letih od osamosvojitve izgubili 70.000 ha, tako da je ostalo še cca 180.000 ha obdelovalnih (njivskih) zemljišč, v občinskih prostorskih načrtih je predvidenih za pozidavo še 57.000 ha. Ni čudno, da imamo le 30 odstotno samozadostnost. Od leta 2000 smo izgubili 10 odstotkov zemljiških površin.

Slovenija je majhna država z malim vplivom na svet, a narava je naša prednost v Evropi in mora biti prioriteta. Ima tudi gospodarski turistični pomen z delovnimi mesti za veliko prebivalcev in generacij. Ena od prioritet so prosto tekoče reke in potoki, za nas in za zanamce. Modrost je v izreku: "Ne uničujmo narave, da bi reševali okolje. " Poznan v tujini kot "Do Not Destroy the Nature to Save the Environment."

Želimo podati usmeritev Slovenije v varno, prijazno, zdravo in kakovostno okolje za vse državljane in državljanke Slovenije. Opozarjamo na prehitro uničevanje okolja, kmetijskih površin, nepotrebno gradnjo novih in novih trgovskih centrov, avtocest in energijskih objektov na najboljših zemljiških površinah.

Je mogoče hkrati spodbujati tehnološki razvoj, uporabo obnovljivih virov in preprečevati negativne vplive na okolje? Smo sposobni preusmeriti antropocentrični razvoj v ekocentričnega? Potrebujemo strožji nadzor varstva na ožjih, širših in vplivnih vodnih območjih za zaščito podtalnice in pitne vode, vključno z ekonomskimi in lastniškimi načeli? Imajo mesta dovolj zelenih površin v mestih, imajo podjetja in inštitucije vse pozidano, v asfaltu in betonu? Kdaj bomo sanirali degradirana območja, na primer Celjsko kotlino?

V letu 2020 smo pripravili Belo knjigo strokovnega varovanja okolja http://library.ijs.si/Stacks/Literature/Bela%20knjiga%20znanost%20o%20okolju%202020.pdf in s tem postavili pomemben mejnik pri izboljševanju slovenskega okolja.

Janez Malačič in Tomaž Ogrin

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

Janez Malačič, predsednik

Matjaž Gams, organizator

Drago Čepar

Christian Gostečnik

Majda Černič Istenič

Boštjan Kerbler

Karin Kasesnik

Dušan Kidrič

Marko Krevs

Tomaž Merše,

Mari Osredkar

Janja Pečar

Janja Povhe

Jože Ramovš

Jože Sambt

Milivoja Šircelj

Petronela Vertot

Božidar Voljč

The Shrinking of Human Population and Causes for it – is Women Education and Empowerment among them?

Zmanjševanje človeške populacije in razlogi – ali sta žensko izobraževanje in emancipacija med njimi?

Matjaz Gams†
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Jozef Stefan Institute
Ljubljana, Slovenia
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ABSTRACT / POVZETEK

The bulk of the paper examines the 2020 Lancet paper about fertility and human demographic projections [1] in particular in relation to the causes of the fertility decline. Also, throughout the paper, comparisons to the previous publication of the author of the paper are presented, again with the relation to the women empowerment, education and implementation. The conclusion is that the best world-wide scientific literature is aligned with the conclusions obtained by the AI methods and presented at the demographic conferences in Slovenia. Therefore, the 2018 national protests regarding exactly the same issues do not hold any scientific merit in light of the recent publications.

KEYWORDS / KLJUČNE BESEDE

Demographic trends, birthrate, fertility, emancipation, women empowerment / demografski trendi, stopnja rodnosti, rodnost, emancipacija, ženske opolnomočenje

1   INTRODUCTION

Demographic projects are primarily based on birthrate, i.e. fertility rate and are commonly measured in terms of children born by a woman in her lifespan on average (in this paper "fertility rate" or "birth rate" denotes the Total Fertility Rate – TFR). There are several other parameters that influence the number of citizens in a particular country, such as emigration, wars and natural disasters, average life span and similar. The projections are in recent years performed by several individual research teams and several official services such as UN, Eurostat https://ec.europa.eu/eurostat/web/population-demography-migration-projections/data or American institutions such as CIA. Through Web it is also possible to observe basic data and projections, e.g. a world population counter https://www.worldometers.info/world-population/ showing current estimate of the world population. The current projection estimates that the world population will reach 10 billion persons in the year 2057. Table 1 presents basic demographic data.

Table 1: World population - basic demographic data (https://www.worldometers.info/world-population)

Year (July 1)	Population	Yearly Change	Median Age	Fertility Rate	Urban Pop %
2020	7,794,798,739	1.05 %	30.9	2.47	56.2 %
2019	7,713,468,100	1.08 %	29.8	2.51	55.7 %
2018	7,631,091,040	1.10 %	29.8	2.51	55.3 %
2017	7,547,858,925	1.12 %	29.8	2.51	54.9 %
2016	7,464,022,049	1.14 %	29.8	2.51	54.4 %
2015	7,379,797,139	1.19 %	30	2.52	54.0 %
2010	6,956,823,603	1.24 %	28	2.58	51.7 %
2005	6,541,907,027	1.26 %	27	2.65	49.2 %
2000	6,143,493,823	1.35 %	26	2.78	46.7 %
1995	5,744,212,979	1.52 %	25	3.01	44.8 %
1990	5,327,231,061	1.81 %	24	3.44	43.0 %
1985	4,870,921,740	1.79 %	23	3.59	41.2 %
1980	4,458,003,514	1.79 %	23	3.86	39.3 %
1975	4,079,480,606	1.97 %	22	4.47	37.7 %
1970	3,700,437,046	2.07 %	22	4.93	36.6 %
1965	3,339,583,597	1.93 %	22	5.02	N.A.
1960	3,034,949,748	1.82 %	23	4.90	33.7 %
1955	2,773,019,936	1.80 %	23	4.97	N.A.

Several studies are concerned with the question what will accompany the slowing of demographic fertility rate and where will it end, and also what influences the decrease of the fertility rate [2,3,4,5,6]. Slovenian studies culminated in the White book of Slovenian demography [7].

The demographic changes are strongly affecting social and economic development [6] and will potentially cause lots of problems unless resolved. Even in Slovenia, the presentation of the studies at the National Council, e.g. [8], published later in the White book [7], caused lots of discussion in public, Web and among political parties. The focus of the criticism was that it is not the case that the Slovenians or native Europeans will diminish with current birthrates, as claimed by the White book, and that relating the level of emancipation and education to lower fertility is both not supported by scientific data, since for example empowerment relates to the improved standard and vice versa, and therefore this relation is not of essence, but collateral as is for example the number of cars to the standard. To explain it with an example: if a country imports a large number of cars, it will not be any richer. The final argument was that the proclaimed relation between education and empowerment on one side and the fertility rate on the other side was not only unscientific, it was also based on ideology – the authors were alleged trying to reverse the women powers back to a patriarchal family, even though fiercely denied by the authors [9]. Due to the ideological polarization of the research question, even some research communities either joined the protests or accepted an indifferent stance [10].

However, that is not the way science works, be it vaccination/anti-vaccination or claims that the world is flat – it is on scientists to provide either evidence on their own or provide quality citations. In this paper we will reexamine the basic causes for lower fertility consequences primarily to the recent Lancet paper [1], and the causes for the polarization of the utterly a scientific question.

2 RECENT SCIENTIFIC CONFERENCES AND PAPERS

In the Ralf Dahrendorf Roundtable on "Population Decline and its Effects in Europe" [11], organized by EU, on 19 November 2019 in Helsinki (Magma 2019), one of the central comments by Nils Erik Forsgård, Director of Magma, was: "At current fertility rates, we Europeans are basically breeding ourselves out of existence." Europe as a whole is facing a severe demographic challenge. With fertility 1.59, as was the rate in the EU in 2017, and the rapidly growing amount of people older than 80 years will provide a surge for emigration.

Dr Daniela Vono de Vilhena from the Max Planck Institute for Demographic Research, observed that Africa and Asia remain the continents of the children of the future. Few changes in fertility levels are expected to occur for the rest of the world: in Europe, demographers are not expecting fertility trends to drastically change in the upcoming decades. Pragmatic migration policies, therefore, are and will be essential to maintain a healthy population structure in Europe. According to the Centre of Expertise on Population and Migration, half of the population of EU-28 was at least 43 years old (median age) in 2015. By 2060, however, 50 % of the population is expected to be at an age above 50 years old. Encouraging longer working life and promoting

healthy lifestyles are strongly recommendations for Europe. Higher education levels are accompanied by decreases in fertility and mortality. Prof. Emma Galli, Scientific Director, Fondazione Luigi Einaudi, Italy, Andrea Virág, researcher of the Republikon Institute, Hungary and Prof. Anna Rotkirch, Director of the Population Research Institute at the Family Federation of Finland provided development in southern Europe, eastern Europe (V4 countries) and Scandinavia/Finland. Amongst these, Finland stands out with its total fertility rate for 2019 at alarming 1.33 children per woman. Prof. Rotkirch gave three possible explanations for this: 1) Lower fertility ideals & more uncertain intentions: there seems to be a greater focus on work as the meaning of life (author remark: neoliberal globalism aims at producing work and capital oriented individual consumers instead of society and family members). The number of women aged 20–39 not wishing children at all has was 1 % in 1977 and 11 % in 2018 in Finland. 2) High previous proportions of childlessness might make not having children more 'normal' (highlighted by the author). Ms. Virág presented the Hungarian orientation towards more children: families receive support for buying a new home (levels depending on the amount of children), a mortgage reduction if the number of children are two or more, support for buying a car if the number of children are three or more, and mothers with four children or more do not have to pay income tax. The roundtable also pointed out the strong relation between politics and demography.

Even though this is just one event, the conclusions from it are so general and supported even by the basic data in Table 1, that there is little doubt that if the current fertility rate in Europe continues, the native European peoples will sooner or later perish unless new solutions are found.

3 THE LANCET DEMOGRAPHIC PAPER

In the Lancet, one of the three major scientific journals (Science, Nature) with more medical orientation, published a paper on the issue of fertility, causes for lowering worldwide birthrates, and consequences [1]. The study was performed at the University of Washington, Seattle, USA, and was funded by the Melinda and Bill Gates foundation. While majority of studies currently project continuing global population growth, the Lancet models highlight the huge challenges to economic growth of a shrinking workforce, the high burden of an ageing population, and the impact on global power. The uniqueness compared to the previous projections is that the Lancet study considers dynamic and simultaneous interchange of the parameters and predictions.

The data obtained from the Global Burden of Disease Study 2017, given to the prediction algorithms developed by the researchers from the Institute for Health Metrics and Evaluation (IHME) at the University of Washington's School of Medicine, projects that in 2100, 183 of 195 countries will have fertility rates below replacement level of 2.1 births per woman. World population is forecasted to peak in 2064 at around 9.7 billion people and fall to 8.8 billion by century's end.

Here is a quote from the Interpretation of the paper (bolded by the author):

"Our findings suggest that continued trends in female educational attainment and access to contraception will hasten declines in fertility and slow population growth. A sustained TFR lower than the replacement level in many countries, including

China and India, would have economic, social, environmental, and geopolitical consequences. Policy options to adapt to continued low fertility, while sustaining and enhancing female reproductive health, will be crucial in the years to come."

Demographic projections, models and studies of relations indicate that the world population will likely shrink after mid-century, forecasting major shifts in global population and economic power. All countries worldwide will continue decreasing their fertility rate with a delayed shrinking of their populations. For example, the USA is projected to have population growth until mid-century (364 million in 2062), followed by a moderate decline of less than 10% to 336 million by 2100. The USA's total fertility rate is predicted to steadily decline from 1.8 in 2017 to 1.5 in 2100 (close to the current Slovenian birth rate). However, the projections are reasonable favorable for the USA (at least compared to Europe and Slovenia) - in 2100, the USA is forecasted to have the fourth largest working-age population in the world (around 181 million), after India, Nigeria, and China. In terms of economic projections, the projections are eve better – while the USA with the largest economy currently will be replaced by China in 2035, the USA is forecasted to once again become the largest economy around 2100.

The new projections anticipate major fertility decline in current high-fertility countries, e.g., in sub-Saharan Africa where rates are expected to fall from an average 4.6 births per woman in 2017 to just 1.7 by 2100. Currently in Niger, where the fertility rate is the highest in the world with 6-7 children per woman, the rate is projected to decline to around 1.8 by 2100. But due to the delayed effect of fertility change on the overall population, the population of sub-Saharan Africa is forecast to triple in this century, from an estimated 1.03 billion in 2017 to 3.07 billion in 2100. According to the projections, North Africa and the Middle East are the only other regions predicted to have a larger population in 2100 (978 million) than in 2017 (600 million).

Asia, Central and Eastern Europe will also face further fast population shrinking. 23 countries will sustain more than 50% decrease, including Japan (from around 128 million people in 2017 to 60 million in 2100), Thailand (71 to 35 million), Spain (46 to 23 million), Italy (61 to 31 million), Portugal (11 to 5 million), and South Korea (53 to 27 million). 34 countries are expected to have population declines of 25 to 50%, including China (1.4 billion in 2017 to 732 million in 2100).

Birthrates will fall to around 1.2 in Italy and Spain, and to 1.17 in Poland. The number of children under 5 years old is forecasted to decline by 41% from 681 million in 2017 to 401 million in 2100, whereas the number of more than 80 years old is projected to increase six fold, from 141 million to 866 million. In other viewpoint, the global ratio of adults over 80 years to each person aged 15 years or younger is projected to rise from 0.16 in 2017 to 1.50 in 2100 in countries with a population decline of more than 25%.

This is the source for the changes in predictions - even slight changes in TFR translate into large differences in population size during decades. For example, increasing TFR by as little as 0.1 births per woman is equivalent to around 500 million more individuals on the planet in 2100.

Surprisingly, the working age-populations decline will hit countries not considered before, e.g. India and China, which will

not just economically bypass the USA and continue extending the lead, but rather will in the forthcoming decades hamper the new superpowers and again lead to shifts in global powers.

Among the core reasons for the birthrate decrease and

subsequent shifts in demographic and economic powers are widespread access to modern contraception and the education of women. The new study also predicts huge shifts in the global age structure, with an estimated 2.37 billion individuals over 65 years globally in 2100, compared with 1.7 billion under 20 years, underscoring the need for either increased immigration of advanced IT solutions to help elderly.

In terms of economic relevance, the demographic changes will result in major power shifts. For example, although numbers of working-age adults in India are projected to fall from 762 million in 2017 to around 578 million in 2100, it is expected to maintain its working-age population over the century. Without COVID-19 interference it is expected to surpass China's workforce population in the mid-2020s, while the number of Chinese workers will decline from 950 million in 2017 to 357 million in 2100 unless China again reintroduces demographic obligatory ruling as the prescript of the number of children. Thus, India will substantially progress in terms of GDP.

A sufficient number of workers will have a major impact on the economic progress also in Sub-Saharan Africa which will become significantly more powerful. Due to the high fertility rate, Nigeria will see its working-age population grow from 86 million in 2017 to 458 million in 2100, and will rise its GDP rankings from 23rd place in 2017 to 9th place in 2100.

Big European countries with reasonable fertility like the UK, Germany, and France are expected to remain in the top 10 for largest GDP worldwide at the turn of the century, but those with particularly low fertility will decrease a lot – e.g., Italy will drop from rank 9th in 2017 to 25th in 2100 while Spain from 13th to 28th.

The population decline could be softened by an increased immigration. Countries like the USA, Australia, and Canada, will probably maintain their working-age populations in this way.

4 DISCUSSIONS BASED AND RELATED TO THE LANCET DEMOGRAPHIC PAPER

The Lancet projections are highlighting the importance of demographic movements on the quality of life and the progress of countries. In the words of IHME Director Dr Christopher Murray, who led the research: "This study provides governments of all countries an opportunity to start rethinking their policies on migration, workforces and economic development to address the challenges presented by demographic change." and

"For high-income countries with below-replacement fertility rates, the best solutions for sustaining current population levels, economic growth, and geopolitical security are open immigration policies and social policies supportive of families having their desired number of children. However, a very real danger exists that, in the face of declining population, some countries might consider policies that restrict access to reproductive health services, with potentially devastating consequences. It is imperative that women's freedom and rights are at the top of every government's development agenda."

IHME Professor Stein Emil Vollset, the first author of the paper, similarly claims that "The societal, economic, and geopolitical power implications of our predictions are substantial. In particular, our findings suggest that the decline in the numbers of working-age adults alone will reduce GDP growth rates that could result in major shifts in global economic power by the century's end. Responding to population decline is likely to become an overriding policy concern in many nations."

And adds: "While population decline is potentially good news for reducing carbon emissions and stress on food systems, with more old people and fewer young people, economic challenges will arise as societies struggle to grow with fewer workers and taxpayers, and countries' abilities to generate the wealth needed to fund social support and health care for the elderly are reduced".

Dr Richard Horton, Editor-in-Chief of The Lancet, agrees: "This important research charts a future we need to be planning for urgently. It offers a vision for radical shifts in geopolitical power, challenges myths about immigration, and underlines the importance of protecting and strengthening the sexual and reproductive rights of women. "

As a Commentator, Professor Ibrahim Abubakar, University College London (UCL), UK, and Chair of Lancet Migration says: "Migration can be a potential solution to the predicted shortage of working-age populations. While demographers continue to debate the long-term implications of migration as a remedy for declining TFR, for it to be successful, we need a fundamental rethink of global politics. Greater multilateralism and a new global leadership should enable both migrant sending and migrant-receiving countries to benefit, while protecting the rights of individuals. Nations would need to cooperate at levels that have eluded us to date to strategically support and fund the development of excess skilled human capital in countries that are a source of migrants. An equitable change in global migration policy will need the voice of rich and poor countries. The projected changes in the sizes of national economies and the consequent change in military power might force these discussions." and

"Ultimately, if Murray and colleagues' predictions are even half accurate, migration will become a necessity for all nations and not an option. The positive impacts of migration on health and economies are known globally. The choice that we face is whether we improve health and wealth by allowing planned population movement or if we end up with an underclass of imported labor and unstable societies. The Anthropocene has created many challenges such as climate change and greater global migration. The distribution of working-age populations will be crucial to whether humanity prospers or withers."

The 21st century will see a revolution in the story of our human civilization. Africa and the Arab World will shape our future, while Europe and Asia will recede in their influence. By the end of the century, the world will be multipolar, with India, Nigeria, China, and the US the dominant powers. The solutions proposed in the paper, however, bare certain amount of ideology as well since there is no influence of IT solutions for taking care of elderly and no mention that increased globalization might not only provide additional stress on our planet, it also possesses one of the existential dangers for the progress of the human civilization. Namely, the neoliberal globalism, be it as successful as it is in terms of providing progress to the rest of the world, it also puts the human civilization in grave danger of stalling and

decline. The author of this paper is studying the longevity of the human technological civilization and the most likely outcomes are between 1000 and 10.000 years [12]. Unless we change our behavior and values, i.e. unless we do not conquer the space and become aware of the silent major dangers like the globalization, which the Melinda and Gates Foundation scientists are totally unaware of, we are in indeed a grave danger.

Nevertheless, the theses proposed in [8] and White book [7] are consistent with the Lancet paper, being the most relevant and novel recent demographic publication with an addition that the Lancet paper [1] provides significant modifications of the current projections and revelations about demographic relations.

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Standardi kakovosti storitev zdravja na daljavo za starejše odrasle - njihov poudarjen pomen v času epidemije Covid-19

Standards of quality for telehealth services for older adults - their augmented significance in Covid-19 pandemics

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POVZETEK

Zaradi trenutne pandemije COVID-19 se je tudi na področju zdravja pomembno povečalo zanimanje za storitve na daljavo (telehealth services). V poplavi informacij in novih rešitev se potencialni naročniki, dobavitelji in končni uporabniki sprašujejo, katere od teh so uporabne, nujne in preizkušene. Kako je z njihovo kakovostjo in ustreznostjo? Posebej občutljiva skupina končnih uporabnikov so starejši odrasli, saj potrebujejo večjo mero zaupanja in vodenja pri izbiri in odločanju za določeno storitev. Vprašanja so relevantna tako v tem trenutku, ko gasimo ogenj pandemije, kot bodo v prihodnosti, ko bomo s sedanjo izkušnjo vse bolj uporabljali storitve na daljavo.Trenutne krizne razmere napoveduje dolgoročne spremembe v načinu zagotavljanja zdravstvenih storitev na daljavo. Pri zagotavljanju kakovosti storitev imajo pomembno vlogo standardi, na katerih temeljijo te storitve. Standardov storitev na tem področju je malo, zato standardizacijske ustanove in združenja uporabnikov pozivajo zainteresirane strani k soustvarjanju pri njihovem razvoju. V prispevku bomo predstavili pomen standardov na področju storitev zdravja na daljavo. Predstavili bomo nekaj praktičnih primerov aplikacije standardov za storitve zdravja na daljavo, ki so v uporabi pri starejših odraslih in sicer CEN standard on the 'Quality of Care for Older People', ETSI standard for the 'Digital Citizen' ter ISO/TS 13131 Health informatics — Telehealth services — Quality planning guidelines. Kot vzorčni primer bomo pogledali "standard" International Code of Practice for Telehealth Services, za katerega smo v sodelovanju z mednarodnimi partnerji izdelali priročno orodje za samoevalvacijo lastne načrtovane ali izvajane storitve za zagotavljanje zdravja na daljavo.

KLJUČNE BESEDE

zdravje, starejši odrasli, storitve na daljavo, standardizacija, samoevalvacija storitve.

ABSTRACT

The current COVID-19 pandemic has also significantly increased interest in telehealth services in the field of telemedicine. In the flood of information and new solutions, potential customers, suppliers and end users are wondering which of these are useful, necessary and tested. What about their quality and relevance? Older adults are a particularly vulnerable group of end users, as they need a greater degree of trust and guidance in choosing and deciding on a particular service. The issues are as relevant at this time as we put out the fire of the pandemic, as they will be in the future, when we will increasingly use remote services building on our current experiences. The current crisis situation predicts long-term changes in the way of providing health care at a distance. The standards on which these services are based play an important role in ensuring the quality of services. There are few standards of services in this area, so standardization institutions and user associations call on stakeholders to co-create in their development. In this paper we will present the importance of standards in the field of remote health services. We will present some practical examples of standards applied to the remote health services used by older adults, namely CEN standard on the 'Quality of Care for Older People', ETSI standard for the 'Digital Citizen' and ISO / TS 13131 Health informatics - Telehealth services - Quality planning guidelines. As a case study, we will look at the "standard" International Code of Practice for Telehealth Services, for which we, in cooperation with international partners, have developed a convenient tool for self-evaluation of our own planned or implemented remote health services.

KEYWORDS

health, elderly adults, distance services, standardization, service self - evaluation.

1 POMEN STANDARDOV NA PODROČJU STORITEV ZDRAVJA NA DALJAVO

Zdravje na daljavo (telehealth) je tehnološka storitev ali sredstvo, katerega ljudje uporabljamo za dostop ali zagotavljanje storitev povezanih z zdravjem in dobrim počutjem, ne glede na svojo lokacijo. Da bi bile storitve zdravja na daljavo uspešne, morajo pridobiti zaupanje tako zdravnikov; izvajalcev zdravstvene in socialne oskrbe ter podpore; kot tudi formalnih in neformalnih negovalcev.

Woolham et al. predlaga [1], da je morda način uporabe zdravja in oskrbe na daljavo prav tako pomemben kot sama tehnološka rešitev oziroma podpora tej oskrbi. Prav tako meni, da so „ne-optimalne" rešitve verjetno povezane bolj s sprejemljivostjo, usposabljanjem, razpoložljivostjo in s tem

posledično, uporabnostjo, kot pa s samo tehnološko komponento ali morebitno "zapletenostjo" tehničnega dela protokola.

Tehnološke rešitve zdravja na daljavo tako pridejo do realizacije le ob doseganju določenih standardov storitve, katerih uveljavitev v konkretnih strategijah je še v razvoju.

Že v bližnji prihodnosti bo večja pozornost potrebna vzpostavitvi operativnih postopkov, ki lahko zagotavljajo ustrezne standarde kakovosti tako za tehnološki del kot za same storitve. Le tako se bo lahko stroka kot tudi družba ustrezno odzvala na povečanje potreb in povpraševanja.

1.1 CEN standard on the 'Quality of Care for Older People'

CEN je ena od treh evropskih organizacij za standardizacijo (poleg s CENELEC in ETSI), ki sta jih Evropska unija in Evropsko združenje za prosto trgovino (EFTA) uradno priznali kot odgovorne za razvoj in opredelitev prostovoljnih standardov na evropski ravni. Področje CEN / TC 449 je razvijanje standardov za oskrbo starejših, ne glede na to, kje živijo, glede na posameznikove potrebe in izbire starejših oseb.

Poudarek je na spodbujanju varnosti in varne oskrbe za starost s samoodločanjem in udeležbo starejše osebe ter njene družine ter bližnjih prijateljev. Prav tako je pomembno tudi zagotavljanje podpore strokovnih delavcev pri ustvarjanju dostopnega in podpornega fizičnega in psihosocialnega okolja, ki zagotavlja priložnost za ohranjanje funkcije in pomembnih dejavnosti za starejše ter zagotavljanje dobrega delovnega okolja za osebje. Oskrba v starosti je zapleten pojem in dejavnost, ki zahteva vzajemno razumevanje in sodelovanje med vsemi sodelujočimi akterji za spodbujanje in razvoj kakovosti storitev. Oskrba predstavlja celovit pojem, ki vključuje socialno in zdravstveno nego, rehabilitacijo, preventivne ukrepe, storitve in druga sorodna področja.

Področje uporabe ne vključuje standardizacije izdelkov (medicinskih pripomočkov in pripadajoče programske opreme), kliničnih in poklicnih kvalifikacij ter grajenega okolja. Vključuje pa vse storitve ne glede na njihovo financiranje.

1.2 ISO / TS 13131 Health informatics - Telehealth services - Quality planning guidelines

ISO / TS 13131: 2014 vsebuje nasvete in priporočila o tem, kako razviti cilje kakovosti in smernice za storitve zdravja na daljavo, ki uporabljajo informacijske in komunikacijske tehnologije (IKT) za zagotavljanje zdravstvenega varstva na dolgih in kratkih razdaljah s pomočjo postopka obvladovanja tveganj. Pri razvoju ciljev in smernic za kakovost storitev zdravja na daljavo se upoštevajo naslednje ključne zahteve:

- upravljanje postopkov za kakovost zdravja na daljavo s strani zdravstvene organizacije;
- upravljanje finančnih virov za podporo storitvam zdravja na daljavo;
- procesi, povezani z ljudmi, kot so načrtovanje delovne sile, načrtovanje zdravstvenega varstva in odgovornosti;
- nudenje virov infrastrukture in zmogljivosti za storitve zdravja na daljavo;
- upravljanje informacijskih in tehnoloških virov, ki se uporabljajo v storitvah zdravja na daljavo.

1.3 ETSI standard for the 'Digital Citizen'

ETSI svojim članom ponuja odprto in vključujoče okolje za podporo razvoju, ratifikaciji in preizkušanju globalno veljavnih standardov za sisteme in storitve IKT v vseh industrijskih in družbenih sektorjih. ETSI je neprofitna organizacija z več kot 900 članskimi organizacijami po vsem svetu iz 65 držav in petih celin. Člani sestavljajo raznolik nabor velikih in majhnih zasebnih podjetij, raziskovalnih organizacij, akademskih krogov, vladnih in javnih organizacij. EU je ETSI uradno priznala kot Evropsko organizacijo za standardizacijo (ESO).

ETSI razvija standardizacijo pametnih mest in skupnosti za državljane in potrošnike. Cilj pobude ETSI je pripraviti in razviti tehnično poročilo ETSI leta 2020, v katerem bodo opredeljene zahteve za standardizacijo, povezano z državljani, na področju pametnih mest. Tehnično poročilo ETSI bo v celoti upoštevalo širok spekter standardnih dejavnosti, ki trenutno potekajo, pojasnilo bo, ali je potrebna nadaljnja standardizacija vprašanj na državnih nivojih, povezanih s pametnimi mesti in bo podprlo priporočila, ki se že izvajajo na ravni politike.

Pametna mesta so zapletena in vključujejo raznoliko paleto storitev, težave pa vplivajo na zelo širok krog zainteresiranih strani, ne glede na to, ali so ta dejavna v standardizaciji ali so potencialni uporabniki standardov, ki jih je treba obravnavati.

Cilj predlagane dejavnosti je pripraviti in razviti tehnično poročilo ETSI, ki opredeljuje zahteve za standardizacijo, povezano z državljani, na področju razvoja pametnega mesta, z naslednjo vsebino: splošne potrebe državljanov, državljani in njihovi lokalni organi, državljani in njihove lokalne službe, kazalniki državljanov, priporočila za standardizacijo.

2 ŠTUDIJA PRIMERA - INTERNATIONAL CODE OF PRACTICE FOR TELEHEALTH SERVICES

Mednarodni kodeks ravnanja za storitve zdravja na daljavo (International code of practice for telehealth services - naprej ICPTS) je razvila skupina za kakovost zdravja na daljavo - TQG (Telehealth Quality Group), ki je Evropska gospodarska interesna skupina - EEIG. Njen predhodni Evropski kodeks je bil razvit v okviru projekta TeleSCoPE, ki ga je financirala Evropska komisija in se je končal leta 2013 (EAHC 2009 11 11). TQG deluje v partnerstvu z Global Community Resourcing (Avstralija).

ICPTS zagotavlja merilo kakovosti, na podlagi katerega je mogoče oceniti in certificirati storitve zdravja na daljavo (vključno z oskrbo na daljavo). Kodeks obravnava zdravje tako v kliničnem vidiku kot tudi v smislu splošnega dobrega počutja. Umeščen je predvsem v preventivni in javnozdravstveni prostor, zato povdarja koristi za uporabnike storitev in način izvajanja storitev.

Kodeks lahko v strateškem položaju deluje kot "dežnik", ki se lahko poveže s številnimi operativnimi kodeksi, povezanimi s posebnimi nalogami, ki jih opravljajo službe zdravja na daljavo (ZD). Zagotavlja visoko merilo kakovosti za storitve ZD. Uporablja se lahko v vseh državah in ustreza smernicam določenim v resolucijah Svetovne zdravstvene organizacije EB101.R3 (1998), WHA58.28 (2005) in WHA 66.24 (2013); ter akcijskemu načrtu Evropske komisije za e-zdravje za obdobje 2012–2020. V Kodeksu so navedeni tudi drugi standardi ISO.

Pomembno je, da kodeks vključuje smernice za načrtovanje kakovosti, določene v ISO / TS 13131 (2014). To pomeni, da storitev ZD, ki je certificirana v skladu s Kodeksom, izpolnjuje tudi zahteve tehničnih specifikacij ISO 13131 (Zdravstvena informatika - Telehealth Services - smernice za načrtovanje kakovosti).

Slika 1: International Code of Practice for Telehealth Services: Okvir delovanja

Kodeks vsebuje devet področji, kot je prikazano na zgornji sliki. V središču je oseba, ki uporablja storitve ZD - ta položaj simbolizira pomen posameznika in svobodo odločanja glede storitev in možnosti storitev. Ključno je sodelovanje, soglašanje k načinu zbiranja, shranjevanja in uporabe njihovih osebnih (vključno z zdravstvenimi podatki); poslušanje in upoštevanje njihova stališča in mnenja ter zaščita njihovih človekovih pravic in dostojanstva.

ZAKLJUČEK

V maju 2020 je bila v okviru Mednarodne organizacije za zdravje na daljavo (International Society for Telehealth - IsfTeh) ustanovljena delovna skupina za standarde in akreditacijo v storitvah zdravja na daljavo (SATS). Vzpostavitev delovne skupine je spodbujalo kontinuirano delo TQG in raziskovalcev v podjetji IZRIIS in MKS, z močno podporo mednarodnih strokovnjakov medicinskih in tehnoloških področij.

Razume se, da se storitve zdravja na daljavo zdaj razvijajo v izrednih razmerah. Vendar pa je ključno, da so standardi, v okviru katerih storitve delujejo stvar skupnih interesov, ciljev in stopnje pomembnosti za vse deležnike vključene v razvoj kot rudi uporabo zdravja na daljavo.

Fisk navaja [2], da je treba vzpostaviti in vzdrževati vsaj osnovne standarde kakovosti v teh razmerah. Nadalje bo tudi po pandemiji potreba po vključitvi zdravja na daljavo v okvire zdravstvenih in socialnih storitev ostala prioriteta. Rudel poudarja, da bomo poleg že uveljavljenih potrebovali tudi povsem nove storitve, ki jih bomo usmerili na posameznika, denimo telemedicinske storitve za podporo bolnikom na domu, ki bodo omogočili obstoječe rešitve na področju IKT.

Menimo, da zdravje na daljavo ni več le alternativna oblika zdravstvenega varstva, zato se mora tudi razvoj standardov,

akreditacij in predpisov vključiti v nacionalne prioritete. S tem se bo zagotovila ne samo tehnološka kakovost, temveč enako pomembna kakovost storitve.

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Delitvena ekonomija za starejše

Sharing Economy for Seniors

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POVZETEK

Zaradi populacijskega staranja gerontologija išče rešitve, ki izboljšujejo kakovost bivanja starejših oseb in jim omogočajo čimbolj samostojno življenje tudi v pozno starost. Tovrstne rešitve so vedno bolj povezane tudi z uporabo sodobne tehnologije. Ena takih rešitev je delitvena ekonomija. V članku predstavimo koncept delitvene ekonomije in preverimo uporabnost le-tega za starejše osebe.

KLJUČNE BESEDE

Delitvena ekonomija, IKT, starejše osebe

1 UVOD

V časih, ko zaradi demografske situacije, v kateri se delež starejših oseb v populaciji vztrajno viša, se v gerontologiji meddrugim usmerjamo tudi v iskanje za starejše osebe primernih inovacij, ki jih omogoča sodobna tehnologija. Ena tovrstnih rešitev, ki veliko obeta, je t.i. delitvena ekonomija. V zadnjem desetletju se je delitvena ekonomija (*ang. sharing economy*) precej razširila in postala inovativen ekonomski model, v katerem več oseb skupaj uporablja dobrine, na primer avto, kolo, stanovanje ali hišo, hišne pripomočke. Pri tem je bolj pomembna dostopnost do dobrin kot pa lastnina dobrin. Na ta način se bolje izkorišča vrednost premalo uporabljenih nepremičnin, naprav in predmetov ter posledično vsem uporabnikom privarčuje čas, energijo in denar. To je tudi priložnost za posameznike, ki zaradi zmanjšanja prihodkov - izgube službe, prekarne zaposlitve, upokojitve ali drugih vzrokov, dajo drugim v začasno uporabo svojo lastnino, vikend, avto, pripomočke ali svoje storitve in s tem poskrbijo za dodaten vir za preživljanje. Razvoj informacijskih tehnologij, predvsem mobilnih naprav in različnih aplikacij je razvoj teh pobud še okrepil, souporaba je s pomočjo tehnologije postala še bolj dostopna, priročna in preprosta.

Če poskusimo konceptualno opredeliti pojem delitvene ekonomije lahko rečemo, da gre za sistem, osnovan na delitvi oz. souporabi neizkoriščenih ali slabo izkoriščenih dobrin ali storitev, brezplačno ali proti plačilu, neposredno od ponudnikov. Ta pojem se je razširil po vsem svetu, a razumevanje je različno, kot so različne tudi aktivnosti, ki jih izraz pokriva. Odvisno od pogleda in ciljev različnih uporabnikov, ta izraz lahko opisuje različne koncepte. Skupna vsem je uporaba spletnih platform za neposredno povezovanje uporabnikov in ponudnikov storitev in blaga; vloga posrednikov odpade in je zato dobrina ali storitev dostopnejša. Poglavitni cilj je učinkovitejša uporaba razpoložljivih sredstev in naravnih ter človeških virov.

2 DELITVENA EKONOMIJA IN STAREJŠI

V Sloveniji upokojitvene reforme generaciji, ki se upokojuje v teh letih, z mnogimi omejitvami prinašajo negotovo prihodnost, saj je njihova pokojnina v povprečju za 40 % nižja od plač v aktivnem obdobju. Izziv za starejše odrasle ob upokojitvi je torej kako se s precej manjšimi dohodki prilagoditi spremenjenim okoliščinam in ohraniti dosedanji življenjski slog.

Delitvena ekonomija sicer prinaša koristi vsem generacijam. Preko platform delitvene ekonomije uporabniki lahko nabavijo, si izposodijo ali najamejo določene dobrine, blago in storitve po ugodni ceni ali ponudijo svoje storitve, znanja in veščine, kot tudi svojo lastnino, tisto česar ne potrebujejo več ali pa je večino časa neizkoriščeno. S tem se zmanjšuje potrošništvo, povečuje pa odgovornost do okolja in socialna vključenost, saj se na tak način spoznavajo ljudje zunaj svojih socialnih mrež. Priložnosti je veliko, potrebno pa jih je starejšim dobro predstaviti in promovirati, da prepoznajo prednosti in koristi. Šele tako se bo ustvarila potreba in povečalo zanimanje za uporabo njenih pestrih pobud in oblik.

Negotovost, ki jo občutijo številni starejši glede uporabe IKT in ekonomije delitve, je še vedno prisotna. Precej starejših sicer uporablja pametne telefone, vendar večinoma pretežno osnovne funkcije, ne pa tudi široke palete ostalih razpoložljivih funkcij in aplikacij. Zato je koristno in priporočljivo razviti izobraževalne programe za napredno uporabo IKT naprav in programov.

3 NAPREDNA UPORABA IKT KOT NUJEN POGOJ ZA UPORABO DELITVENE EKONOMIJE

Po definiciji OECD "digitalni razkorak" pomeni razlike med posamezniki, gospodinjstvi, gospodarskimi in geografskimi področji z različno stopnjo socialno ekonomskega razvoja v povezavi z njihovim dostopom do priložnosti, ki jih ponuja IKT oz. internet (Organisation for Economic Co-operation and Development, 2001).

Usposobljenost za uporabo IKT starejšim pomaga izboljšati komunikacijo z družinskimi člani in prijatelji, povečajo si

možnosti za vseživljenjsko učenje, razširijo socialno mrežo, obogatijo osebne interese, dobijo pa tudi hitrejši dostop do zdravstvenih in drugih uporabnih informacij. Uporaba interneta lahko opolnomoči starejše ljudi, znatno prispeva h kakovosti njihovega življenja in jim pomaga pri soočanju z duševnimi in telesnimi težavami, ki jih lahko prinaša starost. Današnji starejši so se rodili precej pred tehnološko dobo, zato se niso privadili na uporabo IKT v dnevni rutini in jo v vsakdanjem življenju ne pogrešajo; zato jih precej, predvsem starejših nad 70 let, po uporabi IKT niti ne čuti potrebe (Mitzner idr., 2010).

Za uporabo IKT so za starejše največje ovire:

Fizične omejitve - vid, sluh, motorične in taktilne sposobnosti rokovanja z manjšimi napravami, kot je npr. miška ali pametni telefon (Charness & Boot, 2009). Teh omejitev pri rokovanju z napravami pa nimajo samo starejši, zato je pomembno naprave prilagoditi čim širšemu krogu uporabnikov z različnimi potrebami in omejitvami.

Mnogo starejših poroča o tesnobi pri uporabi IKT (Hill, Betts & Gardner, 2015); gre za neke vrste strah in nesigurnost, ki pa izvira predvsem iz nepoznavanja uporabe tehnologije kot tudi iz neinformiranosti kako bi jim lahko olajšala vsakdanje življenje. Odpor nekaterih izvira iz predsodka, da je za obvladovanje IKT naprav potrebno veliko znanja in spretnosti, čemur se niso več sposobni prilagoditi in se naučiti novih stvari, kar bi še povečalo njihove frustracije. A posledično se na ta način izolirajo, ostanejo izven družbenih dogajanj, digitalni razkorak pa se še povečuje. Dandanes sta digitalna in socialna izključenost medsebojno tesno povezana (Delello & McWhater, 2015).

Pomanjkljiva izobrazba in slab ekonomski položaj prav tako vplivata na uporabo IKT naprav in platform med starejšimi (Elliot, Mooney, Douthit & Lynch, 2014). Nekateri si pametnega telefona ali računalnika ne morejo privoščiti; v nekaterih državah v ta namen obstajajo različne ugodnosti in spodbude.

Pomembno je, da navedene ovire in težave rešujemo in starejše še naprej spodbujamo, saj se bodo le tako lahko počutili del družbe in imeli od IKT koristi. Zato je potrebno še naprej razvijati IKT naprave in programe ter jih prilagajati različnim fizičnim in drugim oviram in zmanjšanim sposobnostim starejših. Ker uporaba IKT starejšim lahko prinese precej koristi in olajša vsakdanje življenje, se je vredno in potrebno potruditi, da jim uporabo IKT približamo in olajšamo.

4 UGOTOVITVE ŠTUDIJE EVROPSKE KOMISIJE O DELITVENI EKONOMIJI

S fenomenom delitvene ekonomije se ukvarja tudi Evropska komisija: raziskuje ga in pripravlja ukrepe za ustrezen odziv na mnoge pojavne oblike (Evropska komisija, 2016).
Komisija definira sodelovalno ali delitveno ekonomijo kot poslovni model z naslednjimi kriteriji:
- v transakciji so udeležene tri stranke: ponudnik storitev, on-line platforma in uporabnik - stranka
- ponudnik omogoči dostop do storitev ali blaga za omejeni čas
- blago, storitve ali sredstva, ki jih ponuja v uporabo ponudnik, bi bile sicer neizkoriščene
- blago, storitve ali sredstva so dostopne brezplačno ali proti plačilu
V študiji Evropske komisije (Evropska komisija, 2018) so raziskovali obseg sodelovalne ekonomije v EU-28 državah in

upoštevali različne sektorje: prevoz, nastanitev, finance, učenje znanj in veščin on-line itd. Ocenjujejo, da je skupna vrednost delitvene ekonomije v EU-28 državah 26,5 milijard EUR (0,17 % GDP-ja držav EU-28). Največje tržišče je v Franciji (6,5603 milijard EUR), v Združenem kraljestvu (4.6377 milijard EUR), na Poljskem (2.7366 milijard EUR) in v Španiji (2.5243 milijard EUR). Sedem največjih tržišč delitvene ekonomije v EU – Francija, Združeno kraljestvo, Poljska, Španija, Nemčija, Italija in Danska je v letu 2016 prispevalo približno 80 % vseh prihodkov iz delitvene ekonomije v državah EU-28.

Poznavanje in odnos prebivalcev Evrope do delitvene ekonomije se po različnih državah razlikuje: po podatkih Evropskega barometra (European Commission, 2016) je delež tistih, ki še nikoli niso slišali za delitveno ekonomijo, najmanjši v Franciji s 14 %, v drugih državah pa je bil delež višji: v Španiji 42 %, v Italiji 52 %, v Grčiji 64 % in Sloveniji 68 %. Delež oseb, ki še nikoli niso slišali za delitveno ekonomijo, je med starejšimi od 55 let 55 %, med mlajšimi od 25 do 39 let pa le 38 %. 42 % sodelujočih v raziskavi, je menilo, da je dostop do dobrin oz. blaga in storitev bolje organiziran na sodelovalnih platformah, 33 % da so storitve tam cenejše oz. ponekod tudi brezplačne.

5 OBLIKE DELITVENE EKONOMIJE

Obstaja več pobud in dobro delujočih praks delitvene ekonomije, ki so se v različnih državah različno razvile in prijele:

Transport in mobilnost:

Javni potniški prevoz je tradicionalna in že dobo vpeljana oblika skupnega prevoza, saj potniki souporabljajo isto prevozno sredstvo. Razvoj IKT in delitvene ekonomije pa je v zadnjih letih omogočil nove oblike.

Sopotništvo omogoča povezavo med voznikom prevoznega sredstva - ponudnikom prevoza - in potniki, ki imajo skupni cilj, se peljejo skupaj in si delijo stroške. Javni prevoz je ponekod slabo organiziran, vozni redi pa ne ustrezajo potrebam prebivalcem. Pri nas sopotništvo omogoča platforma prevoz.org: voznik objavi relacijo vožnje, čas odhoda, ceno prevoza in kontaktne podatke, potem pa se za prevoz zainteresirani sopotnik dogovori direktno z voznikom, določita tudi mesto odhoda. Ta način sopotnikom omogoča cenejši prevoz, spoznavanje sopotnikov različnih starosti, po drugi strani pa vsi prispevajo k ohranjanju okolja. Ker več oseb uporablja en avtomobil, se zmanjšajo potni stroški za vsakega potnika, posledično se znižujejo tudi ogljični odtis, zastoji na cestah, potrebe po parkirnih mestih in stres zaradi vožnje. V tujini je zelo razširjena platforma Blablacar. Ta platforma je bila ustvarjena v Franciji, vendar je svojo dejavnost razširila še v enaindvajset držav in ima 80 milijonov uporabnikov. Deluje malce drugače kot naši prevoz.org, francoski partnerji so jo opisali takole: »…Ko voznik objavi svoj prevoz, platforma priporoča ceno na potnika glede na prevoženo razdaljo. Voznik lahko nato zniža ali poviša ceno. Med vožnjo se navadno sopotniki spoznajo in tako se navežejo stiki med osebami, ki se verjetno drugače ne bi nikoli srečale, ne glede na starost in socialno ali drugo pripadnost. Dobra praksa je torej v tem, da povezuje različne ljudi, znižuje prevozne stroške in zmanjšuje onesnaževanje okolja.«

Souporaba prevoznih sredstev:

Že dobro stoletje je znana oblika »rent-a-car«, kjer si posamezniki za nekaj dni ali dlje časa najamejo avto ali drugo prevozno sredstvo. V zadnjem desetletju pa se je pojavilo precej novih oblik trajnostne mobilnosti, ki omogočajo kratkoročni najem oz. souporabo prevoznih sredstev – osebnih avtomobilov, električnih skirojev itd.

V Sloveniji se je uveljavil Avant2Go. Gre za model najema avtomobilov, pri katerem jih vozniki najemajo za kratek čas, za razdaljo od točke A do točke B in plačujejo le glede na čas uporabe in prevoženo razdaljo. Avtomobili so električni in na voljo v posebej določenih parkirnih mestih, celoten proces rezervacije in uporabe avtomobila poteka preko posebne aplikacije na pametnem telefonu. Souporaba avtomobilov je del večjega trenda skupne mobilnosti, ki uporabniku omogoča zniževanje stroškov svoje mobilnosti, saj finančnega bremena lastništva vozila ni več, prav tako ne stroškov vzdrževanja, parkiranja, goriva, cestnin itd. Starejši lahko sodelujejo kot kateri koli drugi uporabniki, potreben je pametni telefon in napredno znanje IKT. S tem ostanejo neodvisni, mobilni, aktivni in vključeni v družbo.

Za starejše osebe uporaben primer na področju prevoza je tudi platforma Drivy oz. po novem Getaround, preko katere lahko lastnik avta drugim odda svoj avto za čas, ko ga ne potrebuje oz. stoji avto neizkoriščen. Še posebej starejši svojih prevoznih sredstev ne uporabljajo toliko kot prej, ker ni več potrebe, a avto še vedno obdržijo kljub rednim stroškov vzdrževanja, registracije itd. Ta pobuda je na voljo v mnogih zahodnoevropskih državah.

ComParko je spletna platforma, ki posreduje med lastniki parkirnih mest oz. garaž in vozniki, ki jih potrebujejo. S pomočjo platforme je mogoče poiskati, najeti ali si deliti parkirno mesto za mesece, tedne, dneve ali celo ure. Ta pobuda se je začela v Španiji in zdaj deluje po vsej Evropi.

Bivanje, nastanitve – souporaba neizkoriščenih kapacitet

Skupnostno bivanje ali sobivanje je alternativa tradicionalnim oblikam bivanja starejših; pri tem platforma nudi možnost navezovanja stikov med ljudmi podobne starosti, ki jih zanimajo tovrstne oblike sobivanja, s čimer se izognejo osamljenosti, spodbuja pa se vključenost in socialni stiki. V Španiji je več tovrstnih iniciativ – stanovanjskih skupnosti starejših, večina je organiziranih kot zadruge. Najbolj znan primer je stanovanjska zadruga Trabensol blizu Madrida https://trabensol.org.

Un toit 2 Générations: http://untoit2generations.fr Gre za medgeneracijsko sobivanje. Platforma omogoča povezovanje starejših – ponudnikov nastanitve - in mladih, največkrat študentov, ki potrebujejo sobo oz. začasno nastanitev. Deluje v Metzu in Nancyju. S tem, ko starejši gosti študenta na svojem domu, dobi družbo in pomoč, lahko deli svoja znanja in hobije ter se uči novih stvari. Družba v hiši je lahko za starejšega človeka poživljajoča in spodbudna. Cilji platforme so spodbujanje medgeneracijske komunikacije in borba proti vse večji socialni izolaciji starejše populacije.

Turistične nastanitve za krajši čas:

Platforme - najbolj poznana Airbnb - omogočajo lastnikom stanovanj ali hiš, da za krajši čas oddajo sobe ali stanovanja, ki so sicer neizkoriščena. Med ponudniki je precej starejših oseb, ki si z dodatnim zaslužkom izboljšajo ekonomski položaj. Na platformi Freebirdclub, specializirani le na starejše od 60 let, ponudniki svoje neizkoriščene nepremičnine – sobe, stanovanja ali vikend hiše – oddajajo izključno starejšim osebam, za počitnice, na potovanjih itd.

Homeforexchange: https://www.homeforexchange.com Gre za ekonomičen in udoben način nastanitve za čas počitnic oz. na potovanjih. Preko te mednarodne platforme, ki je v angleškem jeziku, uporabnika navežeta stik in se dogovorita za izmenjavo domovanja za izmenjavo - stanovanja, apartmaja ali počitniške hiše; izmenjava je lahko simultana, ob istem času ali po dogovoru v različnem obdobju. Na tak način je nastanitev brezplačna, potrebno je le plačilo pristojbine ob registraciji na spletni strani. Potrebna pa je tudi visoka stopnja medsebojnega zaupanja, da bo vsak ravnal z izmenjanim domovanjem kot s svojim.

Affitto Giardino: https://affittogiardino.it/ Deluje podobno kot druge platforme, ki omogočajo souporabo zasebnih nepremičnin z začasnimi uporabniki, ki so pripravljeni za to plačati. Osredotoča se izključno na uporabo zasebnih zunanjih površin – večjih vrtov, atrijev in dvorišč, zato je zanimiv za tiste, ki potrebujejo prostor za izvedbo prireditev oz. manjših dogodkov – praznovanje rojstnih dnevov, obletnic, porok ipd. Na drugi strani so ponudniki - lastniki hiš z večjim vrtom, ponekod z bazenom, letno kuhinjo ali zunanjim žarom itd., ki želijo z oddajo teh površin na prostem povečati svoje prihodke.

Wallapop: https://es.wallapop.com Ta platforma omogoča nakup in prodajo rabljenih predmetov, oblačil itd. V Španiji ima 20 milijonov uporabnikov (skoraj polovica prebivalstva) in 70.000 dnevnih transakcij. Med dobre prakse smo ta primer uvrstili, ker lahko pripomore k socialni vključenosti starejših, ponuja možnost ponovne uporabe za predmete, ki jih ne potrebujemo več in možnost povezovanja ljudi s podobnimi potrebami in hobiji. Ta platforma je primerljiva je s slovensko bolha.com.

Storitve za pomoč starejšim

Ugo: https://hellougo.com Italijanska platforma, ki starejšim in njihovim družinam omogoča iskanje oskrbovalcev in spremljevalcev pomoči potrebnim v njihovem lokalnem okolju. Koordinatorji te platforme izvajalce predhodno preverijo in odobrijo. Gre za različne oblike pomoči starejšim ali invalidnim osebam, od osnovnih vsakodnevnih opravil do spremstva v trgovino, k zdravniku, družabništvo, hišna opravila, vrtnarjenje ipd. Starejši so večinoma uporabniki storitev, ki jih ponuja platforma, saj jim pomoč ali družba oskrbovalcev omogoči varno življenje doma ali pa jim pomagajo pri dejavnostih, ki bi jo sicer težko izvedli sami ali brez pomoči družinskega člana. Po drugi strani pa lahko še aktivni starejši prek platforme Ugo ponudijo svoj čas in storitve drugim ljudem, s čimer ostanejo aktivni, tako fizično kot socialno ter vključeni v družbo.

Village Care: https://www.villagecare.it Deluje kot platforma, kjer se srečujejo potrebe (starejši ljudje in družine) in ponudba (ponudniki storitev). Uporabniki lahko brskajo po ponudbi domov za ostarele, dnevnem varstvu in Alzheimerjevih centrov, oskrbovanih bivalnih enotah, ter poiščejo formalne ali neformalne oskrbovalce in druge možnosti oskrbe na domu. Platforma omogoča starejšim, družinam in oskrbovalcem celovit vpogled in informacije o storitvah za družine in starejše občane, ki iščejo storitve oskrbe, zdravstvene podpore in možnosti bivanja, ki so na voljo v njihovem lokalnem okolju. Široka ponudba priložnosti olajša iskanje pomoči pri aktivnem življenjskem slogu in preprečuje socialno izključenost. Platforma ponuja tudi strokovno svetovanje in orientacijo tako za uporabnike kot za strokovno osebje.

Druga področja:

L'Accorderie: http://www.accorderie.fr
Časovna banka, ki se je dobro ustalila v Franciji: platforma omogoča ljudem vseh starosti posredovanje veščin, znanja in hobijev drugim ali jih sprejemajo sami. Menjalna valuta je čas, ovrednoten po kreditnem principu. Koncept so razvili v kanadskem Quebecu in je zdaj dosegel veliko francoskih mest, vključenih je več kot 4.000 ljudi. Glavni rezultat je medčloveška solidarnost, saj spodbuja socialno angažiranost, medgeneracijsko sodelovanje, lokalno izvajanje in krepitev skupnosti.

Zelemenjava: http://www.zelemenjava.si
Gre za slovensko samoorganizirano civilno iniciativo za izmenjavo presežnih semen, sadik in pridelkov z domačih vrtov, ki udeležencem omogoča samooskrbo in boljše prehranjevanje, prihranek, zmanjšanje živilskih odpadkov in srečevanje z drugimi vrtičkarji in sosedi. Udeleženci so ljudje različnih generacij, ki gojijo zelenjavo za lastno uporabo, ne glede na izobrazbo, starost ali socialni status. Edino pravilo je, da se denar ne uporablja kot menjalno sredstvo, s čimer se spodbuja samozadostnost in solidarnost med člani lokalne skupnosti. Po besedah pobudnic je več kot polovico sodelujočih starejših oseb.

Delitvena ekonomija in koncepti souporabe ob podpori IKT so lahko eden od odgovorov na vprašanje kako lahko starejši ostanejo aktivni, vključeni, neodvisni, varni in mobilni. S tem si izboljšajo svoje življenje in hkrati prispevajo tudi za dobro drugih ljudi, družbe in okolja.

6 ZAKLJUČEK

Koncept delitvene ekonomije lahko doprinese veliko koristi v življenja starejših oseb. Ker starejše generacije nimajo toliko izkušenj z uporabo sodobne tehnologije, na kateri je delitvena ekonomija dandanes utemeljena, je potrebno povečati na eni strani fokus stroke v prilagajanje tehnologije za potrebe starejših ter na drugi strani fokus stroke v oblikovanje učinkovitih usposabljanj za učenje napredne rabe tehnologije za starejše.

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Razlike med spoloma v ekonomski odvisnosti v obdobju 2000–2012

The gender gap in economic dependency in the period 2000–2012

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POVZETEK

V ekonomski analizi je obdobje ekonomske odvisnosti običajno opredeljeno z uporabo fiksnih starostnih mej, neodvisnih od države, leta analize, spola itd. Poleg tega običajno predpostavljamo enak obseg ekonomske odvisnosti, ne glede na starost odvisnih posameznikov. Metodološki okvir računov nacionalnih transferjev (angl. National Transfer Accounts – NTA) nam s pomočjo koncepta primanjkljaja življenjskega cikla omogoča natančno merjenje obdobja in obsega ekonomske odvisnosti. V članku predstavljamo rezultate retrospektivne analize NTA po spolu za Slovenijo v obdobju 2000–2012. Rezultati kažejo, da so bile ženske v letu 2012 sposobne financirati svojo potrošnjo za obdobje 29,0 let, medtem ko moški 35,9 let. Vendar pa se v času razlika med spoloma v dolžini ekonomske neodvisnosti skrajšuje, s 7,9 let v letu 2000 na 6,9 let v letu 2012.

KLJUČNE BESEDE

računi nacionalnih transferjev, ekonomska odvisnost, vidik spola, Slovenija.

ABSTRACT

In the economic analysis, the period of economic dependency is usually defined using fixed age limits, independently of country, year of analysis, gender, etc. Moreover, the same size of economic dependency is usually assumed, independently of the age of dependent individuals. However, by using the concept of the life cycle deficit, the National Transfer Accounts (NTA) framework enables us to precisely measure the period and size of economic dependency. This paper presents the results of a retrospective NTA by gender for Slovenia in the period 2000–2012. Our results show that in 2012, women were able to finance their consumption with their labour income for 29.0 years, whereas men financed their consumption for 35.9 years. However, the significant gender gap in the length of economic independence decreased over time, from 7.9 years in 2000 to 6.9 years in 2012.

KEYWORDS

National Transfer Accounts, economic dependency, gender dimension, Slovenia.

1 UVOD

V času trajanja svojega življenja se posamezniki soočajo z dvema obdobjema ekonomske odvisnosti, v času otroštva in v času starosti. V obdobju ekonomske odvisnosti posamezniki porabijo več, kot zaslužijo, in se na ta način soočajo s t. i. primanjkljajem življenjskega cikla. Ekonomska odvisnost mladih in starih je financirana s strani delovno aktivne populacije, katere delovni dohodek presega potrošnjo. Delovno aktivna populacija se sooča s t. i. presežkom življenjskega cikla, ki jim omogoča financiranje odvisnosti mladih in starih v obliki javnih in zasebnih transferjev ter javne in zasebne prerazdelitve iz naslova sredstev (angl. asset-based reallocations) [2].

V ekonomski analizi je obdobje ekonomske odvisnosti običajno opredeljeno z uporabo fiksnih starostnih mej, neodvisnih od države, leta analize, spola itd. Poleg tega običajno predpostavljamo enak obseg ekonomske odvisnosti, ne glede na starost odvisnih posameznikov. Metodološki okvir računov nacionalnih transferjev (angl. National Transfer Accounts – NTA) nam s pomočjo koncepta primanjkljaja življenjskega cikla omogoča natančno merjenje obdobja in obsega ekonomske odvisnosti. Z vpeljavo vidika starosti v Sistem nacionalnih računov (SNA) nam NTA omogoča ocenjevanje starostnospecifičnih vrednosti ekonomskih kategorij, kot so delovni dohodek, dohodek iz premoženja, transferji, potrošnja in varčevanje. Ker so starostnospecifične vrednosti ekonomskih kategorij močno odvisne tudi od časa in spola, v članku v običajno analizo NTA dodajamo še dimenzijo časa in spola. V članku tako predstavljamo rezultate retrospektivnih NTA po spolu v Sloveniji v obdobju 2000–2012, ki nam pomagajo odgovoriti na naslednja raziskovalna vprašanja:

(1) Kako velike so razlike med spoloma v delovnem dohodku, potrošnji in primanjkljaju življenjskega cikla?

(2) Kako se vzorci delovnega dohodka, potrošnje in primanjkljaja življenjskega cikla obeh spolov spreminjajo skozi čas?

(3) Ima ekonomska kriza vpliv na razlike v dolžini in velikosti primanjkljaja življenjskega cikla med spoloma?

2 METODOLOGIJA IN PODATKI

Metodologija NTA temelji na proračunski omejitvi posameznika, kjer se morajo prilivi izenačiti z odlivi. Med prilive štejemo delovni dohodek (Y^l), dohodek iz premoženja (Y^A) in prilive transferjev (τ^+); med odlive pa potrošnjo (C), odlive transferjev (τ^-) in varčevanje (S). S preureditvijo členov dobimo naslednjo računovodsko identiteto [2]:

$$\underbrace{C(x) - Y^l(x)}_{Primankljaj \; \check{z}ivljenjskega \; cikla} = \underbrace{\tau^+(x) - \tau^-(x)}_{Neto \; transferji} + \\ + \underbrace{Y^A(x) - S(x)}_{Prerazdelitev \; iz \; naslova \; sredstev}. \tag{1}$$

Otroci in starejši se soočajo s pozitivnim primanjkljajem življenjskega cikla (ki je opredeljen kot razlika med javno in zasebno potrošnjo ter delovnim dohodkom). Primanjkljaj življenjskega cikla določa njihovo ekonomsko odvisnost. Na drugi strani, v času delovne aktivnosti, delovni dohodek preseže potrošnjo, kar vodi v negativen primanjkljaj življenjskega cikla, tj. presežek življenjskega cikla. Presežek življenjskega cikla omogoča zaposlenim financiranje primanjkljaja življenjskega cikla ekonomsko odvisnega prebivalstva. Ekonomska odvisnost se financira z različnimi oblikami medgeneracijskih tokov: javni neto transferji (prilivi minus odlivi transferjev), zasebni neto transferji in prerazdeljevanjem iz naslova sredstev (dohodek iz premoženja minus varčevanje).

Za analizo ekonomske odvisnosti je potrebno oceniti številne starostne profile. Starostni profili so starostni vzorci (povprečja) nadalje razčlenjenih spremenljivk, vključenih v računovodsko identiteto. V prvem koraku s pomočjo SNA in drugih podobnih podatkovnih virov izračunamo agregatne vrednosti posameznih spremenljivk. V drugem koraku izračunamo relativno porazdelitev določene spremenljivke po starostnih skupinah s pomočjo anketnih in/ali administrativnih podatkov. Starostne profile iz drugega koraka pomnožimo z ustreznim faktorjem prilagajanja (angl. adjustment factor), tako da se starostni profili, pomnoženi s starostno strukturo prebivalstva, ujemajo z agregatnimi vrednostmi iz prvega koraka. Večina starostnih profilov je izglajena; na ta način izločimo vpliv posledic slučajnih dejavnikov v vzorčnih podatkih [4]. Rezultati NTA so torej presečni rezultati, pridobljeni s pomočjo sekundarnih virov podatkov. Za ocenjevanje retrospektivnega NTA za Slovenijo so uporabljeni mikropodatki iz Ankete o porabi gospodinjstev za leta 2000, 2003, 2005, 2008, 2010 in 2012.

NTA po spolu so ocenjeni podobno kot običajni NTA. Kadar so starostni profili izračunani na podlagi anketnih podatkov, je edina razlika ta, da moramo poleg povprečij po starostnih skupinah izračunati tudi povprečja po spolu. Starostni profili so prilagojeni na način, da se zagotovi skladnost z makroekonomskimi agregati in tudi s starostnimi profili običajne analize NTA [1]. V članku poleg grafične predstavitve razlik v potrošnji, delovnem dohodku in primanjkljaju življenjskega cikla prikazujemo tudi rezultate dveh kazalnikov, ki kažeta razlike v ekonomski odvisnosti med spoloma, in sicer (1) absolutno razliko v dolžini ekonomske neodvisnosti med obema spoloma in (2) razliko v obsegu ekonomske odvisnosti med spoloma, prilagojeno za velikost delovnega dohodka celotne populacije.

3 REZULTATI

Slika 1 prikazuje dohodek iz dela in (javno ter zasebno) potrošnjo obeh spolov. Iz slike je razvidno, da ima delovni dohodek moških in žensk v celotnem obdobju med letoma 2000 in 2012 v Sloveniji tipično obliko obrnjene U-krivulje, vendar med spoloma obstajajo velike razlike v vrednosti delovnega dohodka pri vseh starostih. Delovni dohodek žensk začne naraščati kasneje kot delovni dohodek moških predvsem zaradi višje stopnje vpisa žensk v terciarno izobraževanje. Tudi v delovni starosti je dohodek žensk nižji od dohodka moških, in sicer predvsem zaradi njihove nižje stopnje vključenosti na trg dela in rahlo nižjih plač žensk v primerjavi z moškimi v primeru zaposlitve za polni delovni čas. V višji starosti začne delovni dohodek žensk padati hitreje kot delovni dohodek moških, saj se v povprečju ženske upokojujejo hitreje kakor moški. Ne glede na to, da ženske vseh starosti zaslužijo manj kot moški, je pri praktično vseh starostih njihova potrošnja višja od potrošnje moških. Razlika med spoloma v ravni potrošnje v nižjih starostnih razredih je predvsem rezultat relativno višje stopnje vpisa žensk v formalno izobraževanje. Razlika med spoloma v potrošnji je še bolj očitna v času aktivne delovne dobe, ko imajo v času materinstva ženske višjo predvsem javno in zasebno zdravstveno potrošnjo.

V času se starostni profil delovnega dohodka obeh spolov pomika v desno. Posamezniki namreč v času na trg dela vstopajo pri višji starosti in se pri višji starosti tudi upokojujejo. Zaznati pa je bolj očiten premik delovnega dohodka žensk v primerjavi z delovnim dohodkom moških. V obdobju med letoma 2000 in 2012 se v nižjih starostnih razredih povečuje razlika v delovnem dohodku med spoloma, medtem ko se razlika v dohodku višjih starostnih razredov zmanjšuje. Zadnje je predvsem posledica procesa izenačevanja pogojev za upokojitev obeh spolov. Višja potrošnja žensk v primerjavi z moškimi je značilnost celotnega obdobja 2000–2012, razlike med spoloma v času materinstva pa se skozi čas povečujejo.
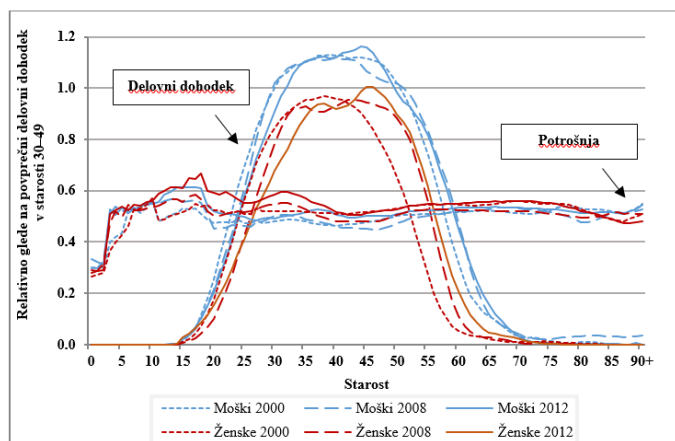
Slika 1: Dohodek iz dela in potrošnja moških in žensk, Slovenija, 2000–2012

Vir: APG 2000–2012, Eurostat, mnogi drugi viri.

Zaradi nižjega delovnega dohodka, a hkrati višje potrošnje žensk v primerjavi z moškimi, so ženske ekonomsko neodvisne krajše obdobje življenjskega cikla kakor moški. V letu 2012 je delovni dohodek žensk presegal njihovo potrošnjo zgolj med 27,7.

in 56,7. letom starosti (glej Tabelo 1). Na drugi strani so bili moški ekonomsko neodvisni med starostjo 24,1 in 60,0 let. Moški so bili tako v povprečju sposobni financirati svojo potrošnjo z delovnim dohodkom 6,9 let dlje kot ženske.

Krajše obdobje ekonomske neodvisnosti žensk in njihovo daljše življenjsko pričakovanje ob rojstvu vodi v daljše obdobje ekonomske odvisnosti oz. primanjkljaja življenjskega cikla žensk v primerjavi z moškimi. Ekonomska odvisnost žensk pa ni zgolj daljša, ampak je tudi bolj intenzivna. V letu 2012 je celoten primanjkljaj življenjskega cikla moških znašal 25,5 % celotnega delovnega dohodka, medtem ko je celotni primanjkljaj življenjskega cikla žensk znašal 30,2 % celotnega delovnega dohodka. To pomeni, da je bilo za financiranje ekonomske odvisnosti žensk potrebnega 4,7 % celotnega delovnega dohodka več, kakor ga je bilo potrebnega za financiranje odvisnosti moških.

V času se, skladno s premikom delovnega dohodka, v desno premika tudi starostni profil primanjkljaja življenjskega cikla. Znatnejši premik za ženske v primerjavi z moškimi vodi v daljše obdobje ekonomske neodvisnosti oziroma daljše obdobje presežka življenjskega cikla za ženske, in sicer z 28,3 let v letu 2000 na 29,0 let v letu 2012. Nasprotno se obdobje ekonomske neodvisnosti moških celo rahlo skrajšuje, in sicer s 36,1 let v letu 2000 na 35,9 let v letu 2012. Razlika v dolžini ekonomske neodvisnosti med spoloma se je tako skrajšala z začetnih 7,9 let v letu 2000 na 6,9 let v letu 2012. Ob tem se v času zmanjšuje tudi razlika v obsegu ekonomske odvisnosti, in sicer z začetnih 6,3 % celotnega delovnega dohodka v letu 2000 na 4,7 % v letu 2012.

Tabela 1. Razlike med spoloma v dolžini/obsegu presežka/primanjkljaja življenjskega cikla, Slovenija, 2000–2012

Leto	Spol	Starostne meje presežka življenjskega cikla		Dolžina presežka življenjskega cikla (LCS; v letih)	Obseg primanjkljaja življenjskega cikla glede na delovni dohodek (NtaDR; v %)	$\Delta LCS_{M/ž}$ (v letih)	$\Delta NtaDR_{Ž/M}$ (v %)
2000	Moški	22,5	58,6	36,1	25,3	7,9	6,3
	Ženski	24,4	52,7	28,3	31,6		
2003	Moški	23,3	59,7	36,4	25,8	7,8	6,2
	Ženski	25,4	54,0	28,6	32,1		
2005	Moški	23,5	59,9	36,4	24,7	7,1	5,7
	Ženski	25,4	54,7	29,3	30,4		
2008	Moški	23,4	60,5	37,1	24,3	7,2	5,2
	Ženski	26,3	56,3	30,0	29,5		
2010	Moški	23,9	59,6	35,7	27,1	6,3	5,4
	Ženski	26,7	56,2	29,4	32,5		
2012	Moški	24,1	60,0	35,9	25,5	6,9	4,7
	Ženski	27,7	56,7	29,0	30,2		

Vir: APG 2000–2012, Eurostat, mnogi drugi viri.

Iz Tabele 1 je razvidno tudi, da se je v obdobju pred krizo, med letoma 2000 in 2008, obdobje presežka življenjskega cikla podaljšalo za oba spola, vendar je bilo podaljšanje bolj očitno za ženske kakor za moške. Kasneje je ekonomska kriza vplivala na skrajševanje obdobja presežka življenjskega cikla za oba spola. Kot rezultat visoke stopnje brezposelnosti v panogah, ki pretežno zaposlujejo moško delovno silo, se je na začetku krize presežek življenjskega cikla moških skrajšal bolj, kakor se je skrajšal presežek življenjskega cikla žensk. V razmahu ekonomske krize, ko se je presežek življenjskega cikla moških začel ponovno podaljševati, se je presežek življenjskega cikla žensk še nadalje skrajševal. To lahko pojasnimo z varčevalnimi ukrepi javnega sektorja, v katerem je zaposlen višji odstotek žensk kakor moških. Ne glede na to so se razlike med spoloma v dolžini presežka življenjskega cikla zmanjšale tudi v času ekonomske krize, med letoma 2008 in 2012.

Ekonomska kriza je prav tako vplivala na razliko v obsegu ekonomske odvisnosti obeh spolov. Medtem ko se je v začetku ekonomske krize razlika v obsegu ekonomske odvisnosti med spoloma povečala, se je v razmahu krize začela zmanjševati. Kljub začetnemu povečanju razlike v obsegu ekonomske odvisnosti obeh spolov, se je le-ta v celotnem obdobju krize zmanjšala. Če

povzamemo, navkljub temu da je ekonomska kriza prekinila približevanje ekonomske (ne)odvisnosti žensk k ekonomski (ne)odvisnosti moških, se je razlika v ekonomski (ne)odvisnosti obeh spolov zmanjšala tudi v celotnem preučevanem obdobju krize.

4 SKLEP

V pričujočem članku predstavimo rezultate retrospektivne analize NTA po spolu. NTA nam s pomočjo koncepta primanjkljaja oz. presežka življenjskega cikla omogočajo analizo posameznikove ekonomske odvisnosti oz. neodvisnosti skozi življenjski cikel.

Iz naših rezultatov izhaja, da je razlika med spoloma v delovnem dohodku prisotna pri vseh starostih, ko ženske zaslužijo manj kot moški, medtem ko je razlika v potrošnji očitna predvsem v času materinstva, ko ženske porabijo več kot moški. Ženske so tako ekonomsko odvisne daljše obdobje življenjskega cikla. V letu 2012 so bile ženske sposobne financirati svojo potrošnjo v starostnem razponu 29,0 let, moški pa 35,9 let. Vendar pa se v času razlika v dolžini ekonomske neodvisnosti skrajšuje, s 7,9 let v letu 2000 na 6,9 let v letu 2012. Prav tako se v času zmanjšuje tudi razlika med spoloma v obsegu ekonomske odvisnosti. Kljub temu da je ekonomska kriza prekinila približevanje obdobja ekonomske neodvisnosti in obsega ekonomske odvisnosti žensk vrednostim za moške, so se razlike med spoloma tudi v celotnem obdobju krize zmanjšale.

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Demonstrational vegetable garden with ReSoil remediated soil

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ABSTRACT

The contaminated calcareous soil from Prevalje, Slovenia was EDTA-washed using novel ReSoil technology. Washing removed 71, 28 and 53% of soil Pb, Zn and Cd, respectively. The vegetable garden with 3 raised beds with non-remediated (original) and 6 beds with remediated soils was set up and realistically tended; a selection of 10 different produces were grown. All vegetables reached the mature phase without difficulties or visible deficiencies, irrespective of soil treatment. Grown on original soil all plants exceeded limits for Pb concentration in their edible parts stipulated by European Union legislature. In remediated soil only carrot exceeded limit for Pb. Remediation was less efficient in mitigation of Cd hazard; concentration of Cd in spinach, second cut of radicchio, and carrot exceeded the allowed values. The vegetable type is a strong determinant of metal concentration in edible crop. The selection of excluders instead of accumulators will thus be crucial for production of safe food on ReSoil remediated soils.

KEYWORDS

Soil, Toxic metals, Remediation, Vegetable garden

1 INTRODUCTION

Fertile soil is a valuable, limited resource. As human population and pressure on limited soil resources are continuously growing, more and more land contaminated with toxic metals is expected to be put under agricultural production in a delicate balance of needs, social & economic benefits and health risks. The harmful, pandemic effect of toxic metals on human health is well documented and governments are setting remediation of contaminated soil as a national priority.

We have recently introduced ReSoil soil washing technology which uses ethylenediamine-tetraacetate (EDTA) as a chelator [1, 2, 3]. The EDTA forms water-soluble complexes (chelates) with most toxic metals and is the most efficient chelator. The ReSoil was designed to recycle most of EDTA and all process water. For this to achieve the process solutions are treated by low-cost materials: lime, H_2SO_4, and wastepaper to impose pH gradient and induce recycling (substitution, precipitation and adsorption) reaction. The recycled EDTA and process water are

reused in a closed loop, no wastewater is generated, and only solid waste enriched with toxic metals is produced. The EDTA is poorly biodegradable and persist in the environment. This has raised concerns about leaching of toxic chelates from remediated soil and risking groundwater contamination. In ReSoil extensive rinsing of remediated soil removes the majority of toxic chelates from the soil and zero-valent Fe (ZVI) is applied to the soil slurry to facilitate the permanent adsorption of the remaining chelates. We demonstrated that in ReSoil toxic emissions are not an issue [2, 4].

The aim of this study was to scale-up the ReSoil technology to provide enough soil to set-up and manage the genuine vegetable garden and to examine the possibility of production of safe food on remediated soil.

2 MATERIALS AND METHODS

2.1 Soil Remediation

The surface soil was excavated from grassland in the bank of the river Meza in city of Prevalje in Meza Valley, Slovenia. The excavated soil was in situ homogenized and then transported to a nearby remediation facility for EDTA-soil washing using ReSoil technology.

2.2 Experimental garden

Raised beds (4 x 1 x 0.5 m) were constructed and vegetables: buckwheat, spinach, lamb's lettuce, radicchio, garlic, onion, leek, lettuce, carrots and kohlrabi were grown in 6 rotations from the July 2018 until the end of November 2019.

2.3 Analysis

Samples of soil and vegetables were prepared as described before [4] and analyzed using graphite furnace AAS.

3 RESULTS AND DISCUSION

The novel remediation plant with ReSoil technology is depicted in **Figure 1**. The Technology Readiness Level of plant operation was TRL 7 (EU, NASA methodology). The permit for construction of ReSoil soil washing plant was granted by Slovenian Environmental Protection Agency in 2017, and the operating permit to remediate in July 2018. For this study the contaminated soil was remediated in series of 16 batchers – these were at the same time the first batches carried out in novel remediation plant. In total 16 tons of soil was washed.

Using EDTA in ReSoil technology decreased Pb, Zn and Cd soil concentration from 1854 ± 120, 3833 ± 135 and 21.2 ± 1.2 mg kg-1 to 545 ± 17, 2743 ± 120 and 9.9 ± 0.4 mg kg-1,

respectively. To improve physical properties of remediated soil for vegetable production the buckwheat was sown as the first crop. Buckwheat is often used for green manuring. It has branched root system that reaches deep into the soil and improves soil aggregation through extensive network of fine roots.

The future of ReSoil, as of any other technological eco-innovation, relies on its social acceptance. Local population was therefore invited to select the final assortment of produces. All plants grown on original and remediated soil reached the mature phase without difficulties or visible deficiencies. We observed no statistically significant differences in plant biomass, and no chlorosis indicating lack of micronutrients (Figure 2).

The metal plant uptake is known to vary strongly across plant species and growing stages. Soil washing with ReSoil the most consistently prevented accumulation of Pb in edible parts of vegetables. The Pb uptake was reduced from 76% in garlic to 95% in kohlrabi. The uptake of essential element Zn was distributed more uniformly, with differences of only 14% between lettuce grown remediated and original soil, and the highest reduction of 76% in the first cut of radicchio. Cadmium (and Pb) is believed to be non-essential element. Nevertheless, plants often adsorb Cd instead of Zn, which is biologically

antagonistic micronutrients with similar ionic radius. The smallest difference in Cd uptake, 33%, was measured in roots of carrots grown on remediated soils, the highest reduction, 90.8 and 91.4% was in the second cut of radicchio and leek.

The European Union has defined maximum levels of Pb and Cd to be found in vegetables. To facilitate comparison with EU guidance values the vegetable samples were analyzed for toxic metals also on a fresh weight basis (Figure 3). Grown on original soil all vegetables exceeded stipulated limits for Pb concentration in their edible parts. In remediated soil only carrot exceeded limit for Pb. Remediation was less efficient in mitigation of Cd hazard; concentration of Cd in spinach, second cut of radicchio, and carrot exceeded the allowed values. In accordance to our results spinach and carrots are often identified as the major Cd accumulators. Substantial genotypic variation, however, exists among species and cultivars [5]. For example Kugonič et al. [6] reported that carrot grown in Zasavje region in Slovenia in unpolluted calcareous soil (similar to soil used in our study) with Cd concentration ranging from 0.13 - 0.69 mg kg-1 accumulated 0.3 - 0.8 mg kg-1 of Cd in roots, which is higher than stipulated by EU, and higher than in carrot grown on remediated soils in our study.

Figure 1: Demonstrational soil-washing plant (TRL 7) with ReSoil technology in the city of Prevalje, Slovenia. The plant with capacity of 1.5 tons of soil per batch is operated by Envit Ltd. The plant construction was supported by the EU project LIFE12 ENV/SI/000969 (http://www.envit.si/).

Figure 2: Vegetable garden with remediated (raised beds 2, 4, 5, 7, 8, 9) and original (beds 1, 3, 6) soil. The growth of leek, lettuce and carrots (4. Rotation, Maj 20, 2019) is depicted.
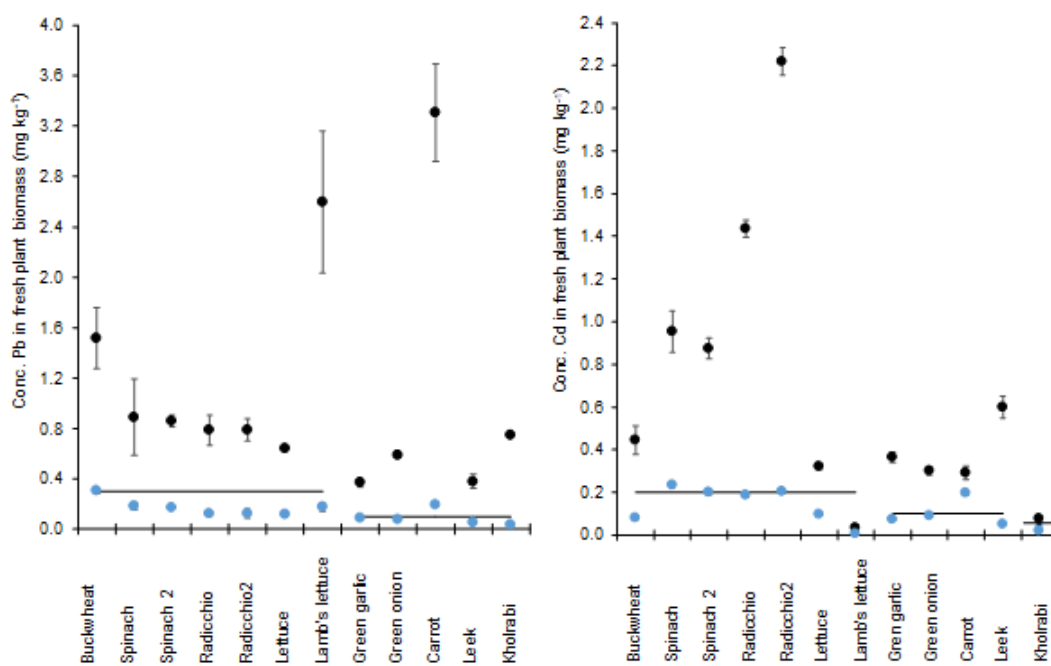
Figure 2: Concentration of Pb and Cd in edible parts of vegetables (wet biomass) grown on original soil (black circles) and remediated soil (blue circles). Horizontal lines depict maximum permissible levels of Pb and Cd in vegetables as stipulated by European Union legislature. Data are given as average of 3 samples with standard error.

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Lahko migracije zaustavijo pritisk staranja prebivalstva Slovenije na ekonomsko vzdržnost?

Can migration stop the pressure of population ageing in Slovenia on economic sustainability?

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POVZETEK

Prebivalstvo Slovenije se bo v prihodnjih treh oz. štirih desetletjih hitro staralo. Najnovejše Eurostatove demografske projekcije kažejo, da naj bi se delež starih 65 let in več povečal z 20,2 % v letu 2020 na okrog 31 % v letu 2050. Ekonomsko gledano, je še bolj pomembno gibanje razmerja med starimi 65+ in prebivalci v delovni starosti 20-64 let. Prva starostna skupina namreč v glavnem predstavlja ekonomsko odvisne prebivalce, druga skupina pa odvisne prebivalce ekonomsko vzdržuje. Hkrati s povečevanjem deleža starih 65+ se bo namreč približno v enakem obsegu zmanjševal delež tistih v delovni starosti, zato se bo to razmerje, imenovano »koeficient starostne odvisnosti starih« še posebej zaostrovalo. V članku pokažemo, kakšne bi morale biti neto migracije, da se ta kazalnik ne bi povečal čez določeno mejo. Izkaže se, da bi bile potrebne za ohranjanje tega kazalnika na sedanji ravni povsem nerealistično visoke neto migracije. Torej bomo lahko v prihodnje z migracijami zgolj nekoliko blažili demografski pritisk na ekonomsko vzdržnost, rešitve problema pa na ta način ne moremo pričakovati. Tako bodo morale biti rešitve usmerjene predvsem v ekonomsko prilagajanje sistemov spremenjenim demografskim razmeram.

KLJUCNE BESEDE

staranje prebivalstva, migracije, ekonomska odvisnost, projekcije.

ABSTRACT

In the next three to four decades the population of Slovenia will rapidly age. The latest Eurostat population projections show that the share of people aged 65 and over will increase from 20.2% in year 2020 to around 31% in 2050. From economic point of view, it is even more important, how the ratio between individuals 65+ and working-age population develops. The former age group namely represent economically dependent individuals, whereas the second group supports those dependent individuals. With the increasing share of individuals 65+ the share of working-age population will decrease accordingly, therefore this ratio, called "old age dependency ratio" will aggravate even more. In this article we present how large the annual net migration should be to keep this indicator below an arbitrarily chosen level. It turns out that keeping this indicator on the current level would require unrealistically high net migration. Thus, in the future we will be able to use migration to somehow alleviate the demographic pressure on economic sustainability, but we can not expect to solve this problem. Therefore, the solutions are expected to go in the direction of adjusting the systems in line with the changed demographic circumstances.

KEYWORDS

Population ageing, migrations, economic dependency, projections.

1 UVOD

Spomladi 2020 je Eurostat objavil nove demografske projekcije prebivalstva z imenom EUROPOP2019 [1]. Gre za neobičajno odločitev, saj je bila ustaljena praksa, da jih pripravi na vsaka tri leta in prejšnje je po tem vzoru pripravil pred enim letom, torej leta 2019 z imenom EUROPOP2018 [2]. Eurostat namreč projekcijam dodeljuje imena po letu, v katerem začne z izdelavo projekcij, hkrati pa iz tega leta tudi vzame dejansko število prebivalstva po starosti in spolu in na njega aplicira predpostavke o rodnosti, umrljivosti in migracijah, da dobi rezultate za vsa ostala leta projekcij.

Glede umljivosti, ki jo običajno sintetično izražamo z življenjskim pričakovanjem ob rojstvu, so predpostavke v EUROPOP2019 skoraj iste kot v EUROPOP2018. Življenjsko pričakovanje so rahlo popravili navzgor – za moške naj bi se od leta 2019 do leta 2060 povišalo z 78,7 let na 84,6 let (prej 84,4 let), za ženske pa z 84,5 let na 89,4 let (prej 89,1 let). Rodnost so tokrat popravili navzdol za nekaj manj kot 0,1 otroka na žensko, izraženo s kazalnikom »stopnja celotne rodnosti«. Porast naj bi bil z 1,55 v letu 2019 na 1,67 v letu 2060 (prej 1,73). Največje razlike pa so pri (neto) migracijah. Kot prikazano v Sliki 1, so v EUROPOP2018 namreč predpostavljali, da se bodo v obdobju do leta 2045 neto migracije gibale na ravni okrog štiri tisoč neto priseljenih na leto, nakar pa naj bi se postopno znižale na okrog tri tisoč neto priseljenih na leto. Proti letu 2060 pa naj bi se še nadalje znižale na okrog dva in pol tisoč. Medtem smo bili v zadnjih dveh letih v Sloveniji priča izjemno visokemu neto priseljevanju v Slovenijo, in sicer 14.928 neto

priseljenih v letu 2018 in 16.213 v letu 2019 [3]. Povprečje za obdobje 1991 do 2019 znaša namreč samo štiri tisoč neto priseljenih na leto, s tem, da lahko vrednosti močno porastejo v času konjunkture. Tako so tudi v obdobju 2007-2009 neto selitve znašale v povprečju 11,5 tisoč na leto, medtem ko so v obdobju po nastopu krize (2010-2017) znašale samo 624 oseb v povprečju na leto [3].

V zadnjih projekcijah tako Eurostat predpostavlja postopno zniževanje iz teh visokih ravni v letu 2018 in 2019 na okrog štiri tisoč oseb na leto. Nato naj bi bile do leta 2045 neto selitve nekoliko višje kot so predpostavljali v EUROPOP2018 [2], predvsem pa naj po tem letu neto selitve ne bi začele upadati, temveč naj bi se začele povečevati, tako da bi v preostanku obdobja projekcij znašale okrog pet tisoč neto priseljenih letno (Slika 1).
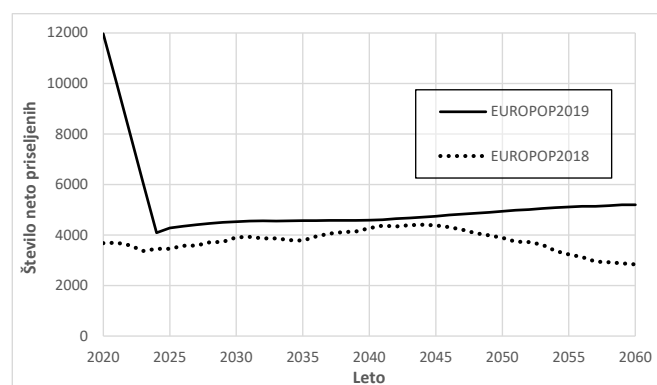
Slika 1: Predpostavke glede gibanja neto migracij v zadnjih treh Eurostatovih demografskih projekcijah (vir: Eurostat, 2019 & Eurostat, 2020)

Ob navedenih predpostavkah je v projekcijah EUROPOP2019 število prebivalcev v obdobju do leta 2060 za okrog 25 tisoč višje kot v EUROPOP2018, saj višje neto migracije (še posebej v začetnih nekaj letih) več kot kompenzirajo učinek nekoliko nižje predpostavljene rodnosti.

V nadaljevanju besedila nas bo bolj kot gibanje celotnega števila prebivalcev zanimala starostna struktura prebivalstva. Osredotočili se bomo na analizo »koeficienta starostne odvisnosti starih« (v nadaljevanju KSOS), ki je opredeljen kot razmerje med številom prebivalstva v starosti 65+ in številom prebivalstva v delovni starosti (20-64 let).

Najprej bomo prikazali naraščanje KSOS v bazni varianti EUROPOP2019, nato pa bomo z migracijami preprečevali porast tega kazalnika nad izbrano vrednost. Zanimale nas bodo neto migracije, ki bodo za to potrebne. Blaženje staranja prebivalstva bi se po predpostavki lahko dosegalo tudi z višjo rodnostjo, vendar se s tem dejavnikom dinamike prebivalstva v tem besedilu ne bomo ukvarjali. Vplivanje na rodnost z ukrepi demografske politike je kompleksno in kontroverzno vprašanje, hkrati pa je domet tega ukrepa na koeficient starostne odvisnosti starih v prihodnjih treh do štirih desetletjih zelo omejen. Prvih dvajset let namreč višja rodnost nima nobenega pozitivnega vpliva na KSOS, saj prebivalstvo 0-19 ne vpliva na ta kazalnik. Po drugi strani pa bi tudi v preostalih dvajsetih letih projekcij (2040-2060) bil vpliv višje rodnosti na KSOS omejen, saj ne bi bilo realistično predpostavljati takojšnjega skoka na visoke vrednosti.

2 METODOLOGIJA IN PODATKI

Pri analizi bomo izhajali iz najnovejših demografskih projekcij Eurostata EUROPOP2019, ki so bile objavljene spomladi 2020. Objavljene rezultate najprej reproduciramo z modelom, ki aplicira posamezne predpostavke glede rodnosti, umrljivosti in (neto) migracij na izhodiščno stanje prebivalstva po spolu in starosti iz začetka leta 2019. Čeprav je v splošnem pristop pri vseh metodoloških izvedbah analitičnih demografskih projekcij zelo podoben, vendarle obstajajo določene razlike glede posameznih tehničnih rešitev in uporabljenih predpostavk – npr. v najvišjem in najnižjem starostnem razredu. Uporabljene metodologije Eurostat ne razkriva, zato reprodukcija rezultatov do zadnjega prebivalca natančno ni mogoča. Vendar pa so razlike med našimi in njihovimi rezultati zanemarljivo majhne (razlika v celotnem številu prebivalstva je največ 1258 oseb oz. 0,6 promila vseh prebivalcev, kar smatramo kot zanemarljivo).

V različnih scenarijih demografskih projekcij, ki jih izdelamo, ohranjamo predpostavke glede rodnosti in umrljivosti povsem enake kot so v osnovni EUROPOP2019 varianti. Spreminjamo samo migracije, da dosežemo zastavljeni cilj. Pri tem spreminjamo samo raven migracij, medtem ko ohranjamo relativno porazdelitev migrantov po starosti in spolu takšno, kot je v posameznih letih projekcij v EUROPOP2019. Kot vidimo v Sliki 2, Eurostat predpostavlja, da se priseljujejo pretežno mlade osebe. Predpostavka seveda sloni na dejanskih podatkih o starostni strukturi migrantov. Eurostat podobno porazdelitev po starosti predpostavlja tudi v preostalih letih projekcij, hkrati pa postopoma nekoliko zmanjšuje razmerje med spoloma. V letu 2019, ki ga prikazujemo v Sliki 2, predstavljajo moški 78 % vseh migrantov, do leta 2060 pa se njihov delež zniža na 60 %.
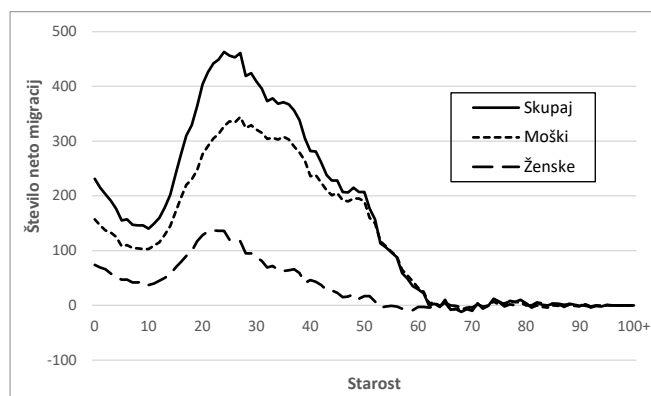
Slika 2: Porazdelitev neto migracij v letu 2019 po starosti in spolu (vir: Eurostat, 2020)

Ob prikazani starostni porazdelitvi migranti prispevajo k pomlajevanju prebivalstva neposredno, hkrati pa priseljene ženske po prihodu v državo realizirajo še določeno število rojstev, če se priselijo v starosti, ko so še v rodni dobi ali pred njo. Predpostavlja se namreč, da priseljene ženske prevzamejo vzorce rodnosti od obstoječih prebivalk Slovenije. Vendar pa se sčasoma tudi migranti postarajo in vstopajo v starostni razred 65+. Zaradi tega se začne vpliv migrantov na zaviranje staranja prebivalstva čez čas zmanjševati.

V Sliki 3 prikazujemo gibanje kazalnika »koeficient starostne odvisnosti starih« (KSOS) v skladu z osnovno varianto demografskih projekcij Eurostata. Hkrati nazorno predstavljamo, na katere tri ravni bomo v posameznem izmed treh scenarijev omejevali vrednosti KSOS.
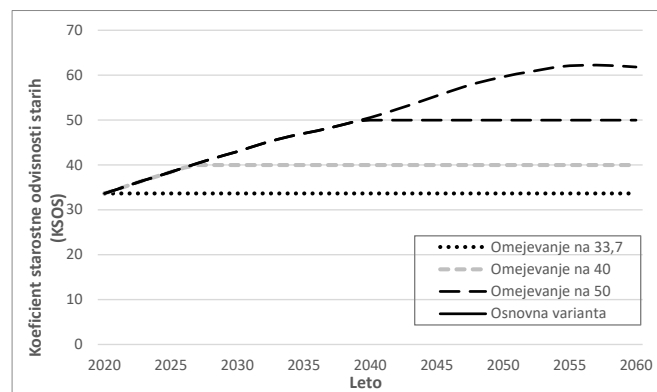
Slika 3: Gibanje koeficienta starostne odvisnosti starih po osnovni varianti EUROPOP2019 in zastavljenih treh scenarijih

Pri prvem scenariju postavimo zgornjo mejo dovoljenega povišanja KSOS na 50. Ko razmerje med starimi 65+ na 100 prebivalcev v delovni starosti doseže vrednost 50, začnemo torej ustrezno zviševati neto migracije, da KSOS te vrednosti ne preseže. Ukrepati začnemo v letu 2040, ko bi vrednost KSOS sicer presegla 50. V drugem scenariju je ta meja postavljena na 40, kar pomeni, da začnemo migracije zviševati že v letu 2027. V tretjem scenariju pa preverimo, koliko bi morale znašati neto migracije, da bi ohranjali KSOS na ravni iz leta 2020, torej na vrednosti 33,7. To pomeni, da začnemo migracije zviševati že v letu 2021.

3 REZULTATI

V Sliki 4 prikazujemo potrebne neto migracije po vseh treh opisanih scenarijih, hkrati pa še za prej prikazano osnovno varianto Eurostatovih projekcij EUROPOP2019. Prikazujemo tudi dejansko gibanje neto migracij v preteklosti – od leta 1991, ko je Slovenija postala samostojna država, pa do leta 2019. Na ta način postavimo dobljene rezultate v kontekst velikosti neto migracij iz preteklosti.
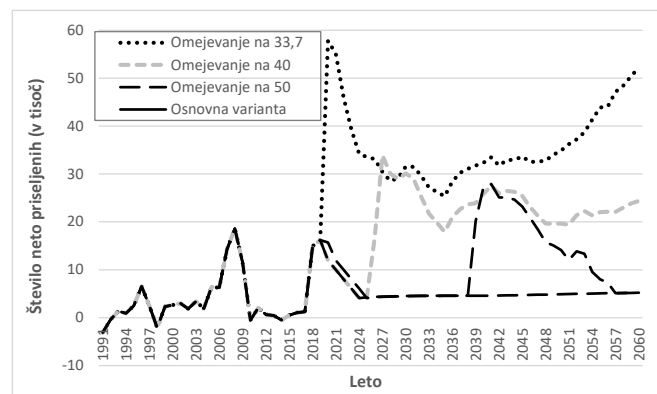
Slika 4: Dejansko gibanje neto migracij v odboju 1991-2019, predpostavljeno gibanje neto migracij po osnovni varianti EUROPOP2019 in potrebna raven migracij po zastavljenih treh scenarijih (vir: Eurostat, 2020)

Razberemo lahko, da bi pri scenariju omejevanja KSOS na največ 50 morale znašati neto migracije okrog leta 2040 približno 25 tisoč na leto, da bi preprečili porast KSOS nad 50. To je znatno več kot so znašale najvišje vrednosti neto migracij v preteklosti. Če bi pričeli z višjimi migracijami že nekoliko prej, bi bile dovolj že nekoliko nižje vrednosti, v vsakem primeru pa se postavlja vprašanje, ali bi bila družba te kontinuirano visoke migracije sposobna sprejeti brez večjih družbenih nemirov in močne krepitve nacionalističnih strank. Navedeno se namreč pogosto pojavi kot problem pri (pre)visokih migracijah, kar se je pokazalo tudi npr. ob masovnih migracijah iz Afrike v Evropo v zadnjih nekaj letih.

Drugi scenarij predpostavlja omejevanje KSOS na največ 40, kjer rezultati kažejo, da bi bile potrebne zelo visoke migracije že v letu 2027 in to kar več kot 30 tisoč za obdobje nekaj let, nato pa med 20 in 25 tisoč letno. Najbolj ekstremen pa je scenarij, v katerem bi KSOS ohranjali na ravni iz leta 2020. To bi zahtevalo takojšnje in povsem nerealistično visoke neto migracije v višini skoraj 60 tisoč oseb, v preostanku obdobja projekcij pa med 30 in 50 tisoč neto priseljenih vsako leto. Prikazane vrednosti moramo jemati zgolj kot matematično vajo in kot kazalnik nerealističnosti, da bi lahko prihajajoče staranje prebivalstva z migracijami preprečili.

Ti rezultati bi tudi povsem spremenili število prebivalcev Slovenije. V Sliki 5 prikazujemo število prebivalcev Slovenije po teh treh scenarijih.
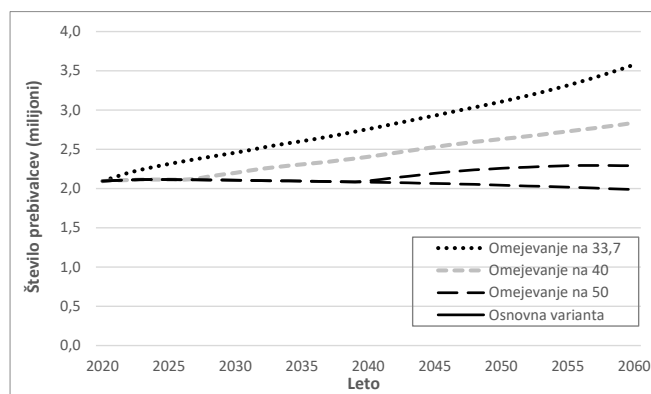
Slika 5: Gibanje števila prebivalcev Slovenije po osnovni varianti Eurostatovih EUROPOP2019 projekcij in po zastavljenih treh scenarijih.

Vidimo, da bi se ob teh izjemno visokih migracijah število prebivalstva Slovenije močno povečalo, še posebej v scenariju ohranjanja KSOS na ravni iz leta 2020. V tem primeru bi namreč prebivalstvo Slovenije do leta 2060 naraslo na več kot 3,5 milijona prebivalcev. Te izjemno visoke vrednosti so samo še dodatna potrditev, da so tako visoke neto migracije povsem nerealistične. Prikazujemo jih zgolj v potrditev, da z migracijami prihodnjega hitrega staranja prebivalstva in s tem močnega demografskega pritiska na ekonomsko vzdržnost ne bo mogoče preprečiti.

4 SKLEP

V prihodnje bomo v Sloveniji in razvitih državah priča hitremu staranju prebivalstva, kar bo imelo močan demografski pritisk na ekonomsko vzdržnost. V besedilu smo preverili, ali bi lahko v prihodnjih štirih desetletjih z neto migracijami zaustaviti naraščanje razmerja med starimi 65 in več let ter prebivalci v delovni starosti. To razmerje se imenuje »koeficient starostne odvisnosti starih«. Ob predpostavljenih neto migracijah Eurostata v višini štiri do pet tisoč oseb letno bi se njegova vrednost povzpela z 33,7 v letu 2020 na 61,8 v letu 2060. V treh scenarijih smo naraščanje tega kazalnika omejili na vrednosti 50, 40 in pa ravni iz leta 2020, to je 33,7. Rezultati pokažejo, da bi že ob prvem scenariju morale biti neto migracije zelo visoke. V zadnjem scenariju pa bi morale biti povsem nerealistično visoke in sicer nekje med 30 in 60 tisoč neto migracijami na leto. Hkrati bi to pomenilo, da bi se do leta 2060 število prebivalcev povečalo na 3,5 milijona. Gre za povsem nerealistično raven migracij, ki kažejo, da z migracijami staranja prebivalstva ne bomo mogli zaustaviti.

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Vetrne elektrarne niso za Slovenijo

Wind turbines not for Slovenia

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POVZETEK

V prispevku je kritično obdelana problematika vetrnih elektrarn (VE), predvsem iz vidika specifičnega hrupa, ki škoduje zdravju. Opozorjeno je, z utemeljitvami, na odsotnost predpisov za merjenje hrupa VE. Zdravju škodljiv hrup VE je bil ugotovljen že v 80-tih letih prejšnjega stoletja. Kljub temu predpisov še nimamo, ker jih politika zaradi pritiska proizvajalcev VE in investitorjev v VE (korupcijsko tveganje) noče sprejeti, kljub zahtevam nevladnih organizacij in civilnih iniciativ. Slovenske izkušnje s tem hrupom so podobne svetovnim, zato ni nobenega razloga za ignoriranje zahtev po ustreznih predpisih. Na tem področju imamo odsotnost prava, ljudje in narava niso pravno zaščiteni.

KLJUČNE BESEDE

Ključne besede: vetrne elektrarne, nizkofrekvenčni hrup, infrazvok, predpisi, zakoni

ABSTRACT

Problems with wind turbines (WT) is critically described. Specifically, from the point of view of noise which is harmful to health. There are no rules to measure and assess this noise. That WT noise is harmful to health was confirmed already in eighties. Politicians ignore demands of NGOs and civil initiatives to set up the proper rules. It could be that corruption risks are on work pushed by investors and producers of WT. Slovenian experience with the WT noise is similar to other countries in the world. There is an absence of regulation in this area in Slovenia and people are unprotected.

KEYWORDS

Keywords: wind turbines, low frequency noise, infrasound, rules, law

1. UVOD

Brez kritičnega odnosa do razvojnih usmeritev ni napredka. Razvoj je sprememba s časom, lahko je pozitiven, lahko pa tudi negativen. Pretekle zablode so obdelane v publikaciji EEA (2001) (European Environmental Agency – Evropska agencija za okolje): Pozne lekcije iz zgodnjih svaril: previdnostno načelo 1896-2000 **[1]**. Leta 2013 je izšel drugi zvezek (Vol. II): Late lessons from early warnings: science, precaution, innovation **[2]**. Slovenskega prevoda še ni. Previdnostno načelo je na razpolago javnosti v Zakonu o varstvu okolja (ZVO-1), da ga argumentirano uporabi. Vetrne elektrarne (VE) v Sloveniji so taka zabloda. K sreči imamo šele dve, zato je še čas, da se izognemo razvrednotenju slovenskega višavja, gozdov, krajine, uničevanja turizma ter zdravja prebivalcev s posebnim hrupom v nizkofrekvenčnem območju (pod 200 Hz) in z infrazvokom (pod 20 Hz).

Tudi v znanosti je argumentiran kritičen odnos osnova za napredek. Le politika ga ne sprejema.

Pozno lekcijo na področju vetrnih elektrarn in njihovega političnega "Energiewende" v Nemčiji doživljamo v sedanjiku. O tem obstaja več strokovnih študij, na primer: dr. Fritz Vahrenholt: Germany's Energiewende, A Disaster in the making (2017) **[3]**. Nedavno je bil nemški elektroenergetski sistem pred razpadom **[4].** Ni bilo vetra. Izpadlo jim je za 20.000 MW vetrnih elektrarn. S svojo rezervo je pomagala reševati nemški elektro sistem tudi Slovenija. Vetra pa ni bilo kaj več niti v sosednjih državah: Avstriji, Franciji, Danski in Veliki Britaniji. Nemčija je bila zaradi pomanjkanja vetra že večkrat na robu zloma. Poljska in Češka pa sta se zavarovali pred nenadnimi sunki vetrne elektrike iz Nemčije s prečnimi transformatorji. Kaj gre narobe? Politika ignorira naravno zakonitost, da s seštevanjem naključnih, kaotičnih pojavov kot so lokalni vetrovi, ne moremo dobiti stalnega vira torej stacionarnega stanja. Z vetrnimi elektrarnami ne moremo zamenjati jedrske elektrarne **(24/7 vir)** pa obe ne spuščata CO2, če že gre za ta cilj, da izjemno velike razlike v gostoti energije niti ne omenjamo.

1.1 Kakšno korist bi imeli od vetrnih elektrarn po hribih?

Poglejmo izkoristek obeh vetrnic na Primorskem **(Tabela 1)**. Borzenov Center za podpore spremlja tudi učinkovitost obeh vetrnic v Sloveniji, ki jim plačuje elektriko. VE 15 je oznaka za VE Dolenja vas, v KS Senožeče, občina Divača z nazivno (teoretično pri nas) močjo 2,3 MW, višina stebra 90 m, ki obratuje večinoma z močjo do 1 MW, saj tudi na Primorskem ni stalnih močnih vetrov. Druga VE je v Razdrtem, z 1 MW nazivne moči, višina stebra 55 m. Spodnja preglednica razgali izredno nizek izkoristek in količine elektrike, ki jih mimogrede lahko privarčujemo za bistveno manjši denar ali pa ta denar raje vložimo v zmanjšanje uporabe kurilnega olja za gretje, kjer lahko neposredno izračunamo zmanjšanje CO2. Izkoristek v prvih 8. mesecih leta 2019 je bil za VE15 16,73 %, za VE Razdrto pa 14,84 %.

Tabela 1: Izkoristki obeh večjih vetrnih elektrarn v Sloveniji

Količina proizvedene električne energije po posamezni vetrni elektrarni za leto 2015, 2016, 2017, 2018

Vir: BORZEN – www.borzen.si

Leto	Naprava	Izplačila v EUR brez DDV	Proizvodnja v KWh	Izkoristek v %
	VE 15			
2015		240.512	3.778.075	17,3
2016		275.519	4.182.766	19,1
2017		254.217	4.097.226	18,3
2018		264.885	4.304.278	21,3
	MVE RAZDRT			
2015		108.442	1.703.458	21,4
2016		105.068	1.595.078	20,0
2017		106.823	1.616.383	20,2
2018		105.408	1.712.839	21,4

Na zgornje vprašanje so dolgoročno odgovorili na Južnem Tirolskem, tudi alpski deželi. Energetski razvoj, ki ne bi škodoval krajini, turizmu in prebivalcem tako, kot vetrne elektrarne, so opredelili v dokumentu Energetski model – Južna Tirolska 2050 (Energy model-South Tyrol 2050) **[5].** V njem ne predvidevajo vetrnih elektrarn, sončne elektrarne pa umeščajo na zgradbe, razen kulturne dediščine, nikakor pa ne na zemljišča.

Brutalno razvrednotenje gorske krajine zaradi načrtov o 19 vetrnih elektrarnah na grebenu Sattelberg, Italija, v bližini prelaza Brenner in meje z Južno Tirolsko, pa je leta 2012 sodišče preprečilo. Med argumenti je bila Alpska konvencija in tudi predpisi o zaščiti hribovitega sveta Južne Tirolske nad 1600 metri **[6].**

Pri nas, na primer, krajine kot pomembnega turističnega produkta sploh ne priznamo. Kar velja seveda za primitivno politiko prostora, ki se boji vsakršnih zaščit, saj je brez selektivne strategije razvoja Slovenije.

2. HRUP VETRNIH ELEKTRARN ŠKODUJE ZDRAVJU

V tem krajšem prispevku se ne moremo posvetiti vsej problematiki vetrnih elektrarn. Posebno pozornost pa moramo nameniti hrupu VE, ker je pri nas popolnoma ignoriran s strani politike, ki vsiljuje VE po Sloveniji, ne glede na to, da hrup VE dokazano škoduje zdravju prebivalcev.

2.1 Domače izkušnje

Izkušnje z VE Dolenja vas v KS Senožeče, občina Divača kažejo, da hrup VE močno zniža kakovost bivanja in ovira spanje. Pri načrtovanju VE po Sloveniji na prebivalce nismo mislili. Predpisov za merjenje specifičnega hrupa VE nimamo. Inšpekcije ne morejo ukrepati, da bi vsaj ponoči VE ustavili.

Nad Dolenjo vasjo v KS Senožeče, občina Divača, 850 m od prvih hiš, obratuje vetrna elektrarna z nazivno (teoretično) močjo 2,3 megavata (MW), ki običajno dela z močjo 1 MW. Prebivalci so bili sprva naklonjeni njeni postavitvi, že po dobrem letu obratovanja vetrnice pa so bili odločno proti. Tudi z referendumom leta 2014 v KS Senožeče, katerega rezultat je tudi občinski svet občine Divača sprejel.

28. februarja 2014 pa so poslali ministru za infrastrukturo in prostor Samu Omerzelu pismo, v katerem opisujejo tudi vpliv tega hrupa na spanje:

"*Ko so vremenski pogoji za delovanje vetrnice ugodni, človek težko normalno funkcionira. Ponoči, ko bi človek potreboval mir in tišino, da se naspi in odpočije za naslednji delovni dan, je to žal nemogoče. Če nam že uspe nekako zaspati, nas zbudi sredi noči in od spanja se lahko poslovimo. Kako je drugi dan, pa si lahko predstavljate - kot po prekrokani noči. In to je dan na dan, noč za nočjo. In tako nas je situacija privedla do tega, da smo začeli preko spleta "izobraževanje" o vetrnicah, in med drugim ugotovili, da poleg fascinantnega slišnega hrupa, oddaja še nizkofrekvenčne zvoke, ki so zelo nevarni za zdravje ljudi – pa nam tudi tega ni nihče predstavil!*"

Od takrat se ni nič spremenilo. Zasebni lastnik vetrnice je niti ponoči noče ustaviti. Pomembnejši mu je dobiček. Prijave inšpektorjem niso dale rezultatov, saj so izjavljali, da za hrup vetrnih elektrarn ni predpisov. In teh še danes ni. Politika v navezavi s kapitalom jih noče sprejeti, kljub mnogim protestom in predlogom nevladnih organizacij in civilnih iniciativ.

2.2. V čem je posebnost hrupa vetrnih elektrarn?

Z izrazom hrup označujemo neželeno zvočno valovanje ali vibracije (lokalne spremembe pritiska) zraka, ki zadenejo ves naš organizem, ne le slušni del. Večinoma ga slišimo (preko bobniča se prenaša v notranjost ušesa), obstajajo pa tudi vibracije, ki jih le čutimo, slišimo pa ne. In vetrne elektrarne oddajajo zdravju

škodljiv hrup ravno v tistem delu spektra, ki ga slabše slišimo (nizkofrekvenčni hrup, pod 200 Hz) ali pa sploh ne (infrazvok, pod 20 Hz). Vibriranje zraka (spremembe tlaka) izražamo s številom nihanj vibracij na sekundo, ki ga imenujemo frekvenca, ime za enoto pa je hertz (Hz).

Merilo za vpliv vibracij na naš organizem pa ni zgolj slišnost, ampak še bolj vibracije, ki jih posamezni deli organizma občutijo. To, da nekih vibracij ne slišimo, še ni dokaz, da jih ni. Tovrstne vibracije niso lastnost le vetrnih elektrarn, ampak se ljudje pritožujejo tudi v mestih in ob določenih industrijskih obratih in letališčih. Vzrok so slabo nameščene velike klimatske naprave na strehah ali določeni veliki vrteči stroji, gradbena mehanizacija in podobno.

Hrup vetrnih elektrarn pa ima še eno, za zdravje zelo škodljivo posebnost, ki ga bistveno loči od vseh drugih hrupov. Vetrna elektrarna oddaja zračne vibracije v ritmu vrtenja krakov vetrnice in sicer na način **pulzov, sunkov**. Vsakič ko gre krak mimo stebra vetrne elektrarne in tudi ko zareže zrak zaradi sile vetra, odda pulzno vibracijo, ki nas zadene.

Strokovno tovrstne pulzne vibracije imenujemo amplitudna modulacija hrupa VE, ki je torej glavni vzrok za onesnaževanje okolja s hrupom. Pri vrtenju krakov VE se namreč ustvarja periodični amplitudno moduliran signal, ki ne odstopa bistveno od sinusne oblike. Amplitudna modulacija VE ima torej najpomembnejši vpliv in s tem so povezane tudi pritožbe izpostavljenih prebivalcev po vsem svetu.

Znanstvene raziskave kažejo, da kar 85% izpostavljenih prebivalcev jasno zaznava hrup VE že pri ravneh 35 dBA . Prav tako je bilo ugotovljeno, da se počutje približno 30% vseh prebivalcev močno poslabša, kadar raven hrupa prometnih virov presega 70 dB(A), medtem ko se enakemu odstotku prebivalcev počutje močno poslabša zaradi hrupa VE, katerega raven dosega »komaj« 40 dBA. Hrup VE je namreč, za razliko od velike večine drugih hrupnih virov, tudi amplitudno moduliran in zaradi tega še posebej škodljiv.

Takšna vrsta hrupa je invazivna in jo hrup ozadja zaradi prisotnosti drugih virov, lociranih blizu tal, težje zamaskira. Kot pove že samo ime, se pri amplitudno moduliranem hrupu njegova amplituda spreminja s časom, običajno periodično, kot na primer pri sirenah vozil na nujnih vožnjah. Takšen utripajoči hrup močno pritegne našo pozornost, saj izstopa iz ozadja celo v primeru majhnih amplitud oziroma ravni. V praksi nas pogosto opozarja na previdnost oziroma nevarnost, če pa predolgo traja pa postane nadležen in stresen; pri vdoru v spalnico pa lahko onemogoči miren spanec prizadetim stanovalcem.

Za razliko od visokofrekvenčnega zvoka, ki ga zadržijo oziroma odbijejo že manjše ovire, sta nizkofrekvenčni in infrazvok izredno prodorna, poleg tega se na ovirah močno uklanjata in se posledično širita okrog vogalov raznih objektov in celo preko visokih hribov. Poleg tega pa kot rečeno prodirata tudi v notranjost prostorov, celo tistih, zaščitenih z masivnimi stenami.

Škodljiv vpliv hrupa vetrnih elektrarn na zdravje prebivalcev je bil dokazan že v 80-tih letih prejšnjega stoletja. Ministrstvo za energijo (DOE) v ZDA je že leta 1985 financiralo raziskave vpliva hrupa vetrnih elektrarn na ljudi. Vključenih je bilo več

raziskovalnih inštitucij in NASA (tudi že 1982). Dr. Kelley je v več člankih (npr:1985) [7] podrobno predstavil meritve zunaj in v stanovanjskih prostorih prebivalcev in dokazal škodljiv vpliv hrupa vetrnih elektrarn na človeka. Modernejše turbine večjih moči in višin oddajajo še bolj zdravju škodljiv hrup kot vetrne elektrarne starejšega tipa.

Že leta 1979 so pri dvokrilni vetrni elektrarni (2 MW MOD-1) dobili vrsto pritožb zaradi hrupa in vibracij v razdalji do 3 km. Prav tako so ugotovili odboje in s tem ojačanje vibracij v notranjih prostorih (resonanca). Vse to imamo še danes, s pojavom višjih in močnejših vetrnih elektrarn še toliko bolj. Že takratna vetrna elektrarna je oddajala najbolj škodljivi pulzni hrup. Na spodnji sliki **Diagram 1 [7]** je prikaz tega hrupa, kjer se vidi, da pulzi dosežejo nivo preko 100 dB. Zato so pulzi tako nevarni. Na sliki so štirje pulzi, ki so nastali, ko je krak vetrnice šel mimo stebra. Njihov učinek na organizem je podoben kapljanju vode na čelo, na primer. Koliko časa ga lahko prenašamo? Kaj pa je ena kapljica za drugo, bi pomislil. Ugotovljeno je, da se organizem sčasoma pred pogostimi pulzi brani s prekomerno tvorbo kolagena, to pa je po drugi strani povezano z odebelitvami žil, povrhnjice srca, spremembami v notranjem ušesu in drugimi spremembami, ki vodijo v resna obolenja.
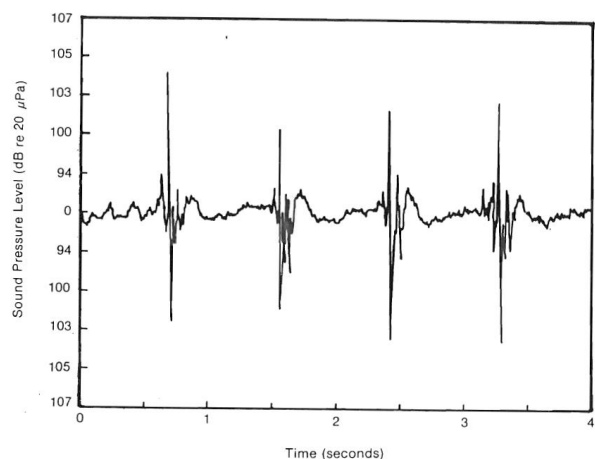
Figure 3-3. Typical Pressure-Time Plot of MOD-1 Acoustic Emissions Containing Strong Period Impulses. (Two complete rotor revolutions and four blade passages)

Diagram 1

Več o tem izvemo v predavanju dr. Pereire, ki ga je imela v Sloveniji v letu 2018 **[8] [9].**

Življenjska doba VE je od 20 do 25 let. V Nemčiji na mestu odsluženih postavijo nove. Torej so cele generacije izpostavljene temu škodljivemu hrupu.

Ker se zaradi hrupa vetrnih elektrarn skupaj pojavlja določena vrsta znakov, ki so jih iz vrste primerov po svetu prepoznali vedno v povezavi z vetrnimi elektrarnami, zaradi nizkofrekvenčnega hrupa in infrazvoka (vibracije) kot so: oviranje spanca, glavoboli, splošno slabo počutje, motenje koncentracije na primer pri učenju in delu, hitrejše bitje srca, naraščanje pritiska, podobni občutki kot pri morski bolezni in še

nekaj drugih, se je uveljavil termin sindrom vetrne turbine ali elektrarne (Wind Turbine Syndrome) **[10].**

Na spodnji sliki levo vidimo tipičen A vrednoten spekter za večjo VE, na sliki desno pa neutežen spekter. Spekter njenega hrupa pada približno s 4 dB na oktavo.
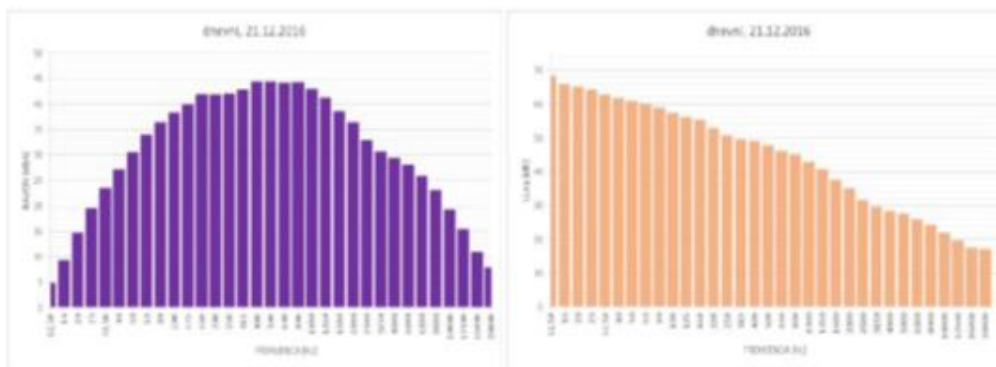
Slika 11. A vrednotena (levo) ter neutežena (desno) spektralna analiza za dnevne meritve

Diagram 2

Wind Turbine Syndrome je tudi naslov knjige zdravnice dr.Nine Pierpont (2009). Ameriška akademija znanosti je leta 2007 naslovila ameriškemu kongresu vprašanje vpliva hrupa vetrnih elektrarn na zdravje. Dr. Pierpontova je s študijskim delom v obliki opisa dejstev na primerih (angleško Case Series), ki je ena od znanstvenih metod dela, na terenu pri prebivalcih (10 družin, 38 posameznikov od otrok do starosti 75 let), ki so se pritoževali zaradi hrupa vetrnih turbin moči od 1,5 MW do 3 MW, želela najti odgovore na to vprašanje.

Nekateri prebivalci od obiskanih so se kasneje izselili, drugi so povedali, da ko so šli za nekaj časa daleč stran od svojih domov, so mnogi bolezenski znaki izginili. Po povratku so se spet pojavili. To je samo eden od strokovno proučenih primerov v svetu, ki dokazuje, da hrup VE res škoduje zdravju.

2.3. Zakaj predpisi za merjenje hrupa na delovnem mestu in v okolju ne zadoščajo za merjenje hrupa vetrnih elektrarn?

Predpisi določajo merjenje slišnega hrupa oziroma je merjenje prilagojeno človeškemu ušesu. Hrup tako merimo z mikrofonom, ki ne upošteva manj slišnega ali neslišnega hrupa. To naredijo tako, da ima mikrofon omejitev (filter) za manj slišni oziroma neslišni hrup. To je filter A (tudi utež imenovan). Enote za nivo hrupa so decibeli, kar pišemo kot dB. Ko merimo s filtrom A, označimo enoto z dBA. Tako **Uredba** o mejnih vrednostih kazalcev hrupa v okolju predpisuje samo meritve s filtrom A, torej v dBA **[11]**.

Filter A izloči znatno več nizkih frekvenc kot drugih in je zasnovan tako, da posnema občutljivost ušesa pri glasnosti 40 fonov. Zato je filter A zelo uporaben za izločanje slabo slišnih in neslišnih nizkih frekvenc: **Diagram 3**.

(originalno: The A-contour filters out significantly more bass than the others, and is designed to approximate the ear at around the 40 phon level. It is very useful for eliminating inaudible low frequencies.) **[12]**
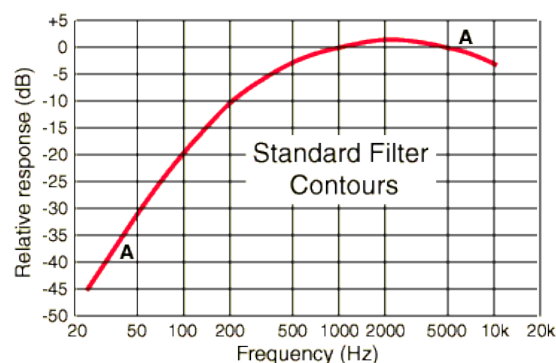
Diagram 3

Vetrne elektrarne pa, kot rečeno, oddajajo škodljiv hrup **izven dBA** in sicer v nizkofrekvenčnem območju in kot infrazvok, ki jih filter A skoraj povsem zanemari.

Uredba torej ne zajame hrupa vetrnih elektrarn.
Napačno merjenje hrupa vetrnih elektrarn v dBA je razvidno tudi iz **Diagrama 2** za VE Dolenja vas (prikazan na Mednarodnem znanstvenem posvetu: Hrup vetrnih elektrarn in mogoči vplivi na življenjsko okolje, Ljubljana, 15. januar 2020, avtor diagrama dr. Ferdinand Deželak) **[13]**, ki primerja merjenje s filtrom A (levo) in brez filtra (desno).

Iz levega diagrama v **Diagramu 2** je razvidno, da filter A vedno bolj zmanjšuje obstoječi hrup proti nizkim frekvencam. Na skrajni levi je oznaka frekvence 12,5 Hz (kar spada v območje infrazvoka), kjer ta filter izmeri le še 5 dBA. Pravi hrup (vibracije) vetrne elektrarne dobimo, če filter A odstranimo in na

skrajni levi desnega diagrama ravno tako pri frekvenci 12,5 Hz, izmerimo dejanski hrup vetrne elektrarne, ki znaša blizu 70 dB. To pa je izredno velika prekoračitev znosnega hrupa in je povsem nesprejemljiva za prebivalce. Posebno se to pozna ponoči, saj ta hrup zaradi nizke frekvence (velike valovne dolžine) prodira skozi zaprta okna. V stanovanjih pa se nizkofrekvenčni hrup, katerega valovna dolžina je primerljiva z dimenzijami posameznih bivalnih prostorov lahko še ojača zaradi resonance (odbitega zvoka med stenami).

Zato bi morali meriti hrup vetrnih elektrarn tudi v stanovanjih. Pa še z dodatno zahtevo, da se merijo **pulzi vibracij** in ne povprečje kot sedaj predvidevajo neprimerni predpisi. V povprečjih se pulzne vibracije zabrišejo, čeprav so glavni vir škodljivih vplivov na zdravje.

Tudi, če hrup vetrnih elektrarn skušajo zatajiti pa je njegov škodljiv vpliv na zdravje tudi že sodno priznan. Imamo torej pravno in sodno prakso, ko so se prebivalci zaradi njega pritožili. Tako je leta 2013 vrhovno sodišče Portugalske odločilo, da mora investitor odstraniti 4 vetrne elektrarne, ki so bile v razdaljah od 322 do 642 metrov od hiš in od 182 do 566 metrov od hlevov **[14]**. Da, tudi živali so ogrožene zaradi tega hrupa kot smo lahko videli v predavanju dr. Pereire **[8][9]**.

Seveda pa je smotrneje postavljanje vetrnih elektrarn takoj odkloniti, kot se pozneje pravdati, s skladu z načelom previdnosti iz zakona o varstvu okolja.

3 ZAKLJUČEK

Seznanjanje z dogajanjem po svetu na področju hrupa vetrnih elektrarn nam je v veliko pomoč, da smo odločno proti njihovemu postavljanju po majhni Sloveniji z razpršeno poselitvijo in čudovito krajino in naravo, ki ju tudi uspešno gospodarsko tržimo kot turistični produkt.

Dejstvo je tudi, da nobena strojna naprava, postavljena v naravno ali kmetijsko okolje, ni dosegla tako množičnega in ogorčenega svetovnega vseljudskega odpora kot ravno vetrne elektrarne.

O tem se lahko prepričamo, če obiščemo na primer strani www.epaw.org (European Platform Against Windfarms) in povezave na severnoameriške in avstralske strani ter na številne civilne iniciative. Nastaja občutek, da se o tem ne sme pisati.

Dokaz za vplivnost hrupa vetrnih elektrarn na prebivalce so tudi mednarodna srečanja. Vsaki dve leti, že od leta 2005, poteka mednarodna konferenca o hrupu vetrnih turbin (International Conferences on Wind Turbine Noise). Deveta po vrsti bo naslednje leto v Dublinu, Irska.

Letos januarja smo imeli tudi prvo mednarodno konferenco o tem hrupu v Sloveniji v organizaciji Slovenskega društva za akustiko **[13].**

Nujno je, da se v Sloveniji problematika vetrnih elektrarn strokovno razčisti, saj ni predpisov, kot smo utemeljili, kakor tudi zato, ker prebivalcem grozijo državni in lokalni načrti za postavitev preko **100** vetrnih elektrarn, od tega kar 60 v KS Senožeče (**Slika 1**), ki bi dobesedno obkrožile 6 naselij, kar bi bil edinstven primer v svetu. Ali pa, zakaj potrebujejo Dravske elektrarne Maribor, ki upravljajo s hidroelektrarnami na Dravi, še nekaj nezanesljivih VE nad 1.200 m na Košenjaku nad Dravogradom, v pristni naravi in v poseljenem širšem območju, kjer bi za vsako posekali 100 x 60 m (nogometno igrišče) gozda in izravnali razgiban teren, razširili ali zgradili ceste za transport tovorov izjemnih velikosti (70 metrov) in teže 30 in več ton, ipd. **[16] (Slika 2) ?**

Vetrne elektrarne so spodbujane s takimi ali drugačnimi subvencijami in izprijenimi tržnimi olajšavami.

Energetika ne potrebuje subvencij, ki povzročajo tudi gospodarsko in finančno škodo državi. Ena 3 MW VE stane 3 milijone evrov. Zato je nujno uvesti poslovne modele brez subvencij.

Ni tudi odgovora na vprašanje, zakaj se proizvajalci VE in investitorji tako bojijo pravilnih meritev nizkofrekvenčnega hrupa in infrazvoka, če pa obenem trdijo, da nimata nobenega vpliva na zdravje ljudi in živali. Obenem zavzeto lobirajo proti uvajanju teh meritev, češ, da bodo morali postavljati VE dalj od naselij. Primer je danski proizvajalec VE Vestas s pismom danski okoljski ministrici leta 2011 **[15]**.

Razen dobičkov nekaterih na račun degradacije slovenske narave in zdravja prebivalcev, koristi od VE ni. Več držav je subvencije za VE že pred leti opustilo. Pravno povsem neurejena je tudi razgradnja VE. Torej odpadki iz VE po končani življenjski dobi. Kraki VE iz kompozita, na primer, se ne reciklirajo ali sežgejo in jih v Nemčiji kar zakopavajo na velikih površinah.

Zanimivo je še, da nihče od odločevalcev ne ve povedati, **kateri CO2** zmanjšujeta obe obstoječi VE, niti kateri CO2 naj bi se zmanjševal zaradi delovanja več VE. Regulacija elektro sistema (poraba – proizvodnja elektrike) namreč najlažje poteka s pomočjo daljinsko vodenih hidroelektrarn, s cenejšo elektriko od tiste iz VE in ne z nihanjem proizvodnje TEŠ6, na primer.

To pa naj bo izziv za drug prispevek še koga iz strokovnih krogov.

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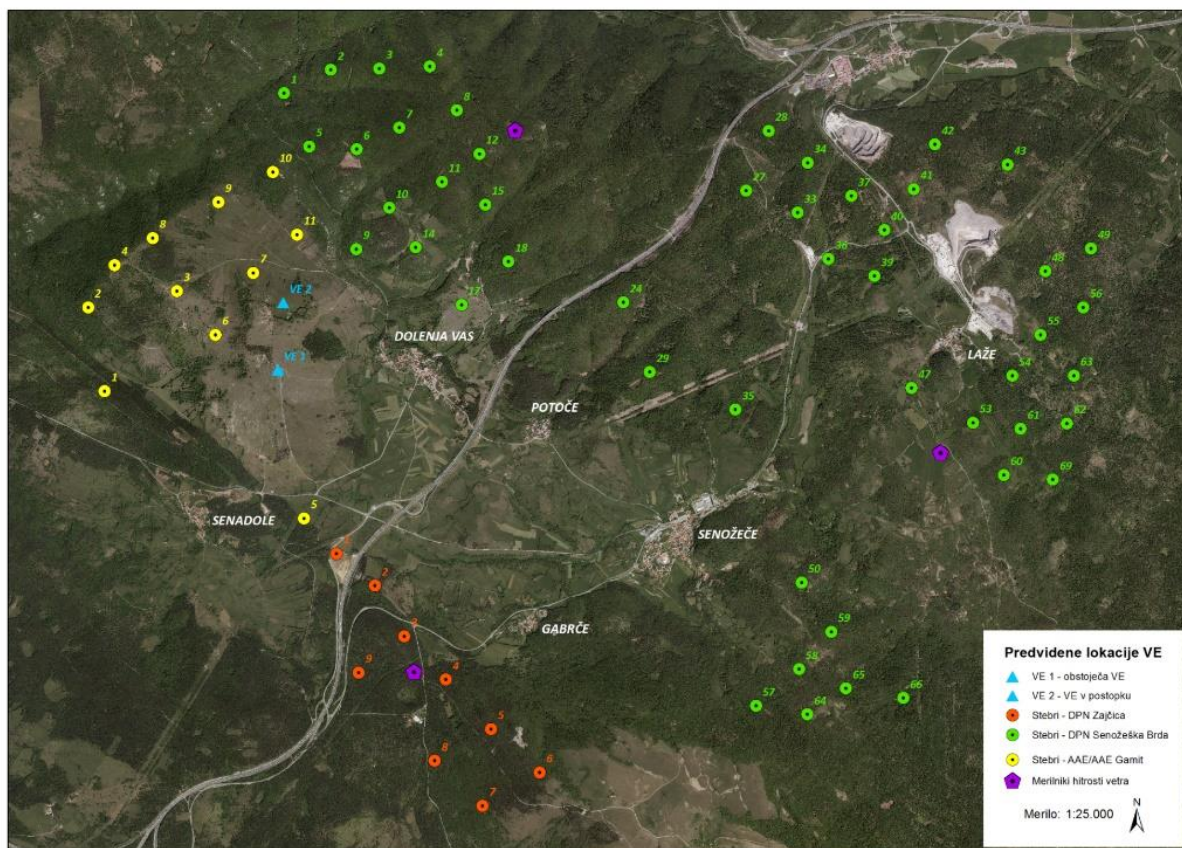
Slika 1   **Slika 2**

Traffic Simulation Software in the Context of Mobility Policy Support System

Programska oprema za simulacijo prometa v kontekstu sistema za podporo mobilnostne politike

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ABSTRACT

Due to novel challenges in large cities' traffic landscape the decision makers face more and more complex situations that are hard to understand while changes to these compound systems of road infrastructure, drivers and other actors can cause hard to predict undesired effects. As part of the H2020 Urbanite project a mobility policy support system is in development. One of the important aspects of this system is an appropriate traffic simulation system that enables non-invasive and cheap evaluation of proposed policies. Simulation results will be further analysed using advanced AI methods that will allow detection of unexpected events and identification of proposed solutions' negative aspects. We evaluated different traffic simulation software packages in the context of supporting mobility policy development. While included simulation software packages mostly provide similar feature sets and capabilities they differ in technology and maintenance status which has implications on the ease of integration and general usability for the project.

KEYWORDS

traffic, simulation, mobility policy, traffic modelling, artificial intelligence

POVZETEK

Nosilci prometnih odločitev v velikih mestih se soočajo z novimi oblikami izzivov, ki izhajajo iz velike kompleksnosti modernih prometnih sistemov, sestavljenih iz prometne infrastrukture, voznikov in drugih akterjev. Vnašanje sprememb v takšne sistemem lahko vodi povzroči nepredvidljive stranske učinke. Da se bodo lahko odločevalci informirano spopadali z novimi metodami mobilnosti se v okviru projekta H2020 Urbanite razvija sistem za podporo mobilnostne politike. Med glavne komponente sistema sodi podsistem za simulacijo prometa, ki omogoča neinvazivno in poceni evalvacijo predlaganih politik. Rezultati simulacij bodo lahko s pomočjo sistema Urbanite nadalnje analizirani s pomočjo metod umetne inteligence, ki bodo omogočile zaznavanje

nepričakovanih dogodkov in identifikacije negativnih aspektov predlaganih rešitev. Ocenili smo več različnih paketov programske opreme za simulcaijo prometa v kontekstu podpore razvoja mobilnostne politike. Ocenjene rešitve imajo podobne funkcionalnosti, potrebovane v okviru projekta H2020 Urbanite, razlikujejo pa se predvsem v tehnologijah implementacije in statusu vzdrževanja, kar ima velik vpliv na uporabnost paketa znotraj projekta.

KLJUČNE BESEDE

promet, simulacija, politika mobilnosti, prometni model, umetna inteligenca

1 INTRODUCTION

European cities are facing new challenges in the form of novel and innovative mobility solutions. On one hand disruptive start-ups are providing mobility on demand using different car sharing models while citizens are also starting to use micro-mobility devices, such as e-scooters and similar devices. These innovations have unforeseen consequences such as e-scooters causing traffic accidents in pedestrian zones, disruptions in the traditional public transport industry that have trouble competing with new business models and electric charging points exacerbating existing problems like the growing demand for public car spaces.

In order to analyse and understand the complex systems of city traffic a novel AI-aided software ecosystem URBANITE is being developed as part of the Horizon2020 European research programme. The URBANITE project is focused in developing a smart city system that will help decision makers in cities handle these new challenges. The project will provide a data management platform supporting the whole data harvesting process including collection, aggregation and provisioning the data, a decision support system including AI based predictive algorithms and simulation models and a social policy lab build upon co-creation session and the empirical analysis of trust, impact, benefits and risks of all stakeholders in the project.

This mobility policy support system will support the decision makers throughout the process of policy design and implementation. The core system includes a data harvesting and curation module, an intelligent algorithmic package and an advanced visualization module. The traffic simulation tool is one of the main components of such an ecosystem, providing information on

the expected results of policy and the possibility of discovering unforeseen consequences of policy changes.

The results of traffic simulations will be further analysed using AI methods for problematic and unexpected traffic events. The traffic data will be linked to other relevant data such as weather condition, street noise levels and air pollution levels. Using linked data the traffic simulation will also be informed about demographic statistical data, such as percentage of household owning cars, general income and education levels etc. Thus the system will be able to take into account commuters preferences using the Belief-Desire-Intention cognitive architecture [6].

2 TRAFFIC SIMULATION

As a tool for municipality decision makers the ecosystem needs to provide accurate and easy to understand information on demand. Since implementing changes to traffic policy is very expensive and takes a lot of time, simulating traffic is a better option. Thus the users can analyse outcomes from traffic policy changes including changes to public transport, car parking and even changes to the infrastructure itself. Traffic simulations are in the realm of operational research, which deals with utilizing the use of available resources in an optimal way while reducing the negative co-products and outcomes.

We can categorise traffic simulations based on the level of detail simulation provides:

- **Macroscopic traffic simulation** does not simulate individual cars but instead treats traffic flow like a fluid or a gas [3], moving through a network of pipes. This allows for good estimations of general road network capacity and helps identify bottle-necks that cause traffic jams.
  Since the traffic flows are usually generic, therefore not split by mode of transport (driving a car, taking the bus, freight trucks etc.) macro simulators often cannot provide detailed analysis of generated pollution, noise or strain on the road surface. The LWR (Lighthill-Whitham-Richards) models common in macroscopic traffic simulators have trouble simulating shock wave traffic jams and phantom traffic jams, which can be problematic when simulating longer road segments or motorways [9].
- **Mesoscopic traffic simulation** deals with traffic flows but takes individual vehicles into account in certain cases, most commonly at junctions (nodes in the network). This technique is a compromise between amount and accuracy of the data generated and the amount of computing power and time needed to produce results [1].
- **Microscopic traffic simulation** simulated individual cars as they move through the network. The results can be analysed per individual rather than only the general traffic flow and different types of vehicles can be simulated. Different types of vehicles can also have different properties, therefore we can accurately predict vehicular noise and generated pollution (e.g. heavy freight traffic produces more noise and pollution than car traffic). Different types of vehicles can also be simulated using different models or with different parameters, such as acceleration and braking [4].
  Microscopic traffic simulations are usually implemented using agent-based modelling, where each person in a city is represented as an individual agent. Each agent plans their trips according to their own scoring function, optimizing their own plan locally. Usually, agents re-plan

their trips multiple times before an equilibrium is reached where all agents are somewhat satisfied, but global optimum is not reached. This is more realistic than globally optimized plans as humans planning their trips have limited knowledge of the traffic system state.

- **Submicroscopic traffic simulation** simulates vehicles using physical models, including steering, power train, braking and suspension of the vehicle. These are extremely computationally demanding and not commonly used in traffic related operational research. Submicroscopic traffic models have been shown to simulate lateral movement (lane switching, trajectory negotiation) with high accuracy [5].

For the purposes of the project a microscopic simulation is needed for tasks such as predicting noise and pollution levels and parking spaces demand. For preliminary quick results a macroscopic traffic

Depending on how the simulators treat time and space, we can further categorize them into

- **time and space continuous models:** traffic flow models (equation models, usually using Ordinary Differential Equations or Partial Differential Equations), pedestrian movement (integration over path) etc.
- **time and space discrete models:** cellular automata traffic models (e.g. rule 184 - not commonly used anymore) and numeric models with limited precision (PDE based models, ODE based models, some Monte Carlo methods).

Other combinations of time and space discrete and continuous including discrete/continuous state can be identified.

3 SIMULATION SOFTWARE PACKAGES

Simulator is a software package used to test, replicate and predict real world traffic situations. They require a lot of processing power to be as accurate as possible. Processing power needed is largest for running microscopic simulations. Commonly multi agent based they require to locally optimize plans for each agent.

To run a minimal traffic simulation we need a representation of the city road network and a representation of the population that includes data informing agent's planning decision[1]. Most traffic simulation software also allows other inputs:

- public transit lines and schedules,
- locations and capacities of parking places and public parking houses
- details about existing vehicles (e.g. a segmentation of vehicles based on European emission standards),
- bicycle lanes included in the road network,
- number of available taxi cabs,
- locations of electric charging stations etc.

3.1 Evaluated software packages

We have evaluated the following packages:

- SUMO (Simulating Urban MObility [4]
- MATSim (Multi-Agent based Traffic Simulation [10],
- PTV Vissim [2] [7] and PTV Visum [8],

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[1]To inform planning and routing choices of an agent one can take into account their financial status, largest allowed lateness of arrival, whether or not they own a car etc.

Figure 1: Part of a traffic simulation of Bilbao, made with MATSim. Triangles represent a sampled subset of the vehicles in the network, where cyan-colored vehicles are moving at high speed and pink-colored vehicles are stationary - either waiting at traffic lights or stuck in traffic.

3.2　Reasons for simulating traffic

Implementation of a new mobility policy is a long and expensive process. Solving the problem of a single congested road may results in other problems that can hardly be predicted without some computational help. Traffic simulations allow the traffic engineers to see the impact of changes without testing them out in real world, which would take a lot of time and is very expensive. Some changes to the road network may also need invasive actions such as relocating citizens. There needs to be strong evidence that the results will have positive impact before implementing such changes.

Traffic simulations also allow cities to gain more insight into the city traffic patterns by identifying common trip patterns, providing data about pollution and noise levels in residential areas or identifying the areas where certain problem arise, such as low parking space capacities.

Some of the use cases identified in the project are:

- traffic pattern recognition,
- analysis of mobility modality - comparing travel by car, bike, public transport or by foot,
- analysis of public transport - line usage, congested lines,
- identification of districts affected by noise and air pollution,
- analysis of traffic accidents - most affected junctions or roads etc,
- analysis of universal access to facilities,
- identification of bicycle traffic patterns and bicycle traffic jams,
- comparison of expected traffic trends with actual traffic trends and
- analysis of capacities and demand for parking places.

Through the use of advanced simulators one can simulate different aspects of traffic. All simulators considered for the project include multi-modal approach supporting at least car, public transport, bike and walk modes. Multi-modality supporting changing mode of transport during one trip is vital for our goal of simulating the complex interactions between different parts of the traffic system. Support for multi-modality in traffic

simulation packages is quite widespread, but most do not have a great variety of transport mode options. While using a car or other similar transport modes such as taxi cabs or car sharing are almost ubiquitously supported others are missing - even public transport support is lacking in some of them. The biggest obstacle is simulation of bicycle traffic.

3.3　Evaluation results

3.3.1　PTV Visum and PTV Vissim. PTV Group is a major company in the field of traffic management and both products are the industry standards for macroscopic traffic simulation and microscopic traffic simulation, respectively. While not useful for the project due to copyright restrictions and proprietary source code we have included them in order to compare with other open source tools.

PTV Visum is a macroscopic traffic simulation tool that support multi-modal transport and transit. It's primary purpose is analysis of large, regional road networks it can also be used on the level of a city.

PTV Vissim is a microscopic traffic simulation tool that supports multi-modal transport and many other advanced use cases such as indoor pedestrian traffic simulations and quasi-realistic 3D visualization. While Vissim can interact with GIS data sources it does not support importing open data sources and is primarily used to simulate small road subnetworks such as complex junctions that are usually designed using the inbuilt network manager.

These tools are not extensible by third parties and while they provide beautiful user interfaces therefore not usable for the projects.

3.3.2　SUMO. SUMO is an open source, microscopic and space and time continuous traffic simulation software package. It supports multi-agent based multi-modal simulations. SUMO is a relatively old and mature software package that supports most of the identified use cases. It has been used in many real-world cases with good success. SUMO package contains all the tools needed to prepare a network, run a simulation and analyze the results.

It is a complete package containing a full set of GUI tools which can prepare the network, model traffic demand, run the simulation and visualize the results. The GUI simulator application allows even inexperienced users to set up simple simulations. However the true power of the package is unveiled when working with the command-line interface (CLI). There are a lot of utilities and tools included to manipulate the configuration of the scenario and to set up the network.

However due to its monolithic nature (excluding CLI tools that are mostly implemented as python scripts) it is not easily extensible and adaptable to the project's specific needs. Some of the problems we have encountered are out of date documentation, the simulation crashing due to lack of memory available [2], lack of informative error reports that slow down the workflow and lack of support for simulating bicycle traffic [3].

3.3.3 MATSim. MATSim is a java based framework which provides the user with multitude of tools which are used to run agent-based large-scale simulations. MATSim's strengths lie in its adaptability and malleability for user preferences. MATSim includes tools which can be used to set up different simulations and analyze the results. It does however not include a visualizer, a third party visualizer was used to generate video, a frame from which is seen in figure 1. MATSim is the most demanding to work with in comparison with the other simulators discussed in this section.

Unlike other simulators MATSim is primarily run from command line and needs programming knowledge to operate beyond most basic simulations. A simple GUI application is available but it only supports most basic simulations, advanced simulations have to be developed by implementing a custom Java simulation controller class or extending the default GUI applications class.

Unlike other simulators where the agent is a person which boards and operates vehicles in MATSim the basic unit is a car. This means that while its motorized aspects of simulation are superb, simulating pedestrians and cyclists in larger volumes is less accurate. Simulating pedestrian and bicycle traffic is a need for the project and this presents a problem, but due to the extensibility of the framework we believe we can overcome it.

4 DISCUSSION

A microscopic traffic simulation software package is needed in the project URBANITE in order to inform AI based methods for predicting traffic trends, identifying traffic patterns and understand the complex interactions between elements of the city traffic system. We have evaluated multiple available open source and closed source software packages in the terms of how well they cover identified use cases and the complexity of integration into a larger mobility policy support system.

We have discovered that except for the user experience, industry standard traffic simulation software is on par current state of the art research projects. Due to ease of integration and extensibility of the framework the best choice for the project is MATSim even as it has missing functionality (only most basic visualizations are included and simulating bicycle traffic is hardly supported).

Finally, due to large amount of computer power needed to run such simulations, for the project we will complement microscopic traffic simulations with faster and less precise macroscopic traffic simulations. Thus we will be able to run optimization algorithms and evolutionary algorithms to discover possible solutions to traffic problems.

ACKNOWLEDGMENTS

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[2] The memory problems were solved by compiling for 64 bit systems and running on a machine with more than 8GB of main memory.
[3] Bicycle traffic can be simulated, however bicycles can either behave like slow cars and drive on the roads or like fast pedestrians and drive on sidewalks. Collision between bicycles is hard to model and detecting bicycle traffic jams is not possible.

Kako so predvidevale razvoj prebivalstva Slovenije tri izbrane projekcije prebivalstva Slovenije v preteklosti

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POVZETEK

Besedilo obravnava (ne)uresničevanje treh avtorjevih projekcij prebivalstva izdelanih za obdobje 35 let in objavljenih v šestih izdajah učbenika Demografija do leta 2020 posebej za moške in ženske. Izmed vseh variant (konstantna, nizka, srednja in visoka) treh projekcij se je do leta 2020 uresničila le visoka varianta projekcije 1991-2026 za ženske. Vse ostale variante projekcij so podcenile dejansko rast števila prebivalstva Slovenije do leta 2020.

1   UVOD

Projekcije prebivalstva običajno delimo na perspektive in napovedi. Prve izdelamo v več variantah. Največkrat so štiri: konstantna, nizka, srednja in visoka. Napoved pa je praviloma ena sama in sicer tista, za katero avtor smatra, da se bo uresničila. V tem prispevku bomo obravnavali tri perspektive prebivalstva Slovenije, ki so bile izdelane za pedagoške namene na osnovi Shorterjevega programa FIVFIV in objavljene v šestih izdajah avtorjevega učbenika Demografija (Malačič, 1993, 1996, 1997, 2000, 2003, 2006). Od objave je minilo dovolj dolgo obdobje, da lahko primerjamo dejanski razvoj prebivalstva Slovenije in predvidevanje tega razvoja v treh izbranih projekcijah, ki so bile izdelane za 35 let (1991-2026, 1996-2031 in 2006-2041). Ker pa se projekcijsko obdobje še ni izteklo niti za eno projekcijo, bo naša obravnava le delna in bo zajela le malo manj kot trideset let po letu 1991. Že sedaj pa lahko rečemo, da je trideset let v modernem svetu izredno dolgo obdobje.

Prostor nam tukaj ne dopušča zelo podrobne analize razlik med projekcijami in dejanskim razvojem prebivalstva, saj bi takšna analiza zahtevala celo knjigo, ker je razvoj prebivalstva zelo kompleksen in obsežen, časovno obdobje pa sorazmerno dolgo. Zato se bo naša obravnava omejila na osnovne značilnosti posameznih hipotez projekcij in okvirne rezultate projekcij v primerjavi z dejanskim razvojem prebivalstva Slovenije do leta 2020 ter na pomen takšne obravnave.

2   HIPOTEZE PROJEKCIJ IN DEJANSKI RAZVOJ PREBIVALSTVA SLOVENIJE DO LETA 2020

S pomočjo hipotez o smrtnosti, rodnosti in migracijah avtor projekcij predvideva prihodnji razvoj osnovnih demografskih procesov in s tem ključnih elementov prihodnjega razvoja prebivalstva v obdobju za katerega se izdelujejo projekcije prebivalstva. V konkretnih projekcijah uporabljeni računalniški program zahteva postavitev hipoteze o smrtnosti v eni varianti ter hipotez o rodnosti in migracijah v štirih variantah. Te variante so konstantna, nizka srednja in visoka. Zaradi omejenega prostora tukaj ne moremo obravnavati hipotez v vseh elementih in podrobnostih, prav tako pa tudi ne bomo obravnavali podrobnega dejanskega razvoja posameznega demografskega procesa. Omejili se bomo na nekaj agregatnih kazalcev, ki pa kljub vsemu okvirno dovolj dobro pokažejo razlike med postavljenimi hipotezami in kasnejšim dejanskim razvojem.

Naslednja pomembna omejitev naše obravnave je dejstvo, da se projekcijsko obdobje še ni v celoti izteklo pri nobeni od treh projekcij. Zato bomo morali to dejstvo upoštevati. Ker pa je narava hipotez takšna, da je težko enoznačno izdvojiti do leta 2020 pretečeno obdobje, bomo v nadaljevanju obravnavali tudi del obdobja, ki sega v celotno projekcijsko obdobje. Pri obravnavi posameznih hipotez pa bomo upoštevali tudi razlike med njimi samimi in način, kako so konkretno vgrajene v sam program FIVFIV. Upoštevati pa je potrebno še ažurnost statističnih podatkov v času izdelave projekcij. Ta se je med tremi projekcijami izboljševala, saj se je uradna statistika v Sloveniji izboljševala in nekje od sredine 1990ih let tudi hitro evropeizirala. Pri prvih projekcijah, ki imajo začetek v letu 1991, izdelane pa so bile v letu 1992, pa je na ažurnost podatkov vplival tudi razpad jugoslovanske države in nastanek samostojne Slovenije.

Najbolj enostavna varianta projekcij je konstantna varianta. Pri njej vzamemo za rodnost, smrtnost in migracije podatke iz izhodiščnega leta ali zadnje razpoložljive podatke čim bliže izhodiščnemu letu in izdelamo projekcijo pod predpostavko, da ostanejo posamezni demografski procesi nespremenjeni naslednjih 35 let. V naših treh projekcijah smo pri zaporednih projekcijah 1991, 1996 in 2006 zabeležili

naslednje izhodiščne podatke: pri rodnosti Rn zaporedoma 0,70, 0,64 in 0,60, pri smrtnosti e0,m zaporedoma 67,34, 70,27 in 73,7 ter e0,f 75,16, 77,76 in 81,2 ter pri migracijah v povprečnem letnem meddržavnem migracijskem saldu pri moških zaporedoma 1300, 800 in 1950 ter pri ženskah 1200, 700 in 450. Dejanski podatki, ki so na voljo leta 2020 kažejo velika nihanja rodnosti in migracij ter hitro rast življenjskega pričakovanja po petletnih obdobjih in tudi po spolu. Konstantna varianta bi bila primerna samo pri hipotezi o rodnosti v letu 1991, pa še pri tej v povprečju in ne zaradi konstantnosti. Rn se je namreč od 0,70 leta 1991 znižal na 0,59 v povprečju v obdobju 2001-05 in nato dvignil čez 0,7 od leta 2008 naprej. V letih 2016-19 je bila povprečna vrednost 0,77. Vrednosti Rn za leti 1996 in 2006 sta bili prenizki. Pri smrtnosti je bila konstantna varianta zaradi velikega povečanja e0,m in e0,f slaba. Podobno velja pri migracijah za moške in nekoliko manj za ženske, vendar je pri migracijah ključni problem izredno veliko nihanje med posameznimi leti in tudi petletnimi povprečji. Podrobnejše podatke o smrtnosti in migracijah bomo navedli nekoliko kasneje.

Hipoteza o smrtnosti je bila postavljena za nizko, srednjo in visoko varianto projekcij samo v eni varianti, vendar so bili uporabljeni kazalci koeficienti doživetja za petletne starostne razrede, e0 in e5 za moške in ženske. Tukaj si bomo okvirno ogledali le hipotezo in dejanske podatke za e0. Naša hipoteza o povečanju e0 v projekcijskem obdobju 35 let za tri projekcije je bila pri moških zaporedoma od 67,34 na 72,51, od 70,27 na 73,8 in od 73,7 na 77,9 ter pri ženskah od 75,16 na 79,35, od 77,76 na 80,5 in od 81,2 na 84,6 let. Hipoteze so prenizke, saj dejanski podatki za leto 2019 kažejo, da je e0,m 78,5 in e0,f 84,22. Za projekcijo z začetkom leta 1991 pa je potrebno dodati, da so bili ob izdelavi na voljo le skoraj deset let stari podatki iz tablic smrtnosti. Pričakujemo pa lahko še nadaljnje naraščanje tega kazalca in tudi, da sedanja kriza zaradi COVID 19 ne bo bistveno vplivala na trend.

Naslednja hipoteza je hipoteza o rodnosti v nizki, srednji in visoki varianti treh obravnavanih projekcij. Prva značilnost hipoteze o rodnosti v vseh variantah in vseh treh projekcijah je ta, da razen izjemoma ne predvideva nihanja navzdol in navzgor ali obratno. Omembe vredna izjema je le srednja varianta projekcije 1991-2026. Ta varianta se od začetne vrednosti Rn 0,70 v naslednjih treh vrednostih za petletna obdobja spusti pod to raven (tudi do 0,62), v zadnjih treh vrednostih pa se dvigne nad začetno vrednost vse do 0,84 v zadnjih petih letih. Na tak način v povprečju kar dobro odraža dejanska gibanja rodnosti. Nizka in visoka varianta te prve projekcije se nista uresničili, saj je projekcija predvidela za zadnjih pet let projekcijskega obdobja Rn vsega 0,50 za nizko in kar 1,0 za visoko varianto. Na podoben način se nista uresničili nizka in visoka varianta hipoteze o rodnosti v projekciji 1996-2031, čeprav visoka varianta ni več predvidevala dviga rodnosti na raven enostavnega obnavljanja prebivalstva do leta 2031. Tudi v tej projekciji je bila najboljša srednja varianta hipoteze o rodnosti. Ta sicer ni predvidela znižanja Rn na ravni med 0,60 in 0,57 med leti

1997 in 2005, kasneje pa z nekoliko zaostanka dobro sledi dejanskemu gibanju. Za vse variante hipoteze o rodnosti zadnje projekcije 2006-2041 pa lahko zapišemo, da so pod močnim vplivom zelo nizke rodnosti v letih 2001 do 2005. Zaradi tega je bila predvidena rodnost v vseh variantah projekcijskega obdobja do leta 2020 precej nižja od dejanskih podatkov o rodnosti v tem obdobju.

Za hipotezo o migracijah v vseh treh projekcijah in v vseh variantah lahko najprej ugotovimo, da je dosledno predvidevala pozitivne neto migracije tako za moške kot tudi za ženske. To je bilo pravilno, saj so bile neto migracije le izjemoma negativne v kakšnem letu ali pri spolu, nikakor pa ne za pet let zapored ali za pet let v povprečju. Tudi pri tej hipotezi so dejanski podatki po petletnih obdobjih izrazito nihali, predvidene vrednosti v hipotezah pa nihanj razen izjemoma ne kažejo. To je po svoje razumljivo, saj so dejanska migracijska gibanja zelo odvisna od cikličnega gibanja gospodarstva, tega pa ekonomska znanost še ni sposobna napovedovati niti na srednji rok, na dolgi kar 35 let raztegnjen rok pa nikakor ne. Vse hipoteze o migracijah v treh projekcijah so tudi bistveno podcenile razliko med moškimi in ženskami. Migracijski saldi pri moških so v Sloveniji v dobrih in slabih časih bistveno večji kot pri ženskah. Za ženske lahko še zapišemo, da so hipoteze predvidevale praviloma previsoke neto selitve v vseh variantah in vseh projekcijah. Če na kratko pogledamo še posamezne projekcije, lahko za projekcijo 1991-2026 ugotovimo, da nobena varianta ni predvidela zelo nizkega salda v prvih petih letih samostojne Slovenije. V kasnejših petletnih obdobjih se hipoteze pri ženskah gibljejo med 800 in 2500 na leto pri ženskah in med 900 in 2700 na leto pri moških. Dejanski petletni podatki pa nihajo med 441 in 2013 na leto pri ženskah in 201 in 8005 na leto pri moških. Za leta krize so hipoteze previsoke, za leta ugodnih gospodarskih gibanj pa so prenizke. Projekcija 1996 – 2031 je v primerjavi s prvo projekcijo znižala predvideno neto priseljevanje v Slovenijo v vseh variantah hipoteze o migracijah. Zato so v njej dejanske neto migracije na splošno podcenjene v vseh variantah. Projekcija 2006-2041 je pod vplivom dejanskih podatkov o neto migracijah v letih 2001-2005 povečala razliko med spoloma v korist moških. To razliko kasneje v vseh variantah postopoma zmanjšuje, kar verjetno ne bo dobro v naslednjih dvajsetih letih. Če pa se omejimo samo na prvih 15 let projekcijskega obdobja, lahko zapišemo, da je hipoteza o migracijah v vseh treh variantah podcenjena.

3 REZULTATI PROJEKCIJ NA PRIMERU ŠTEVILA PREBIVALSTVA IN NJIHOVO (NE)URESNIČEVANJE

Model analitičnih projekcij prebivalstva nam da izredno bogastvo podatkov o predvidenem prihodnjem razvoju prebivalstva v okviru projekcijskega obdobja. To velja tudi za naše tri izbrane projekcije. Na voljo imamo podatke o strukturi prebivalstva po starosti in spolu z intervalom pet let, izračunamo lahko celo vrsto enostavnih in bolj

kompleksnih kazalcev razvoja prebivalstva, vsekakor najpomembnejši podatek pa je število celotnega prebivalstva. Zaradi prostorske omejitve bomo obravnavali rezultate izbranih projekcij prebivalstva do leta 2021 na primeru števila prebivalstva posebej za moške in ženske. Posebna obravnava moških in žensk je posledica narave modela projekcij prebivalstva pa tudi narave samih demografskih procesov. Že pri obravnavi hipotez projekcij prebivalstva smo videli, da se podatki pri smrtnosti in migracijah zelo razlikujejo po spolu. Te razlike pa se najlepše pokažejo pri ločeni obravnavi rezultatov projekcij po spolu. Podatki so v tabeli 1.

Namen prikaza podatkov v tabeli 1 je izrazito ilustrativen. Na osnovi teh podatkov ne bomo izračunavali nobenih relativnih števil ali morebitnih drugih kazalcev, ki bi podrobneje prikazali primerjavo med predvidevanjem prihodnjega razvoja prebivalstva Slovenije v treh obravnavanih projekcijah prebivalstva in kasnejšim dejanskim razvojem prebivalstva. Za podrobnejši analitični prikaz razlik bi potrebovali veliko več prostora, kot je na voljo v tem besedilu. Ne glede na vse to pa je iz tabele 1 že na prvi pogled mogoče izluščiti osnovne in najbolj pomembne značilnosti (ne)uresničevanja v projekcijah predvidenega razvoja prebivalstva Slovenije do konca drugega desetletja 21. stoletja.

Tabela 1: Število prebivalstva po spolu v projekcijah 1991-2026, 1996-2031 in 2006-2041 in po dejanskem razvoju v izbranih letih. Vir: Malačič, 1993, 1997 in 2006; SISTAT, dostop 23. 9. 2020.

Projekcija/ Razvoj P	Varianta	Spol	Leto		
			2001	2011	2021
1	2	3	4	5	6
1991 – 2026	Nizka	M	958.641	932.579	879.500
		Ž	1.016.981	994.976	953.441
	Srednja	M	961.271	952.614	944.633
		Ž	1.019.109	1.013.238	1.014-615
	Visoka	M	962.822	977.134	985.833
		Ž	1.020.603	1.036.863	1.054.248
1996-2031	Nizka	M	970.053	955.640	915.759
		Ž	1.022.008	999.523	954.580
	Srednja	M	970.053	960.485	939.637
		Ž	1.022.008	1.004.226	977.450
	Visoka	M	970.053	971.244	967.363
		Ž	1.022.008	1.014.570	1.004.105
2006-2041	Nizka	M	-	978.933	952.735
		Ž	-	1.009.977	973.364
	Srednja	M	-	978.933	957.879
		Ž	-	1.009.977	979.080
	Visoka	M	-	978.933	966.772
		Ž	-	1.009.977	986.060
Dejanski razvoj		M	972.749	1.014.563	1.051.066[x]
		Ž	1.017.352	1.035.626	1.044.795[x]
		Skupaj	1.990.094	2.050.189	2.095.861[x]

[x] Podatek je za leto 2020

Rezultate projekcij in njihovo primerjavo z dejanskimi statističnimi podatki, ki jih je objavil Urad za statistiko Republike Slovenije, je potrebno obravnavati skupaj z vsem tistim, kar smo povedali že pri obravnavi posameznih hipotez projekcij in primerjav hipotez z dejanskim razvojem na primeru posameznih uporabljenih kazalcev. Že pri obravnavi hipotez smo lahko videli, da so se predvidevanja slabo uresničila.

Za obravnavo uresničevanja projekcij in njihovih posameznih variant smo izbrali leta 2001, 2011 in 2021. Pri slednjem letu imamo dejanski podatek za leto 2020, vendar to ni problem, ker je zelo jasno, da so podatki za leto 2020

precej višji od vseh variant projekcij, z izjemo visoke variante projekcije 1991-2026 za ženske. Ta varianta je tudi edina, za katero lahko rečemo, da se je pri ženskah uresničila. Za vse druge variante projekcij za moške in ženske pa lahko rečemo, da so prenizke. Težko je na kratko dobro odgovoriti na vprašanje, zakaj smo pred 30, 25 in 15 leti predvidevali prenizko rast ali celo upadanje prebivalstva. Pri nizki varianti je to deloma tudi posledica narave nizke variante. Veliko bolj pomembno pa je bilo demografsko dogajanje v zadnjem desetletju prejšnjega in v prvi polovici prvega desetletja sedanjega stoletja. V tem obdobju je transverzalna rodnost v Sloveniji padla na najnižje do sedaj zabeležene ravni, kar je vplivalo v kombinaciji z gospodarskim in političnim dogajanjem na to, da so vsake naslednje projekcije slabše predvidevale dejanski razvoj. Dokončna analiza posameznih projekcij pa bo v celoti možna šele po izteku projekcijskih obdobij.

4   SKLEP

Analiza uresničevanja v projekcijah prebivalstva predvidenega prihodnjega razvoja prebivalstva je pomembna zaradi številnih razlogov. Ti so tako strokovni kot širše družbeni in politični. Pri prvih je namen predvsem napredek pri razvoju metodologije in stroke, pri družbenih in političnih vidikih pa je najpomembnejša ocena uporabnosti projekcij prebivalstva za vodenje različnih konkretnih družbenih politik, od politike prebivalstva do gospodarske, socialne, regionalne in drugih politik.

Projekcije, ki smo jih obravnavali v tem besedilu so bile izdelane za pedagoške namene. Zato verjetno niso imele posebnega vpliva na širše družbene vidike in vodenje konkretnih politik. Kljub temu pa so nekatere ugotovitve tega besedila širše pomembne. Verjetno sta najbolj pomembni dve. Prva je ta, da bodo strokovnjaki imeli zmeraj težave pri predvidevanju dolgoročnih gibanj procesov, ki so po svoji naravi ciklični. Prihodnje krize v več desetletnem obdobju verjetno ne bo nikoli mogoče točno napovedati. Druga ugotovitev pa je, da na vsako projekcijo najbolj vpliva gibanje demografskih procesov v pet do deset let dolgem obdobju pred izhodiščnim letom projekcije. Če se v tem obdobju pojavi odstopanje od siceršnjih trendov, bo to gotovo vplivalo na uresničevanje projekcij.

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PREDGOVOR

Letošnje šolsko leto je bilo povsem drugačno od preteklih let in tudi za prihodnje leto se nam obeta zelo posebno šolsko leto. Zaznamovala ga je odsotnost učencev iz šolskih prostorov in odsotnost neposrednega kontakta z učitelji, na vseh nivojih od vrtca do univerze. Pri tem so v ospredje stopili, bolj kot kadarkoli do sedaj, informacijsko komunikacijska tehnologija in veščine vzgoje in izobraževanja na daljavo.

Zato je tudi letošnja konferenca drugačna od ostalih. Pogovorili se bomo predvsem o rezultatih novega načina dela, s katerim smo bili in bomo verjetno tudi v prihodnje soočeni. Pogledati moramo dobre prakse in tudi spodrsljaje. Iz obojega želimo izoblikovati sodobno digitalizirano vzgojo in izobraževanje, ki ne bo brez kontakta z učenci, brez učiteljev oz. brez neposrednega kontakta med vsemi deležniki, če je to le mogoče. Soočamo se s potrebo novega opolnomočenja učencev, staršev, učiteljev, vodstva šol, nenazadnje tudi državnih organov, kot sta Zavod Republike Slovenije za šolstvo in pristojno ministrstvo.

Zato vas vabimo, da se aktivno udeležite konference Vzgoja in izobraževanje v informacijski družbi 2020, da predstavite svoje poglede in izkušnje ter da skupaj poiščemo rešitve za v bodoče.

Uredniški odbor

FOREWORD

This school year was very different from previous years and we are looking forward to a very special school year ahead. It was marked by the absence of students from school premises and the absence of direct contact with teachers, at all levels from kindergarten to university. At the same time, information and communication technology and distance education skills have come to the fore, more than ever before.

That is why this year's conference is different from the others. We will mainly discuss the results of the new way of teaching and learning that we have been and will probably continue to face in the future. We need to look at good practices as well as shortfalls. We want to create a modern digitized education and training, which will not be without contact with students, without teachers or without direct contact between all stakeholders, if at all possible. We are facing the need for new empowerment of students, parents, teachers, school management, and last but not least, state bodies such as the National Education Institute Slovenia and the responsible ministry.

Therefore, we invite you to actively participate in the conference Education in Information Society 2020, to present your views and experiences, and to find solutions for the future together.

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Poučevanje programskega okolja LabView

Teaching LabView software

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POVZETEK

Dijaki se želijo izobraževati na področjih, ki so v praksi uporabna. Poznavanje programskega okolja LabView je vsekakor eno izmed njih. Gre za grafični programski jezik, kjer programiramo tako, da povezujemo funkcijske bloke v celoto. Uporablja se v industriji za avtomatizirane meritve, vodenje sistemov, simulacijo in analizo signalov.

Podjetje National Instruments poleg programske opreme ponuja tudi kartice za zajemanje podatkov (DAQ card). Nanje lahko priključimo vhodno-izhodne elemente kot so senzorji, tipke, LED, idr. Zaradi cenovne dostopnosti smo namesto kartic uporabili razvojno ploščo Arduino UNO, ki smo jo preko USB-povezave priključili na računalnik, kjer je bilo nameščeno okolje LabView.

Pri praktičnem delu modula Regulacije smo najprej spoznali osnove LabView programiranja na primeru izdelave programa, ki je omogočal simulacijo nivoja tekočine. Izdelali smo tudi dva kompleksnejša programa, kjer lahko naključno izbiramo dijaka in mu dodelimo izpitno vprašanje oz. generiramo loto kombinacijo.

V naslednjem koraku smo napisali program, ki je omogočal serijsko komunikacijo med razvojno ploščo Arduino UNO in računalnikom. Preko virtualnega gumba smo nadzirali branje analognih vhodov in prižigali oz. ugašali vgrajeno LED na enem izmed digitalnih izhodov.

Ob koncu pouka smo dijake v anketi povprašali kaj menijo o vključevanju vsebin s področja LabView programiranja v pouk. Večini se zdi, da je programsko okolje LabView uporabno. Kljub temu, da svoje znanje ocenjujejo kot dobro, bi si ga želeli še poglobiti in spoznati tudi praktične projekte iz industrije.

Glede na pozitivne odzive bomo v prihodnosti dijakom poleg vsebin znotraj rednega pouka ponudili tudi LabView krožek, delavnice na Dnevih na vedoželjne, povezali se bomo s podjetjem National Instruments ter spodbujali uporabo programskega okolja LabView pri izdelavi zaključnih nalog.

Predstaviti jim nameravamo tudi konkretne projekte iz industrije, kjer je bil uporabljen LabView.

Vsekakor je LabView programiranje praktično uporabno, zato bomo z njegovim poučevanjem nadaljevali.

KLJUČNE BESEDE

LabView, grafično programiranje, Arduino UNO, DAQ kartice

ABSTRACT

Students want to be educated in areas that are useful in practice. Knowledge of the LabView software environment is one of them. It is a graphical programming language where we program by connecting function blocks into a whole. It is used in the industry for automated measurements, system control, simulation and signal analysis.

Besides software, National Instruments also offers DAQ cards. We can connect input-output elements such as sensors, keys, LEDs, etc. Due to affordability, we used the Arduino UNO development board instead of cards, which we connected via a USB connection to a computer where the LabView environment was installed.

In the practical part of the Control systems module, we first learned the basics of LabView programming in the case of creating a program that allowed the simulation of the fluid level. We created two more complex programs, where we can randomly select a student and assign him an exam question, or we generate a lotto combination.

In the next step, we wrote a program that allowed serial communication between the Arduino UNO development board and the computer. Through the virtual button, we controlled the reading of analog inputs and turn on or off the built-in LED on one of the digital outputs.

At the end of the lesson, we asked the students in the survey what they thought about using the LabView programming in the lesson. To most, the LabView software environment seems useful. Even though they assess their knowledge as good, they would like to deepen it and get to know practical projects from the industry.

According to the positive responses, in the future we will offer students a LabView circle, workshops at the Days of the Curious, connect with National Instruments and encourage the use of the LabView software environment in the preparation of final assignments. We also intend to present concrete projects from the industry where LabView was used.

In any case, LabView programming is practically useful, so we will continue to teach it.

KEYWORDS

LabView, graphical programming, Arduino UNO, DAQ cards

1 UVOD

Dijaki se velikokrat sprašujejo kje se da znanja, ki jih pridobijo v šoli, praktično uporabiti. Od tod tudi izvirajo vprašanja v smislu "Kdaj/kje bom pa to rabil?". Menimo, da uvodna motivacija dijakov izboljša proces pridobivanja znanja. Motiviramo pa jih lahko, da jim pokažemo kje so znanja, ki naj bi jih pridobili, tudi praktično uporabna. Da poučujemo tiste stvari, ki se v praksi uporabljajo.

V nadaljevanju se bomo osredotočili na poučevanje programskega okolja LabView, podjetja National Instruments [1], katerega logotip prikazuje Slika 1. LabView je grafični programski jezik. Programiramo tako, da povezujemo bloke in programske strukture, ki tvorijo program. LabView se uporablja za avtomatizirane meritve, vodenje sistemov, simulacijo in analizo signalov itd.

Slika 1: National Instruments – LabView logotip

2 LABVIEW

Pomemben dejavnik za poučevanje tega programskega okolja je to, da se ga uporablja v marsikaterem podjetju oz. industriji. Če bi pobrskali po oglasih za delo, bi opazili, da nekatera podjetja zahtevajo znanje LabView programiranja. S tem znanjem smo torej konkurenčni na trgu dela.

Pri podjetju National Instruments imajo tudi možnost pridobitve certifikata, ki podaja oceno o našem znanju. Certifikati so razdeljeni v več nivojev zahtevnosti:

- CLAD (Certified LabView Associate Developer) - osnovno poznavanje okolja
- CLD (Certified LabView Developer) - načrtovanje in razvoj osnovnih aplikacij
- CLA (Certified LabView Architect) - načrtovanje in razvoj zahtevnejših aplikacij

Certifikat pridobimo tako, da bodisi odgovarjamo na vprašanja izbirnega tipa oz. rešujemo problemske naloge. Preden opravimo preizkus znanja nam je na voljo tudi tečaj, ki nas pripravi na tovrstne naloge. Na spletu je možno dobiti tudi veliko gradiva, ki nam je v pomoč pri učenju.

Preden se dijaki lotijo učenja je dobro, da imajo vsaj minimalno znanje s področja programiranja. Zaželeno je tudi osnovno poznavanje elektronike in načinov komunikacije. Zato bi, za srednješolski nivo, LabView priporočali višjim letnikom (3. ali 4.) srednješolskega strokovnega izobraževanja (SSI) s področja elektrotehnike ali mehatronike.

2.1 NI USB 6009

Programsko okolje LabView je kompleksno in omogoča izdelavo najrazličnejših aplikacij. Poleg programske opreme imamo na voljo tudi strojno opremo kot so npr. kartice za zajemanje podatkov (DAQ – data aquisition) [2]. Pri poučevanju smo se osredotočili na to, kako zajeti signal s senzorja in ga pripeljati do računalnika, kjer je nameščeno programsko okolje LabView. Podatke nato shranimo, prikažemo na grafu ali izvedemo izračune.

Signal s senzorja je najprej potrebno ojačati, filtrirati in prilagoditi območje. Nato sledi pretvorba v digitalno obliko, kar nam omogoča analogno-digitalni pretvornik. Kartice za zajemanje podatkov vsebujejo digitalne in analogne vhode ter izhode (Slika 2). Nanje lahko priklopimo različne vhodno-izhodne elemente (senzorje, tipke, aktuatorje ipd.).

Obstajajo različni vmesniki, ki se razlikujejo po številu vhodov/izhodov, ločljivosti A/D pretvornika, hitrosti zajemanja podatkov itd. V Tabeli 1 so prikazane nekatere lastnosti kartice NI USB 6009.

Tabela 1: Lastnosti DAQ kartice NI USB 6009

NI USB 6009	
Analogni vhodi	8 (14-bitni ADC)
Analogni izhodi	2 (12-bitni DAC)
Digitalni vhodi/izhodi	13
Števec	32-bitni

Slika 2: Kartica NI USB 6009 in razporeditev vhodno-izhodnih priključkov

2.2 Alternativa DAQ karticam

Glede na to, da DAQ kartice niso ravno poceni, bi bil nakup večjega števila le-teh kar velik finančni zalogaj. Zato smo se odločili za alternativo. Namesto DAQ kartice lahko uporabimo tudi poljubno razvojno ploščo, s katero zajamemo signale. Odločili smo se za platformo Arduino UNO, ki jo dijaki dobro poznajo, saj jo uporabljajo tako pri pouku kot tudi pri izdelovanju zaključnih nalog. Prav tako je omenjena platforma enostavna za uporabo in cenovno ugodna. LabView tudi omogoča programiranje Arduino plošče z uporabo posebnega programskega modula. V okviru našega poučevanja smo sami napisali program za enostavno serijsko komunikacijo med Arduinom in računalnikom, na katerem je nameščen LabView.

3 LABVIEW V OKVIRU POUKA

Poleg organiziranja različnih krožkov, tečajev in delavnic lahko znanje LabView programiranja dijakom ponudimo tudi v okviru pouka. Na ta način namreč vsi dobijo potreben vpogled v tovrstno programiranje. Strokovni modul Regulacije, ki se

poučuje v 4. letniku programa Tehnik mehatronike, pri praktičnem delu predvideva tudi spoznavanje programskega okolja LabView. Dijaki se seznanijo z osnovnimi strukturami in koncepti grafičnega programiranja. V nadaljevanju bo predstavljen potek poučevanja LabView-ja pri praktičnem delu modula Regulacije.

3.1 Prvi LabView program

Ko odpremo programsko okolje, se nam prikažeta dve okni. Prvo okno imenujemo čelna plošča (front panel) (Slika 3). Na njej so elementi, ki so vidni uporabniku končne aplikacije. To so npr. grafi, gumbi, indikatorji, polja za vnos in prikaz podatkov. V drugem oknu pa izdelujemo program v obliki blokov, zato to okno imenujemo tudi bločni diagram (block diagram) (Slika 4).

V prvem delu z dijaki naprej skupaj izdelamo preprost program, ki ga nadgrajujemo in spoznavamo osnove. Program omogoča simuliranje nivoja tekočine. V kolikor je nivo nad zgornjo mejo ali pod spodnjo mejo, se pokaže rdeč indikator, sicer pa zelen indikator. Dodatno se prikaže obvestilo "nivo je izven meja" ali "nivo je znotraj meja." Na primeru omenjenega programa razložimo različne podatkovne tipe, pogojni stavek, zanko itd.
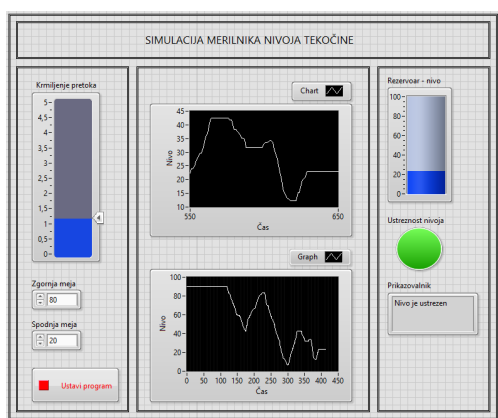
Slika 3: Simulacija merilnika nivoja tekočine (čelna plošča)
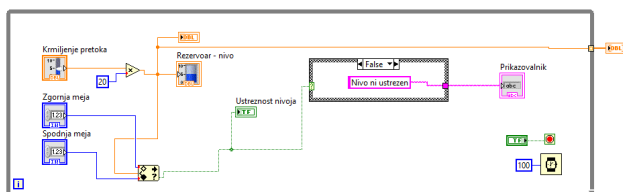
Slika 4: Simulacija merilnika nivoja tekočine (bločni diagram)

Dijaki pod mentorstvom učitelja nadaljujejo z izdelavo preprostih programov, ki vključujejo osnovne programske strukture.

3.2 Nadgradnja

Ko utrdimo osnove, skupaj naredimo dva bolj kompleksna programa. Pri prvem je omogočena naključna izbira dijaka s podanega seznama, pri drugem pa program izžreba loto kombinacijo (Slika 5).
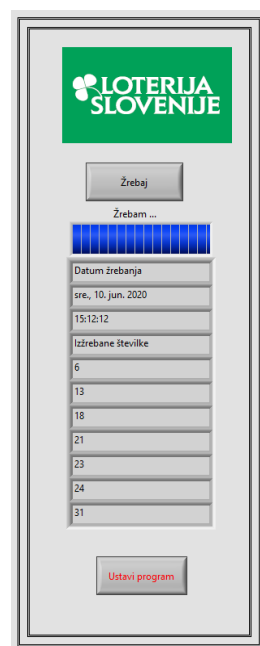
Slika 5: Žrebanje Loto (čelna plošča)

3.3 LabView in Arduino

Namesto DAQ kartice lahko za zajemanje podatkov uporabimo kar razvojno ploščo Arduino [3]. Potrebno je napisati program, ki bo omogočal serijsko komunikacijo med Arduinom in računalnikom, kjer je nameščen LabView.
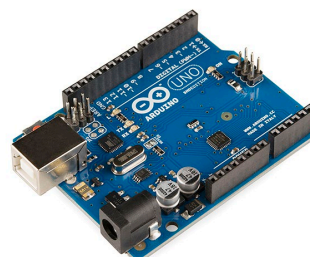
Slika 6: Razvojna plošča Arduino UNO

Oglejmo si nekaj preprostih programov, ki nam omogočajo upravljanje z razvojno ploščo Arduino UNO (Slika 6) preko serijske komunikacije.

V prvem primeru s pritiskom na virtualni gumb nadziramo kdaj se preberejo analogni vhodi in njihova vrednost prikaže na čelni plošči (Slika 7,8,9). Gumb lahko v drugem primeru odstranimo in dosežemo konstantno branje analognih vhodov in prikaz vrednosti na grafu čelne plošče LabView-a.
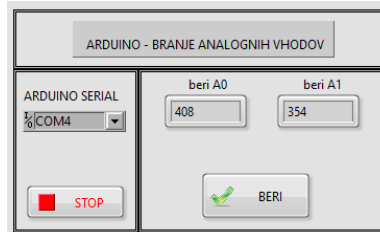
Slika 7: Branje analognih vhodov (čelna plošča LabView)
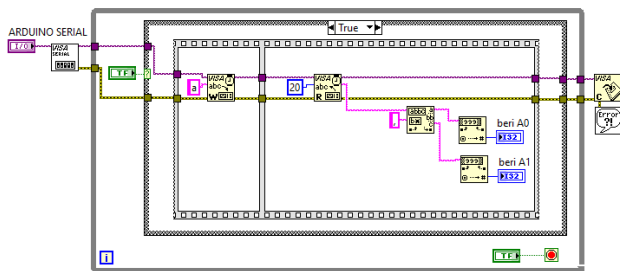
Slika 8: Branje analognih vhodov (bločni diagram LabView)

```
int beri0;
int beri1;
char ukaz;
void setup()
{
        Serial.begin(9600);
}
void loop()
{
        if(Serial.available()>0)
        {
                ukaz=Serial.read();
                if(ukaz=='a')
                {
                        beri0=analogRead(A0);
                        beri1=analogRead(A1);
                        Serial.print(beri0);
                        Serial.print(",");
                        Serial.println(beri1);
                }
        }
}
```

Slika 9: Programska koda Arduino

Upravljamo lahko tudi digitalne izhode Arduino plošče. Preko virtualnega gumba na čelni plošči lahko prižgemo in ugasnemo vgrajeno LED, ki se nahaja na enem izmed digitalnih izhodov (Slika 10).

Slika 10: Vklop/izklop LED (čelna plošča LabView)

4 REFLEKSIJA

Dijake 4. letnikov programa Tehnik mehatronike smo po koncu pouka povprašali kakšno je njihovo mnenje o programskem okolju LabView. Preko ankete na MS Forms smo jim zastavili nekaj preprostih vprašanj izbirnega tipa. Anketo je izpolnilo 11 dijakov.

Rezultati ankete so prikazani na grafih (Slika 11). Dijaki so ocenjevali praktično uporabnost okolja LabView. Večina jih LabView prepoznava kot praktično uporabno programsko okolje. Slednje pomeni, da so verjetno tudi dovolj motivirani za nadaljnje izobraževanje, kar je potrdilo 7 od 11 dijakov. Prav toliko dijakov bi si želelo tudi predstavitve praktičnih projektov iz industrije. Svoje znanje jih na lestvici od 1 do 5 kar 9 od 11 ocenjuje kot dobro (3), kar je smiselno, saj si po eni strani želijo nadaljnjega izobraževanja. Po drugi strani pa so v okviru pouka že spoznali osnovne koncepte LabView programiranja.

Glede zahtevnosti je večina dijakov odgovorila, da se jim zdi LabView programiranje srednje zahtevno oz. zahtevno. Iz tega lahko sklepamo, da so bili učni cilji postavljeni ustrezno oz. nekoliko višje, kar je dobro, saj se morajo zaradi tega dijaki bolj potruditi.

Rezultati ankete nam kažejo, da je potrebno s poučevanjem LabView-a nadaljevati, saj je bilo programsko okolje med dijaki dobro sprejeto.

Slika 11: Rezultati ankete

5 ZAKLJUČEK

Predstavljeno je bilo poučevanje programskega okolja LabView. Zaenkrat le-to poteka zgolj pri praktičnem delu strokovnega modula Regulacije.

Načrti za prihodnosti so sledeči. Za dijake bomo organizirali LabView krožek. LabView vsebine bodo na voljo na Dnevih za vedoželjne. V preteklem letu smo jim to že ponudili in odziv je bil relativno dober, vendar za bolj poglobljeno delo ni bilo dovolj časa. So pa dijaki dobili dober vpogled.

Povezali so bomo s podjetjem National Instruments, ki trži programsko in strojno opremo in se pogovorili o možnostih za sodelovanje.

Spodbudili bomo dijake za uporabo LabView-a pri izdelavi zaključnih nalog.

Predstavili jim bomo realen projekt iz industrije, kjer je bilo uporabljeno omenjeno programsko okolje. Na ta način jih bomo dodatno motivirali za učenje.

Menimo, da je poznavanje programskega okolja LabView vsekakor dobrodošlo, zato bomo nadaljevali z njegovim poučevanjem in izvajanjem izobraževalnih dejavnosti.

LITERATURA IN VIRI

[1] National Instruments www.ni.com, pridobljeno 20. 8. 2020

[2] Data acquisition https://en.wikipedia.org/wiki/Data_acquisition, pridobljeno 20. 8. 2020

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Programska koda kot izrazni medij ustvarjalnosti v izrednih razmerah

Program code as an expressive medium of creativity in emergency situations

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POVZETEK

Izobraževanje na daljavo je v času koronavirusa slonelo na sodobnih informacijskih tehnologijah, ki so zagotavljala prostorsko in/ali časovno neodvisnost ključnim deležnikom v izobraževalnem procesu. Ob relativno zadovoljivi informacijsko-komunikacijski infrastrukturi z dostopom do širokega nabora različnih spletnih učnih okolij in orodij, smo nekateri učitelji s sistematičnim in strukturiranim vodenjem učnega procesa med drugim prek praktičnih aplikacij in ustvarjalnih medijskih praks skušali dijake spodbujati, da del svojega časa zapolnijo z dejavnostmi, ki jih v času običajnega poteka življenja odrivajo na obrobje, npr. s sodobno medijsko generativno umetnostjo. V prispevku so predstavljene aktivnosti, ki smo jih znotraj strokovnega modula kreativno kodiranje v izbrani učni situaciji izvedli s ciljem opolnomočenja dijakov v razvijanju računalniškega mišljenja za razumevanje vloge novih tehnologij v procesu ustvarjanja algoritmične računalniške umetnosti. Po opravljeni učni situaciji smo na osnovi evalvacije izdelkov ugotovili, da je povezovanje določenih konceptov programiranja z osnovnimi načeli likovne umetnosti prek ustreznega programskega jezika dijakom omogočilo razviti svoj osebni slog za ustvarjanje tako statičnih digitalnih vizualizacij kot dinamičnih, interaktivnih ali animacijskih projektov vizualne umetnosti, a hkrati razumeti algoritmični način mišljenja ter tako spoznavati in utrjevati zmožnosti reševanja problemov danega področja.

KLJUČNE BESEDE

Računalniško mišljenje, algoritmično mišljenje, računalniški koncepti, osnove programiranja, načela likovnega snovanja in oblikovanja

ABSTRACT

At the time of the coronavirus, distance learning was based on modern information technologies that ensured spatial and / or temporal independence for key stakeholders in the educational process. With a relatively satisfactory information and communication infrastructure with access to a wide range of different online learning environments and tools, some teachers tried to encourage students to fill part of their time with activities through systematic and structured management of the learning process through practical applications and creative media practices. which are pushed to the periphery during the normal course of life, e.g. with contemporary media generative art. The paper presents the activities that we carried out within the professional module creative coding in the selected learning situation with the aim of empowering students in developing computer thinking to understand the role of new technologies in the process of creating computer algorithmic art. After the learning situation, based on the evaluation of products, we found that connecting certain programming concepts with the basic principles of fine arts through appropriate programming language allowed students to develop their personal style to create static digital visualizations and dynamic, interactive or animation visual arts projects, but at the same time understand the algorithmic way of thinking and thus get to know and consolidate the ability to solve problems in a given field.

KEYWORDS

Computational thinking, algorithmic thinking, computational concepts, programming basics, principles of art and design

1 UVOD

Izredne razmere, ki jih je povzročila epidemija novega koronavirusa, so celotno izobraževalno sfero nedvomno postavile v povsem nove okoliščine, kjer so bili njeni ključni deležniki prostorsko oziroma časovno ločeni. Sodobne informacijske tehnologije in novi mediji so v veliki meri postali osrednji vir znanja na šolah za kakovostno izvajanje izobraževanja na daljavo. Njihova integracija in učinkovita raba v učnem procesu, ob zadovoljivi informacijsko–komunikacijsko infrastrukturi, sta omogočala razvoj ustvarjalnega učenja in inovativnih metod poučevanja. Dostopnost do izbranih informacij v realnem času in velik nabor različnih spletnih učnih okolij sta bila osrednjega pomena. To je ob smiselno organiziranih učnih vsebinah učiteljem omogočalo uporabo različnih spletnih orodij in elektronskih gradiv pri pouku za sistematično in strukturirano vodenje učnega procesa ter povezovanje s sodelavci, hkrati pa je dijake iz pasivnega

postavilo v aktivnejši položaj, predvsem v smislu intenzivnejšega vzpostavljanja medvrstniške komunikacije in bolj kreativne rabe spletnih orodij. Raziskava ZRSŠŠ [1] je sicer pokazala, da so učitelji kot prevladujoči način izvajanja pouka navedli kombiniranje pouka z videokonferencami in usmerjanje učenja prek pisnih navodil. Ob uporabi raznolikih metod je ocenjevanje doseganja standardov znanja in učnih ciljev potekalo večinoma ustno prek videokonferenc, kot tudi ocenjevanje praktičnih izdelkov in avtentičnih problemov.

V času negotovosti in socialne distanciranosti, ko so izobraževalne ustanove zaprle vrata in smo šolniki in šolajoči obtičali doma, smo nekateri med drugim ohranjali medsobojne povezave prek praktičnih aplikacij in ustvarjalnih medijskih praks. Kot odziv na ohranjanje žive komunikacije ob hkratnem usvajanju učnih vsebin, smo dijake spodbujali, da del svojega časa zapolnijo s spoznavanjem sodobne medijske generativne umetnosti, natančneje z digitalno generativno postopkovno grafiko. Ustvarjanje te sodi v algoritmično računalniško umetnost, katere jedro sloni na postopku, s katerim opišemo potek nastajanja digitalne slike v obliki navodil za računalnik (konceptualni model slike je vgrajen v algoritem ali program). Sliko nato računalnik generira sam po navodilih, ki smo jih zapisali v programu. Na podlagi ustreznih navodil lahko računalnik izdela množico slik – variacije o določeni temi v stilu, ki ga vgradimo v program. V nasprotju s koncepti klasične umetnosti sodobna medijska umetnost s svojim interaktivnim značajem vzpostavlja dvosmerno komunikacijo med ustvarjalnim delom in gledalcem, torej uporabnikom.

Pri strokovnem modulu kreativno kodiranje [2] smo v ta namen znotraj učne situacije Spoznavanje osnov programskega jezika JavaScript izvedli šest vsebinskih enot v predvidenem časovnem obsegu sedmih didaktičnih enot. Vsebinske enote so zajemale običajne ustvarjalne pristope in sodobne oblikovalske prakse, ki jih medijski tehniki lahko uporabljajo v svojem učnem procesu, vključno z osnovami statičnega generativnega snovanja (uporaba programskih konstruktov za ustvarjanje različnih enostavnih ali zapletenih vizualnih rezultatov iz enega dela napisane programske kode), dinamičnega snovanja (uporaba programske kode za ustvarjanje dinamičnih vizualnih komunikacij, ki se lahko spreminjajo s časom ali se odzivajo na vstopajoče podatke) in interakivnega snovanja (uporaba programske kode za ustvarjanje vizualnih rezultatov, ki so prilagodljivi in vezani na odziv na dogodke uporabnika, povezane z uporabo miške ali tipkovnice). Omenjena učna situacija se je v vsebinskem kontekstu opirala na ponavljanju in izpopolnjevanju temeljnih programerskih konceptov in programiranju v izbranem besedilnem programskem jeziku z ustvarjalnimi vajami in majhnimi projekti. V ta namen so dijaki raziskali koncepte spremenljivk, uporabo več stavkov (ukazov) programske kode v določenem zaporedju (pomebnost vrstnega reda), sprejemanje odločitev (vejitve) in ponavljanje istega procesa (zanke), modularne strukture (uporabniške funkcije), geometrijske transformacije na slikovni ravnini digitalnega platna, delo z nizi in s seznami, z objekti in z razredi ter s funkcijami s programiranjem večpredstavnosti, kot so digitalna slika, digitalni zvok, digitalni video, digitalna animacija in interaktivnost.

Aktivnost dijakov oz. njihove učne obveznosti, ob morebitnem vključevanje drugih programskih enot, ki so bile del ocenjevanja znanja ali pogoj za ocenjevanje znanja, smo izvedli ustno in praktično. Ustno ocenjevanje je obsegalo večinoma odgovore na kontekstna vprašanja znotraj posameznih učnih sklopov modula. Praktično ocenjevanje je zajemalo praktične izdelke in rešitve avtentičnih nalog, ki so jih dijaki shranjevali v digitalno tehnično mapo projekta, kjer so poleg kontekstualne vsebine posamezno, v paru ali skupinsko beležili napredek, težave in načine reševanja zastavljenih problemov, opisali strategije za njihovo reševanje in inovacije, ki so morda pri tem nastale. Po končanem učnem sklopu so dijaki za tehnično mapo projekta prejeli oceno praktičnega izdelka.

2 METODA DELA

2.1 Izpeljava učne situacije

Eden pogosto najzahtevnejših vidikov poučevanja in učenja osnov programiranja je najti zanimive vsebine, ki niso le zabavne in navdušujoče, ampak tudi ponazarjajo obravnavano temo. V našem primeru je ta vključevala računalniško manipulacijo različnih konceptov, ki so osnovni gradniki računalniške grafike: točke, črte in oblike; teksture in barve; čas, z njim povezane spremembe osnovnih gradnikov in gibanje; reaktivnost, povezljivost in povratne informacije. Iskanje motivacije, izbira ustreznega programskega jezika, opravljanje miselnih priprav, postavljanje ciljev, dodajanje nekaterih omejitev, skiciranje podrobnosti in kodiranje generativne postopkovne grafike so bile aktivnosti, ki so determinirale vsebino omenjene učne situacije. Cilj učne situacije je bil združiti teorijo in metodologijo iz računalništva z načeli estetike in teorije vizualnih medijev, kreativno prakso, pedagoškimi pristopi iz likovne in grafične umetnosti ter vizualne kulture. Vsaka vsebinska enota je vključevala gradivo, osredotočeno na generativno umetnost in oblikovalske koncepte. Dijaki so se vključevali v koncepte tako, da so se učili iz obstoječih primerov in nato usvajali ustrezne tehnične spretnosti za izdelavo digitalne generativne postopkovne grafike, ki je prikazovala določen koncept. S tem so hkrati vadili in utrjevali bistvene koncepte, ne le v sodobni medijski generativni umetnosti, temveč tudi v računalniškem mišljenju, oblikovanju preprostih algoritmov in programiranju. Prva enota je dijakom omogočila, da so začeli razvijati svoj umetniški in oblikovalski besednjak skupaj z uvajanjem v razvojnem okolju in programsko sintakso. Druga enota je temeljila na nadgradnji ustvarjalnega besednjaka in dijakom omogočala, da so vadili svoje osnovne programerske spretnosti. Tretja enota je omogočala raziskovanje razlik med digitalno generativno umetnostjo z uporabo naključnih števil in ponavljajočih se naključnih dogajanj ter klasično zasnovanih ustvarjalnih pristopov v tovrstni grafiki. V tej enoti smo med drugim uvedli tudi uporabo matematičnih funkcij (parametrično podane krivulje), da bi dijakom omogočili ustvarjanje organskih oblik. Dijaki so nadgrajevali svoje znanje iz programiranja s tem, da so razširili nabor rabe konstruktov za nadzor normalnega toka programa pri ustvarjanju svojih umetniških del. Četrta enota je predstavljala temeljne umetniške in oblikovalske koncepte, ki so se nanašali na dojemanje informacij, pridobljenih iz svetlostnih razlik na slikovni ploskvi digitalnega platna in njegove teksture. Dijaki so nadgrajevali svoje znanje na rabi in razumevanju zank (tudi vgnezdenih), za ustvarjanje strukturalnih lastnosti nastale digitalne grafike. Peta enota je dijake seznanila z digitalno predstavitvijo slik in fotografij. Njen namen je bil spodbuditi dijake, da so s svojimi pametnimi telefoni posneli sebe ali

zanimive predmete v bližnji okolici in jih nato na kreativen način programsko spreminjati. Vključevanje ustvarjalih praks popart umetnosti so združevale ustvarjalnost s tehnologijo, hkrati pa so dijaki vadili in poglabljali razumevanje zank in seznamov. Zadnja, šesta enota, je uvedla nekaj načel animiranja spletnih animacij z namenom dijakom pomagati ustvariti prepričljivejše animacije. Uvedeni so bili nekateri naprednejši programerski koncepti, kot so objekti in razredi, ki so dijakom omogočali, da vidijo zmogljivejše podatkovne strukture v akciji.

2.2 Pedagoško-didaktične ustreznosti učne situacije

V praksi kreativnega kodiranja se algoritmična abstrakcija in slikovna konkretizacija združita v iterativni delovni proces. Algoritemsko generirana digitalna slika je zato dvoplastna, v njej se prekrivata abstraktni formalizem in konkretna vizualizacija. Abstraktni formalizem, ki izraža pravilnost semantike programskih stavkov, se v konkretni vizualizaciji kaže kot lik, oblika, forma, barva, tekstura, ritem, kontrast, gibanje itd. Nastalo razmerje med abstrakcijo v programski kodi in konkretizacijo v digitalni vizualizaciji naloge je dijakom na področju ustvarjalnosti omogočilo razumevanje artikulacije njene vsebine ter interpretacijo posamezne rešitve. Zato so vsebinske enote v uvodu vsebovale ali vsaj nakazale poti do pregleda zgodovine in prakse generativne umetnosti ter računalniške ustvarjalnosti s poudarkom na formalnih paradigmah in algoritmih, ki so se uporabljale za generiranje umetniških del generativne umetnosti, katera so dijakom ponujala priložnosti za reinterpretacijo in osebno ustvarjanje.

Pedagoško-didaktične ustreznosti omenjene učne situacije so v učnem procesu obsegale naslednje pristope: strukturirani zaporedni vsebinski moduli, različne stopnje zahtevnosti reševanja problemov, navodila za izvedbo, ki jih je bilo enostavno razumeti, potrebno minimalno branje predstavljene teorije, uporaba zanimivih in ustreznih primerov, možnost takojšnje povratne informacije, učenje v ritmu z lastnim tempom in daljinsko spremljanje dela dijakov, individualno delo.

Takšen način poučevanja zahteva uvedbo daljših in krajših projektnih nalog ter njihov nadzor.

2.3 Kreativno kodiranje v konceptu splošne medijske umetnosti

Splošna medijska umetnost v srednješolskem izobraževanju je relativno nova pot v raziskovanju rabe programiranja za ustvarjalno izražanje v digitalnem mediju. Vsestranskost kreativnega kodiranja medijskemu tehniku med drugim omogoča ustvarjanje izraznih del digitalne umetnosti. Učenje programskih jezikov kreativnega kodiranja je bistvenega pomena za izražanje v digitalnih medijih, ki ima vse večji pomen za mladino in družbo na splošno, saj smo skozi pridobljeno prakso znotraj programske enote ugotovili, da ne gre samo za pasivni ogled ali predvajanje digitalnih medijev, temveč tudi za konstruktivno izkušnjo, s pomočjo katere je mogoče vzpostaviti povezave z umetnostjo.

Kreativno kodiranje je zelo interdisciplinarno zasnovano področje, ki združuje osnove računalništva z estetskimi načeli in kreativnimi praksami iz umetnosti in oblikovanja. Dijaki so se s pomočjo programskega jezika p5.js urili v računalniškem mišljenju, povrh pa so ustvarili digitalni portfelj estetsko zasnovanih generativnih vizualizacij, ki so vključevale osnovne koncepte in konstrukte programiranja, povezane z likovno kompozicijo in načeli likovnega reda. Cilj takšnega pristopa je bil prinesti navdušenje, ustvarjalnost in inovacije, ki jih spodbuja kontekst kreativnega kodiranja.

2.4 Programski jezik p5.js ter spletni učni okolji editor.p5js in peblio.co

Relativna enostavnost učenja programskih jezikov na področju digitalne generativne vizualizacije, med katere nedvomno sodi p5.js, omogoča dostopnost besedilnega kodiranja v različnih disciplinah medijske produkcije. p5.js je JavaScript knjižnica s široko paleto dodatnih programskih grafičnih knjižnic, ki v svojem jedru ponuja preprost API (vmesnik za namensko programiranje) za izrisovanje v strukturnem elementu <canvas> spletnega standarda HTML 5. Element <canvas> si lahko predstavljamo kot digitalno slikarsko platno spletnih razvijalcev, ki omogoča prikazovanje dvorazsežne računalniške grafike, izdelovanje spletnih animacij ter vključevanje zvočnih in video vsebin, s čimer je zagotovljena večpredstavnostna funkcionalnost. Sintaksa med JavaScriptom in p5.js je identična, toda p5.js doda abstrakcije za grafiko in interaktivnost. Dijakom omogoča, da se po nekaj zaporednih vrsticah hitro potopijo v programiranje, ki ustvarja sprotne vizualne rezultate. Zaradi razmeroma nizke krivulje učenja pomaga motivirati za nadaljnje učenje jezika. Poleg tega p5.js pomaga dijakom bolje razumevati in razvijati nekatere logične spretnosti, povezane s programiranjem, ne da bi od njih zahtevali, da razvijejo toliko tehničnega znanja kot mnogi drugi programski jeziki. Tak način razmišljanja je dijakom dragocena kompetenca za ustvarjalni razvoj. Če združimo vse našteto skupaj, lahko dijaki razmeroma hitro in enostavno uporabijo programski jezik p5.js z namenom razvijati kreativne in inovativne projekte, povezane z medijskimi študijami, ki ponujajo mešanico teorije in prakse. Osnovni pristop v razvoju urejevalnika namreč temelji na ideji o skiciranju. Tako kot je skiciranje mogoče razumeti kot minimalen pristop k risanju z namenom hitrega oblikovanja neke ideje, je tudi jedro p5.js zasnovano na konceptu pisanja minimalne količine kode, s katero svoje vizualne, interakcijske ali animacijske ideje prenesemo na zaslon.

Potrebe po namestitvi posebnega integriranega razvojnega okolja IDE ni, saj p5.js premore precej dober in popoln spletni urejevalnik, ki se nahaja na spletnem naslovu editor.p5js.org (Slika 1). Ob ustreznem vpisu in kasnejših prijavah v samem spletišču so dijaki pisali in poganjali izvorno kodo v lastnem spletnem brskalniku, jo ustrezno shranjevali v programskih skicirkah, ki so jih glede na vsebino učne enote združevali v zbirke, za povrh pa so zraven lahko naložili še slikovne datoteke, seveda v omejeni velikosti. Osnovni funkciji, ki tvorita pomensko strukturo programske skicirke, v katerima opišemo določene postopke brez vračanja rezultatov, sta funkciji setup() in draw() (Slika 2a). p5.js ti funkciji kliče v določenem zaporedju. Funkcijo setup() postavimo na začetek naše programske kode in se zažene samo enkrat na začetku programa. V njej inicializiramo začetno grafično stanje svojega ustvarjalnega okolja v programski skicirki. Funkcija draw() se prikliče neposredno po izvedbi funkciji *setup()* in vsa koda v njeni notranjosti se neprestano izvaja (privzeto 60-krat na sekundo), dokler se izvajanje programa ne ustavi (npr. z uporabo ukazov *exit()* ali *noLoop()*) .
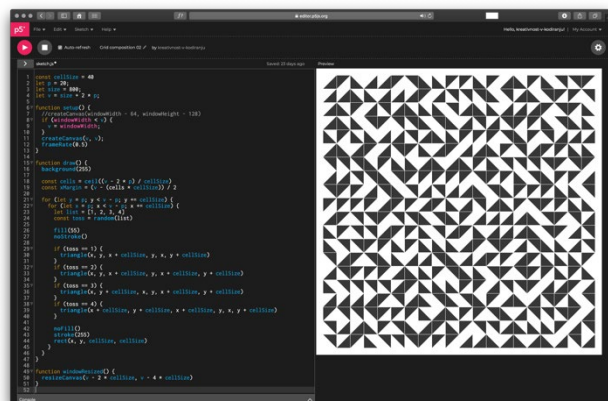
Slika 1: p5.js spletni urejevalnik, dostopen na naslovu editor.p5js.org

Poleg osnovnih strukturnih funkcij *setup()* in *draw()* se velikokrat uporablja funkcijo *preload()*. Ta priročna funkcija zagotavlja, da se digitalne slike ali drugi zunanji podatkovni objekti, končajo z nalaganjem v programski skicirki, preden se pokličeta funkciji *setup()* in *draw()* (Slika 2b).

(a)   **(b)**
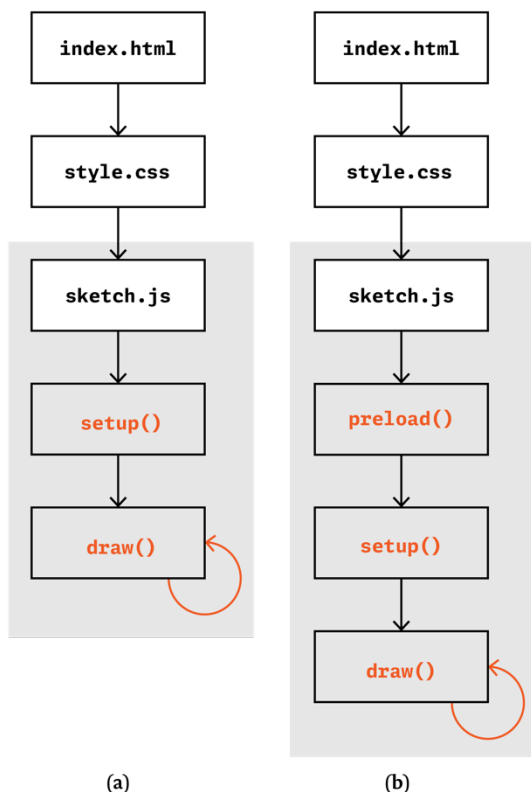
Slika 2: Diagram poteka izvajanja kode v programski skicirki p5.js brez prednaloženih zunanjih podatkovnih objektov (a) in s prednaloženimi (b). Za pomensko strukturo in oblikovani izgled vizualizacije vsebine programske skicirke v spletnem urejevalniku skrbita vnaprej vzpostavljeni datoteki *index.html* in *style.css*.

Spremenljivke so deklarirane s ključnima besedama *var* ali *let*. Obseg spremenljivk, deklariranih z *var* je globalni ali funkcijski, medtem ko je obseg spremenljivk, deklariranih z let, lokalni.

Ustrezni nabor 2D grafičnih geometrijskih primitivov z natančno semantično opredelitvijo (točka, črte (daljice in krivulje), nekateri liki (trikotniki, štirikotniki in elipse)) nudi ustrezno grafično okolje s potrebnimi funkcionalnostmi za ustvarjanje v spletnem brskalniku.

Poglobljeno spoznavanje lastnosti in zmogljivosti programskih gradnikov ter njihovo uspešno aplikacijo za ustvarjanje digitalne generativne postopkovne grafike so dijaki pridobivali na izvornem spletnem naslovu https://p5js.org.

Različne spletne učne platforme, podprte z multimedijskimi gradniki in interaktivnimi nalogami dijakom omogočajo uporabo različnih oblik in metod za predstavitev kvalitativnih in deloma kvantitativnih podatkov, pa tudi zaključkov ob ustreznih rešitvah. V našem primeru smo dijakom ustvarili prilagodljivo spletno učno okolje Peblio (Slika 3), dosegljivem na spletnem naslovu https://www.peblio.co, v katerem so ustvarjali v svojem tempu in imeli dovolj časa za učenje. Izbrali smo večpredstavnostna gradiva, ki spodbujajo pridobivanje in utrjevanja znanja. Z digitalnimi orodji smo ustvarili interaktivne učne enote, združljivimi za delo v vseh operacijskih platformah in spletnih brskalnikih.
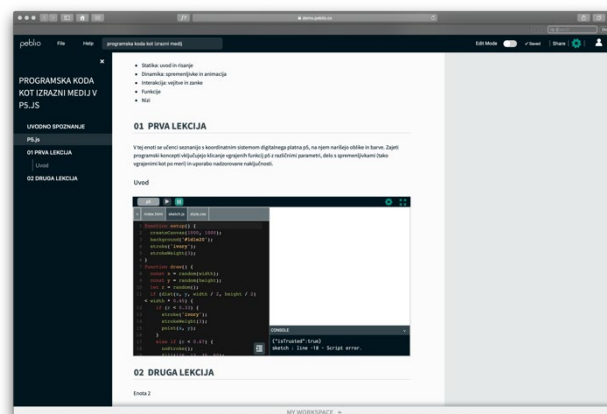
Slika 3: Spletno učno okolje Peblio

Sprotno ustvarjanje in organiziranje predavanj, vaj in nalog, učinkovito posredovanje povratnih informacij in preprosto komunikacijo z dijaki smo dosegli na dva načina: z uporabo učnega okolja Googleove učilnice in s skupno rabo povezav znotraj omenjenega učnega okolja Peblio. Pri uporabi Googleove učilnice se je posamezni razred prijavil z ustreznim računom, interaktivne učne liste pa smo delili neposredno razredu s pritiskom na ustrezni gumb.

Enako dinamiko smo lahko dosegli z deljenjem povezav naprej in nazaj. Kopirali smo povezavo do shranjenega interaktivnega učnega lista in jo delili po e-pošti ali znotraj uporabljenih komunikacijskih kanalov. Prek deljene povezave so dijaki dostopali do interaktivnih učnih listov, ki so vsebovali izvlečke predavanj, demonstracijskih vaj in kreativnih nalog. Ko so opravili tedensko določene naloge, so jih lahko odložili v učne liste in nam nazaj delili svoje povezave.

Podrobnejša navodila za delo v predstavljenem spletnem okolju se nahajajo na spletnem naslovu https://demo.peblio.co/.

3 REZULTATI IMPLEMENTACIJE POVEZOVALNIH KONCEPTOV

Za usvajanje računalniškega mišljenja smo dijakom pripravili podlago za didaktične aktivnosti, prek katerih so usvojili osnovne programerske koncepte. Obseg in zaporedje v učni situaciji uporabljenih programerskih konceptov so determinirali vrstni red predstavljenih tehnik kreativnega kodiranja (Tabela 1). Vsebinske in tehnične prilagodljivosti znotraj posameznih učnih enot so dijakom omogočale, da so svoje ustvarjalne spretnosti usmerili v sestavljanje tako preprostih kot zapletenih računalniških programov v ustvarjanju digitalne generativne postopkovne grafike. Cilj, ki smo si ga zadali doseči, je obsegal tri stopnje: najprej smo dijakom predstavili osnove besedilnega programiranja in računalniškega mišljenja skozi učenje predstavljenega programskega jezika; nato smo izpostavili scenarije, kje in kdaj je mogoče kodiranje uporabiti za skiciranje konceptualnih idej in razvoja delujočih prototipov programske kode, ki se osredotočajo na izrazne medije; na koncu smo dijake spodbujali, da so razumeli etiko odprte kode z uporabo kode, ki je na voljo na spletu, in s sprostitvijo in dokumentiranjem svojega projekta z istim pristopom.

Tabela 1: Povezovalni koncepti računalniškega mišljenja z likovno vizualizacijo

Osnovni programerski koncepti	Tehnike kreativnega kodiranja
Osnove programiranja v izbranem programskem jeziku / okolju	Vgrajene funkcije risanja, osnovni liki (grafični primitivi), koordinatni sistemi, načela kreativnega kodiranja
Spremenljivke, podatkovni tipi, izrazi, stavki	Risanje v ustreznem merilu, sorazmernost razdalj med grafičnimi primitivi
Interakcije, ustvarjene s klikom na miško	Liki in oblike, grafično ustvarjene z miško
Krmilne strukture in vejitve	Uporaba preprostih iteracij za izrisovanje velikega števila različnih likov in grafičnih oblik, uporaba pogojnih stavkov v preprostih simulacijah, rekurzija
Modularnost: pisanje funkcij, z vsebovanimi krmilnimi strukturami in generatorji naključnih števil	Izrisovanje parametrično podanih grafičnih oblik:lega, velikost, barva obrobe in polnila itd., naključno ustvarjene kompozicije na digitalnem platnu
Seznami in nizi	Kompleksnejše strukturne likovne kompozicije z mnogo različnimi oblikami (predmeti), shranjenimi v seznamih
Uporaba matematičnih konceptov: kotne funkcije, geometrijske transformacije na ravnini	Kompleksnejše abstraktno / geometrijsko oblikovanje, strukturne likovne kompozicije pravilnih
	večkotnikov in črt (daljic), ustvarjalna estetika

Rezultati preverjanja in ocenjevanja implementacije povezovalnih konceptov skozi ustvarjene digitalne portfelje estetsko zasnovanih generativnih vizualizacij so pri 92 dijakih iz populacije 136 dijakov (celotni tretji letnik na smeri medijski tehnik) pokazali doseganje sposobnosti za reševanje kompleksnejših in zahtevnejših kreativnih nalog, doseganje višjih ravni znanja, pridobivanje sposobnosti za povezovanje znanj z različnih strokovnih področij, razvijanje računalniškega mišljenja in ustvarjalnosti. Preostali dijaki so delno (tudi naključno) izpolnili zahteve po izdelavi kreativnih nalog in digitalnega portfelja; najpogostejši navedeni vzrok je bil slabša internetna povezava ter zato posledično neaktivna udeležba na videokonferenčnih prenosih predavanj in nepravočasna oddaja izdelkov v pregled, zato smo pri njih iskali doseganje minimalnih standardov znanja.

Predstavljeni sliki (Slika 4 in Slika 5) prikazujeta primere rabe različnih povezovalnih konceptov v ustvarjanju digitalne generativne postopkovne grafike in sodijo v digitalni portfelj dijaških izdelkov.
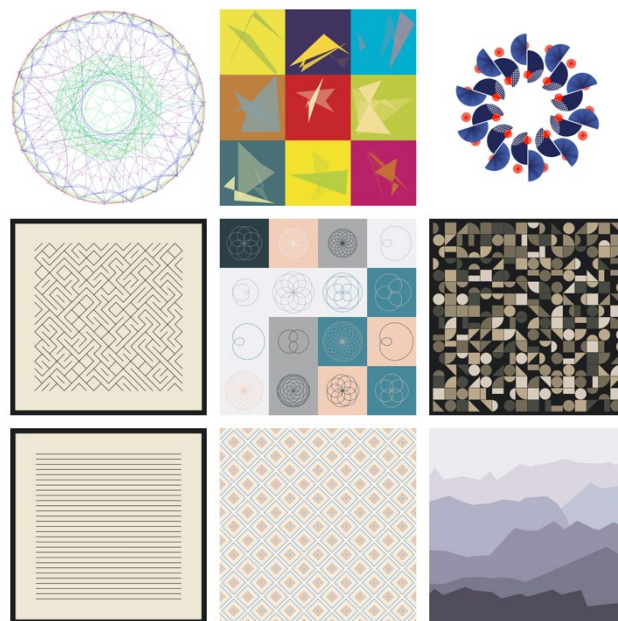
Slika 4: Raba preprostejših povezovalnih konceptov
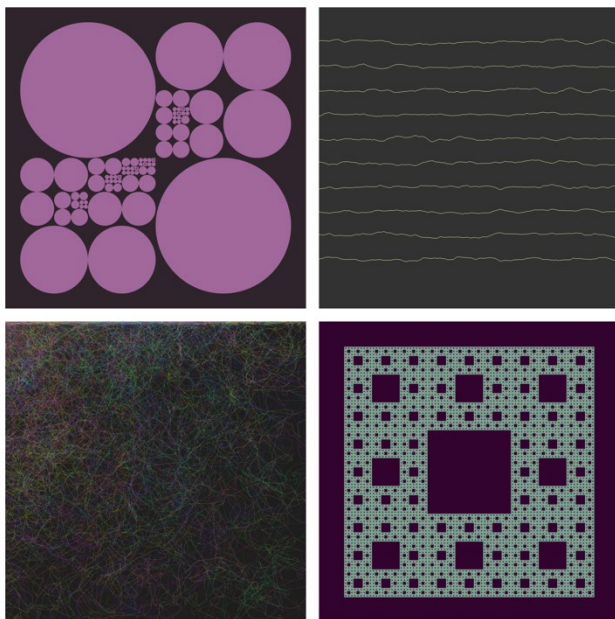
Slika 5: Raba zahtevnejših povezovalnih konceptov

4 ZAKLJUČEK

V prispevku smo predstavili dejavnosti v okviru izpeljave učne situacije, namenjene poučevanju medijskih tehnikov osnov besedilnega programiranja v programski knjižnici in naboru orodij p5.js, ki olajšajo uporabo programskega jezika JavaScript za kreativno kodiranje. Dijaki so skozi učne aktivnosti utrjevali način postopkovnega mišljenja, se sporazumevali o kodiranju in ga usvajali v okviru svojih ustvarjalnih delovnih procesov.

Poleg tega so dijaki ponovili, kako lahko strukturni elementi HTML in slogovni elementi CSS komunicirajo s p5.js, da v celoti izkoristijo razvoj vsebine za brskalnik.

Učna situacija se je opirala na izbiro tehnologije, ki je dijakom pomagala ublažiti krivuljo učenja z zagotavljanjem sprotnih vizualnih povratnih informacij. Učne vsebine smo posredovali prek videkonferenčnih prenosov znotraj predstavljenih spletnih okolij v obliki demonstracij in projektnih srečanj. Dijaki so lahko preizkušali in eksperimentirali z usvojenimi pojmi v tedenskih nalogah in v zaključni skupinski (predvsem v paru) predstavitvi, ki je nudila prostor za kreativno izražanje, raziskovanje in nadaljnje učenje.

Predavanja v obliki demonstracij so bila strukturirana tako, da so čim bolj spodbujala interakcijo. Kodiranje v "živo" in praktični prikazi naj bi v dijakih vzbujali dvome in radovednosti glede tematske vsebine predavanja. Dijaki so tako lahko znotraj spletnega učnega okolja hitro preskusili svoje ideje, in posegali po pomoči učitelja, če niso razumeli določenih konceptov.

Predstavljene študije primerov, ki so prikazovale kreativno rabo kode kot izraznega medija, so postale navdih za kasnejše ustvarjalno vzdušje. Poleg uvedbe programske kode v procesu ustvarjanja digitalne generativne postopkovne grafike in premagovanja tehničnih izzivov se z raziskovanjem individualnih in projektov v paru zdi samoumevno, da je kreativno kodiranje povzročilo večjo ustvarjalnost dijakov glede na doseženo stopnjo izvirnosti pri vsakem praktičnem izdelku.

Iz navedenega je razvidno, da je bil obseg učne situacije v svoji ponovljivosti prilagodljiv in razširljiv: učitelji smo lahko skrajšali ali razširili vsebinsko strukturo odprtega kurikula glede na posebne okoliščine in s tematsko izbranimi vsebinami izpolnjevali njegove splošne cilje – uporabo kreativnega kodiranja v procesu reševanja problemov, oprtih na izrazne zmožnosti sodobne medijske umetnosti.

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E-učenje na dokazih podprte zdravstvene nege

E-learning for evidence based nursing

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POVZETEK

Znanstveni dokazi so zlato pravilo v primeru intervencij, ki jih izvajajo medicinske sestre, vendar pa medicinske sestre niso vedno usposobljene in vajene dela na osnovi raziskovalnih dokazov. Mednarodni izobraževalni programi s področja zdravstvene nege, še posebej v trenutni situaciji, zahtevajo implementacijo v spletnem okolju. Platforme za spletno izobraževanje s svojimi raznolikimi aktivnostmi učinkovito podpirajo učenje na dokazih podprte zdravstvene nege. V prispevku predstavljamo prototip spletne učilnice na platformi Moodle, ki je nastala v okviru projekta ProCare financiranega s strani Evropske komisije. Spletna učilnica vključuje različne interaktivne vsebine in aktivnosti. Poleg osnovnih aktivnosti, ki jih ponuja Moodle, so dodane tudi aktivnosti, ki jih omogočata vtičnika BigBlueButton in H5P. Na osnovi prikazanega prototipa se izvajalci tečaja lažje odločajo o najprimernejšem načinu za prikaz posamezne tematike. V nadaljevanju nameravamo v spletno učilnico vključiti tudi koncept igrifikacije, ki udeležence izobraževanj dodatno motivira, ter možnost dostopa do virtualnega namizja s statističnimi orodji.

KLJUČNE BESEDE

Na dokazih podprta zdravstvena nega, e-učenje, zdravstvena nega, projekt ProCare

ABSTRACT

Scientific evidences are intended to be the gold standard for nursing professional interventions, although nurses worldwide are not always trained and accustomed to working on the basis of this research evidence. International nursing education programs, especially in the current situation, require implementation in an online environment. Online education platforms effectively support evidence-based nursing through the diversity of online activities. In this paper we present the prototype of an online classroom on the Moodle platform, which was developed within the ProCare project funded by European Comission. The online classroom comprises a variety of interactive content and activities for the implementation of evidence-based nursing education. In addition to the basic activities offered by Moodle, there are also activities made possible by the BigBlueButton extension and the H5P plugin. Based on the prototype presented, it will be easier for course providers to choose the most appropriate way of presenting an individual topic. For the future we plan to expand the online classroom with the concept of gamification, which will provide additional motivation of the participants and the possibility of accessing the virtual desktop with statistical tools.

KEYWORDS

Evidence based nursing, e-learning, nursing, ProCare project

1 UVOD

Izobraževanje na vseh področjih je vedno bolj prisotno na spletu. Različne prosto dostopne spletne platforme kot tudi specifične interne spletne učilnice ponujajo raznolik nabor predstavitev, aktivnosti in možnosti izmenjave mnenj sodelujočih v procesu izobraževanja. Na podoben način kot ostala področja, se razvija tudi podiplomski študij zdravstvene nege. V poročilu s srečanja Sekcije za informatiko v zdravstveni negi [1] je podan tudi sklep, da se mora e-izobraževanje uveljaviti kot oblika formalnega, vseživljenjskega in samoizobraževanja medicinskih sester.

Predhodne raziskave kažejo, da je e-učenje na področju informacijskih sistemov s pomočjo spletne učilnice in videokonferenčnega sistema enako učinkovit način učenja kot klasična avditorna predavanja [2]. Podobno kot študij informacijskih sistemov, tudi področje študija zdravstvene nege zahteva zbiranje, predstavitev, vizualizacijo in interpretacijo podatkov. Vse to vodi v prakso, ki temelji na dokazih. Na dokazih podprta zdravstvena nega je proces, v katerem medicinska sestra pri obravnavi pacienta sledi petim korakom: 1. postavitev pravega vprašanja; 2. iskanje najboljših dokazov za odgovor na vprašanje; 3. evalvacija dokazov; 4. implementacija izbranih dokazov v klinično prakso, ki vključuje predhodno proučene potrebe in pričakovanja pacientov in 5. evalvacija učinkovitosti uporabe na dokazih podprte prakse. Poleg 5-ih korakov uporabi tudi svoje strokovno znanje, da zagotovi optimalno zdravstveno oskrbo za pacienta [3].

Uporaba e-izobraževanja na področju zdravstvene nege še vedno predstavlja izziv zaradi vrzeli v poznavanju metodologij in uporabe programskih rešitev. Kot navajajo Rohwer et al. [4] učenje na dokazih podprte medicine lahko uspešno nadgradimo z vključevanjem e-učenja, pri čemer se je kot posebej učinkovito izkazala kombinacija klasičnega in e-učenja. Pozivajo tudi, da se na tem področju izvede več raziskav, ki bi bolj specifično pokazale, katera komponent e-učenja je bolj učinkovita. Različne kombinacije klasičnega in e-učenja so se izkazale kot učinkovite za učenje na dokazih podprte zdravstvene nege. Chu et al. [5] opisujejo primer obrnjenega učenja (ang. flipped learning), Oh in Yang [6] pa primer mešanega učenja (ang. blended learning).

V okviru projekta ProCare (Hospitals and faculties together for prosperous and scientific based healthcare) smo za e-učenje na dokazih podprte zdravstvene nege izbrali spletno platformo Moodle [7], v kateri nastaja spletna učilnica. Za lažjo izbiro primernih oblik e-izobraževanja prikazujemo nekaj naprednih, inovativnih možnosti, ki jih ponuja platforma Moodle in njeni vtičniki.

2 E-IZOBRAŽEVANJE

Tudi na področju zdravstvene nege so študenti psihološko pripravljeni na e-izobraževanje [8], čeprav nekateri avtorji menijo, da je učinkovitost e-izobraževanja na področju zdravstvene nege odvisna od različnih dejavnikov [9]. E-izobraževanje se izkaže še posebej uporabno v kombinaciji s klasičnim načinom poučevanja [10]. Čeprav pred leti študenti zdravstvene nege v Sloveniji niso bili naklonjeni e-izobraževanju [11], pa se z leti nivo informacijske pismenosti viša in tako tudi v slovenskem okolju najdemo nekaj primerov e-izobraževanja na področju zdravstvene nege. Kot del uvajalnega seminarja za zaposlene v zdravstveni ustanovi [12] predstavljajo projekt v

okviru katerega so pripravili nekaj izobraževalnih vsebin v obliki spletnih tečajev.

V nadaljevanju prispevka predstavljamo nekaj inovativnih pristopov, ki jih je mogoče uporabiti kot metodo za učenje na dokazih podprte zdravstvene nege.

2.1 Skupnost praks

Koncept skupnosti praks (ang. Community of Practice) se uveljavlja tudi na področju zdravstva. Skupnost praks je skupina ljudi, ki si izmenjujejo mnenja o določenih tematikah in idejah na ta način krepijo svoje izkušnje [13]. Kot navaja [14] lahko skupnost praks pomaga tako pedagogom kot študentom pri kompleksnem izobraževanju s področja zdravstva. Skupnosti sestavljajo učitelji in študenti. V nekaterih primerih e-izobraževanja se formirajo tudi virtualne skupnosti praks, v okviru katerih se razprave in izmenjave izkušenj na določenem področju izmenjujejo v spletnem okolju. Tovrstne skupnosti se že oblikujejo in funkcionirajo, kot na primer skupnost v okviru projekta Palliare [15].

2.2 Bralni klub

Srečanja bralnih klubov (ang. Journal Club) so se tradicionalno odvijala znotraj akademskih ali zdravstvenih ustanov, danes pa se v vedno večji meri selijo na splet in družbena omrežja [16]. Srečanja, na katerih se razpravlja o novejši znanstveni literaturi, imajo dva osnovna cilja: spodbujati kritično razmišljanje in širiti nova odkritja [17] in kot taka predstavljajo osnovno z dokazi podprtega izobraževanja v zdravstvu [18].

2.3 MOOC

Množičnih odprti spletni tečaj (ang. Massive Open Online Course – MOOC) je koncept izobraževanja, ki omogoča načeloma neomejen dostop in udeležbo na tečaju preko spleta. Poleg klasičnih vsebin tečajev, MOOC omogoča tudi interakcijo udeleženca izobraževanja pri različnih aktivnostih kot so forumi, razprave na družbenih omrežjih, ter s tem spodbuja razpravo med udeleženci tečaja, pedagogi in ustvarjalci vsebin tečaja. Uporaba MOOC se je v zadnjem času razširila tudi na področju zdravstva [12]. Izkušnje izobraževalnih ustanov s področja zdravstva kažejo, da MOOC predstavlja nadgradnjo in dopolnitev obstoječega izobraževalnega sistema [19].

2,4 Interaktivne vsebine

V okviru spletnega izobraževanja, tudi v obliki MOOC se kot posebej pomemben element pokažejo interaktivne vsebine. Gre za način predstavitve tematike, pri katerem lahko udeleženci izobraževanja aktivno sodelujejo tako, da se pomikajo po predstavitvah, odpirajo dodatne informativne vsebine, izbirajo pravilne rešitve s pomočjo odločitvenih dreves, sproti preverjajo svoje znanje s kvizi in podobno. Kot navaja [20], uporaba interaktivnih elementov pri e-izobraževanju s področja zdravstva spodbuja učenje. Čeprav prve raziskave na področju izobraževanja v zdravstvu zaenkrat še ne kažejo pozitivnih izkušenj z uporabo virtualne resničnosti [21], pa je uporaba krajših izobraževalnih videoposnetkov izkazala kot zelo uporabno [22].

2.5 Igrifikacija

Igrifikacija (ang. Gamification) je uporaba elementov in postopkov igre v izobraževalne namene. Udeleženci izobraževanja s pomočjo elementov igre rešujejo različne probleme. Igrifikacija ima velik vpliv na uspeh spletnega izobraževanja posameznika [23], zato se poskusi uporabe igrifikacije pojavljajo tudi na področju izobraževanja v zdravstvu [24]. Kot po pregledu uporabe principov igrifikacije v visokošolskem izobraževanju ugotavlja, lahko pravilna uporaba igrifikacije motivira študente k učenju [25] ter hkrati poveča študentov učni uspeh, tehnične in vedenjske veščine [26].

3 METODOLOGIJA

Pred pripravo vsebin oziroma prototipa spletne učilnice za podporo učenja na dokazih podprte zdravstvene nege, smo izbrali spletno platformo Moodle, v okviru katere bo potekalo izobraževanje [7]. Platforma Moodle že v osnovi ponuja nekaj aktivnosti, ki poleg prikaza vsebin vključujejo tudi sodelovanje udeležencev izobraževanja (forum, klepet, oddaja naloge, virtualna knjiga, kviz ipd.) in tako omogoča izvedbo nekaterih naprednejših oblik e-izobraževanja. Če želimo izgled spletne učilnice pripraviti na bolj atraktiven način, pa uporabljamo različne razširitve oziroma vtičnike.

Zelo dobrodošlo razširitev predstavlja videokonferenčni sistem BigBlueButton [27], ki ga lahko vgradimo v spletno učilnico in omogočimo virtualno druženje udeležencev izobraževanja. Vtičnik H5P [28] lahko uporabimo za pripravo še bolj atraktivnih in interaktivnih aktivnosti [29]. Tako lahko v spletno učilnico vključimo na primer časovni trak za zgodovinski pregled razvoja posameznega področja, odločitveno drevo, ki udeležencu pomaga pri izbiri ustrezne metode dela, stolpce s sprotnim preverjanjem znanja, zvočne in videoposnetke, pa tudi virtualne oglede in še mnoge druge aktivnosti.

4 PRIMERI NA DOKAZIH PODPRTEGA UČENJA ZDRAVSTVENE NEGE

Spletne učilnice postajajo vse pogosteje tudi del izobraževalnega procesa na področju zdravstva in zdravstvene nege. Pri razvoju spletnih učilnic pa zaradi specifike poznavanja tehnologije pogosto poleg pedagoškega osebja sodeluje tudi tehnično osebje. Pedagoško osebje prispeva vsebine, ter ideje kako predstaviti posamezno temo, tehnično osebje pa pomaga pri sami implementaciji ideje v spletni učilnici. V okviru projekta ProCare smo za lažje odločanje pedagogov o uporabi različnih aktivnosti v okviru na dokazih podprtega učenja zdravstvene nege, pripravili nekaj predlogov aktivnosti, ki jih lahko uporabijo za predstavitev vsebin.

4.1 Videokonferenčni sistem BBB

Razširitev platforme Moodle z vtičnikom BigBlueButton (BBB), ki omogoča izvedbo videokonferenčnih sestankov ali predavanj, predstavlja osnovo e-izobraževanja, saj omogoča enostavnejšo komunikacijo med udeleženci izobraževalnega procesa. Videokonferenčni sistem BBB je enostaven za uporabo, saj je podoben ostalim sistemom, ki jih je svet dodobra spoznal v času izobraževanja in dela od doma zaradi COVID-19. Na sliki 1 je predstavljeno osnovno okno videokonferenčnega sistema, ki je vgrajen v spletno učilnico. Pred uporabo vodja izobraževanja

nastavi uro, ko je mogoče dostopati do sistema. Dostopne pravice imajo vsi udeleženci izobraževanja, ki se lahko prijavijo na platformo Moodle. Ena od možnosti za izmenjavo mnenj in izkušenj v okviru videokonferenčnega sistema so tudi skupni zapiski (ang. Shared notes). Skupne zapiske lahko uporabimo za simultano pripravo dokumenta, pri katerem sodelujejo vsi udeleženci sestanka.

Slika 1. Videokonferenčni sistem BigBlueButton

4.2 Skupnost praks

Ideja o skupnosti praks na področju zdravstvene nege ni nova, saj se že dlje časa uporablja v zdravstvenih ustanovah. Novost predstavlja skupnost praks v spletni učilnici. Kot primer skupnosti praks v spletni obliki, smo v testni učilnici pripravili forum. Posebna tema »Welcome – new members« je namenjena kratkim predstavitvam vsakega od udeležencev izobraževanja, kar predstavlja izhodišče za lažjo komunikacijo v spletnem okolju. Ostale teme moderator dodaja glede na predloge udeležencev v procesu izobraževanja. Slika 2 prikazuje vstopno stran v forum z najpogosteje porabljeno temo »Resources«, kjer udeleženci objavljajo povezave do virov in raziskav s področja zdravstvene nege.
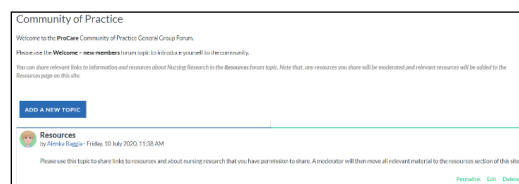
Slika 2. Skupnost praks v spletni učilnici

4.3 Bralni klub

Zanimiva aktivnost za podporo obrnjenega učenja (ang. flipped learning) je bralni klub. Bralni klubi v obliki fizičnega druženja so stalna praksa pri študiju zdravstvene nege. Bralni klubi kot aktivnost v spletni učilnici pa predstavljajo svojevrstno novost. V prototipu spletne učilnice so predstavljene 3 možnosti za izvedbo bralnega kluba, ki omogočajo različne načine interakcije (slika 3):

- Spletni klepet v živo

- Razprava preko videokonferenčnega sistema

- Razprava v obliki foruma

Poleg predlogov za izvedbo sestanka bralnega kluba, je potrebno v spletno učilnico vključiti tudi ocenjevalni list, na katerem udeleženci bralnega kluba kritično ocenijo prispevek, o katerem teče beseda. Ena od možnosti za implementacijo zbirke mnenj, ki jo lahko vidijo vsi udeleženci izobraževanja je aktivnost baza podatkov. V primeru, da sestanek poteka preko

videokonferenčnega sistema, pa udeleženci mnenja o prispevku lahko delijo tudi preko skupnih zapiskov.
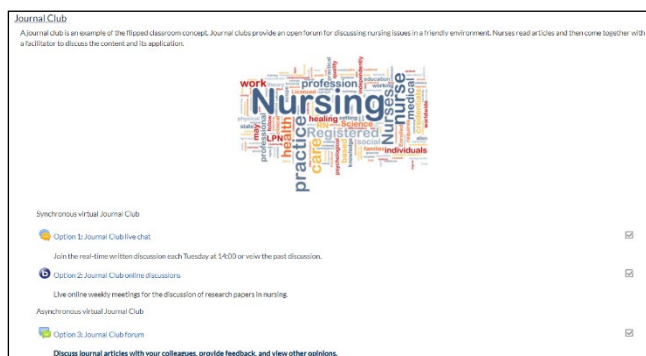
Slika 3. Možnosti izvedbe sestankov bralnega kluba

4.4 MOOC

Odprti spletni tečaji so načeloma prosto dostopni in je za vstop potrebna samo registracija. Vsebine MOOC med drugim vključujejo povezave na družbena omrežja in javno dostopne vire informacij, do katerih lahko dostopajo udeleženci tečaja. Na sliki 4 je prikazan primer povezave na MOOC druge izobraževalne institucije, ki se enostavno vključi v spletno učilnico.
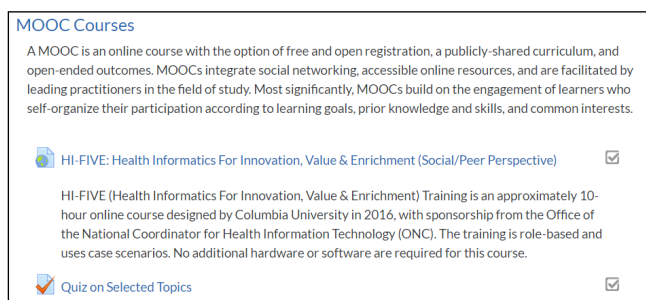
Slika 4. Povezava do zunanjega MOOC-a

4.5 Interaktivne vsebine

Pri pripravi interaktivnih vsebin v okviru platforme Moodle lahko izbiramo med vsebinami, ki jih ponuja sama platforma, ali pa dodamo vtičnike za naprednejše aktivnosti. Lekcija omogoča, da pripravimo razvejano vsebino z različnimi dodatki in možnostjo prehajanja med posameznimi vsebinami. Ker je eno od ključnih področij za uspešno raziskovanje na področju zdravstvene nege tudi poznavanje raziskovalnih baz, smo kot lekcijo pripravili uvod ter navodila za uporabo raziskovalnih baz, kot prikazuje slika 5.

Slika 5. Lekcija za predstavitev raziskovalnih baz

Del izobraževalne vsebine v prototipni rešitvi smo prikazali kot e-knjigo, v katero je mogoče vključiti tudi zunanjo vsebino, na primer videoposnetek, kot prikazuje slika 6.

Slika 6. E-knjiga

Podobno kot v e-knjigi lahko vsebine na interaktiven način predstavimo tudi v aktivnostjo »Course presentation«, ki jo ponuja vtičnik H5P. »Course presentation« omgoča še več sodelovanja udeleženca izobraževanja, saj vsebino lahko dopolnimo tudi s sprotnim preverjanjem znanja, na primer na karticah z vprašanji in odgovori, ali s trditvami in primeri kot prikazujeta sliki 7 in 8.
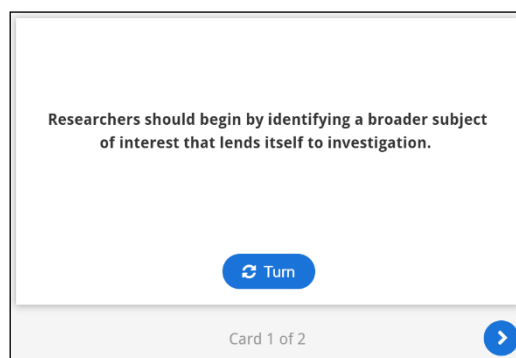
Slika 7. Trditev na kartici

For example, a researcher may be interested in childhood obesity.

⟳ Turn

Card 1 of 2
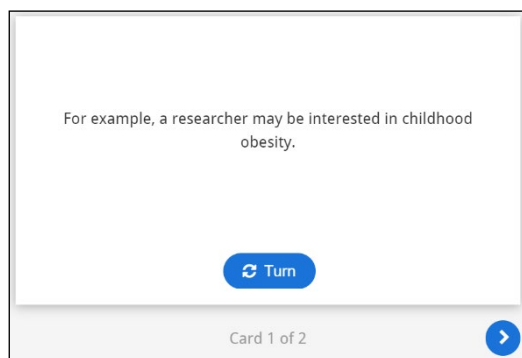
Slika 8. Primer povezan s trditvijo

Zanimiv primer nadgradnje e-knjige v »Course presentation« aktivnost je tudi dodajanje preverjanja znanja znotraj multimedijske predstavitve, kot lahko vidimo pri vprašanju, ki se pojavi znotraj posnetka na sliki 9.
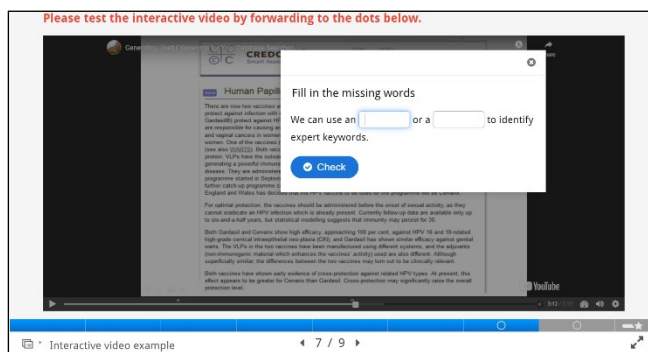
Slika 9. Preverjanje znanja med predvajanjem posnetka

Zgodovino razvoja posameznega področja lahko na zelo pregleden način predstavimo s časovnim trakom H5P. V časovni trak lahko vključimo povezave in fotografije (slika 10).

Slika 10. Časovni trak razvoja zdravstvene nege

V okviru zdravstvene nege izvajamo tudi različne raziskave, pri katerih za analizo zbranih podatkov uporabljamo statistične metode. Udeležencem izobraževanja lahko pomagamo tako, s pripravo odločitvenega drevesa za izbor prave statistične metode (slika 11). Vprašanja povezana z vzorcem in njegovimi značilnostmi (slika 12) ter odgovori uporabnika pripeljejo do izbora najustreznejše statistične metode (slika 13).

Slika 11. Odločitveno drevo za izbor statistične metode
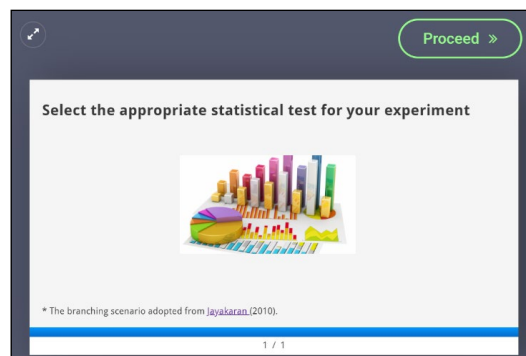
Slika 12. Začetni ekran vodiča za izbor statistične metode
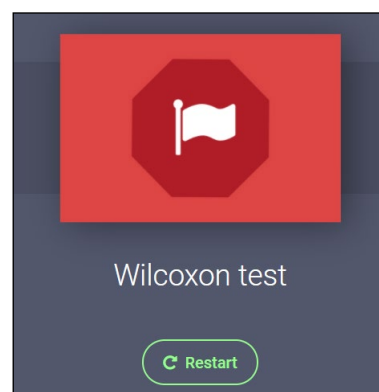
Slika 13. Končni ekran vodiča za izbor statistične metode

Eno od zanimivih možnosti v spletni učilnici predstavlja tudi slovar novih izrazov, pri čemer lahko vsebino lahko dopolnjujejo vsi udeleženci izobraževanja (slika 14).
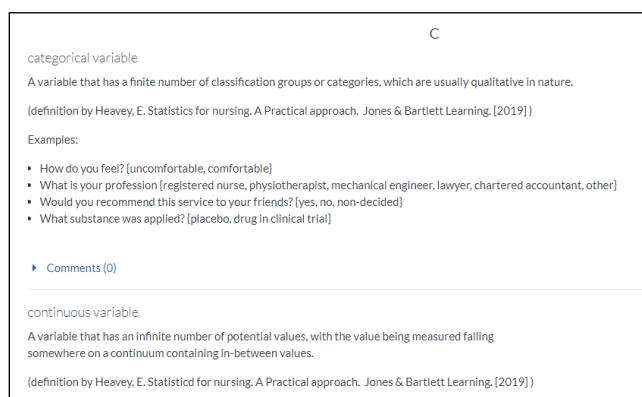
Slika 14. Slovar novih izrazov

5 ZAKLJUČEK

V prispevku prikazujemo predlog uporabe spletne učilnice za učenje na dokazih podprte zdravstvene nege. Za razvoj prototipa je bila uporabljena platforma Moodle, z vtičnikoma BigBlueButton in H5P z več aktivnostmi. Prikazani so primeri skupnosti praks, bralnega kluba, spletnega tečaja z neomejenim dostopom ter nekaterih interaktivnih vsebin. Glede na predhodne raziskave lahko sklepamo, da uporaba interaktivnih vsebin v okviru podiplomskega izobraževanja s področja zdravstvene nege lahko v veliki meri doprinese k uspešnemu zaključku izobraževanja, hkrati pa za udeleženca izobraževanja predstavlja prijetno in motivacijsko izkušnjo.

V nadaljevanju razvoja prototipa predlagamo tudi implementacijo koncepta igrifikacije. Vtičnik Level Up! v okolju Moodle omogoča igrifikacijo, ki udeležence izobraževanja še dodatno motivira. V vsakem primeru zahteva vzpostavitev spletne učilnice z interaktivnimi vsebinami:

- strokovnjake za področje zdravstvene nege, ki pripravijo vsebine in koncept poučevanja ter
- strokovnjake za IKT, ki s svojim strokovnim znanjem realizirajo učinkovito implementacijo novih aktivnosti.

Za uporabo statističnih metod in orodij, ki predstavljajo osnovo na dokazih podprte zdravstvene nege, načrtujemo povezavo spletne učilnice z oddaljenim namizjem. Na namizju bo nameščena programska oprema za urejanje, vizualizacijo in statistične obdelave podatkov.

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Inovativni pristop k širjenju znanja o standardih

Innovative approach to the dissemination of knowledge about standards

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POVZETEK

Inovativni pristopi v izobraževanju udeležencem izobraževanj ponujajo širok nabor možnosti, s katerimi lahko enostavneje in bolj učinkovito napredujejo in osvajajo nova znanja. V prispevku predstavljamo rezultate projekta Inovativni pristopi k širjenju znanja o standardih, sledljivosti, preskrbovalni verigi in trgovini v visokošolsko izobraževanje, katerega cilj je bil razviti prototip inovativnega izobraževanja o obravnavani tematiki. Po analizi obstoječega stanja smo raziskali različne inovativne pristope k učenju ter kot najprimernejšo metodo učenja za izbrani primer ocenili izkustveno učenje. Sodobna tehnologija omogoča veliko različnih načinov uporabe IKT elementov za podporo izkustvenega učenja. V spletni učilnici smo s pomočjo naprednih vtičnikov predstavili izobraževalne vsebine na inovativen in udeležencu prijazen način, ki udeleženca spodbuja k uspešnemu zaključku izobraževanja. V prispevku prikazujemo nekatere učinkovite interaktivne načine predstavitve vsebin, ki jih lahko uporabimo za izobraževanje o globalnih standardih GS1.

KLJUČNE BESEDE

Standardi GS1, globalni, izobraževanje, spletna učilnica, Moodle

ABSTRACT

Innovative approaches in education offer participants a wide range of opportunities to progress more easily and effectively and acquire new knowledge. In this paper we present the results of the project Innovative approaches to the dissemination of knowledge about standards, traceability, supply chain and trade in higher education. The main objective of the project was to develop a prototype for innovative education on the discussed topic. After an analysis of the current situation, different innovative approaches to learning were examined. Experiential learning was assessed as the most appropriate learning method for the selected case. Modern technology offers many different ways to use ICT elements to support experiential learning. Using advanced plug-ins in the online classroom, educational content was presented in an innovative and participant-friendly way that encourages the participant to successfully complete the training. Several effective interactive approaches to present content that can be used to learn GS1 standards are presented.

KEYWORDS

GS1 standards, global, education, e-classroom, Moodle

1 UVOD

Sodobna podjetja se vedno bolj zavedajo pomena standardov, ki z enotnimi pravili omogočajo bolj zanesljivo, učinkovito in okolju prijaznejše globalno poslovanje. Standardi sledljivosti GS1 določajo minimalne podatkovne zahteve in aktivnosti, ki jih je treba izvajati v organizacijah ali v skupini poslovnih partnerjev za dosego učinkovitega sistema sledljivosti [1]. Izobraževanje o standardih je redko vključeno v ustrezne izobraževalne programe, zato se GS1 Slovenija kot neodvisna in nepridobitna organizacija na področju standardov GS1 v Sloveniji sooča tudi s problemom širitve znanja o uporabi standardov v gospodarstvu. S ciljno usmerjenimi aktivnostmi se je tako GS1 Slovenija v zadnjih letih aktivno vključil v izobraževalni proces nekaterih visokošolskih institucij [2]. Seznanitev s standardi GS1 v terciarnem izobraževanju poteka po vnaprej določenem sistemu, ki vključuje frontalna predavanja (v zadnjem času tudi kot spletni seminarji), študij literature ter izpit za pridobitev certifikata Certifikat stopnje 1 - Razume standarde GS1. V okviru projekta *Inovativni pristopi k širjenju znanja o standardih, sledljivosti, preskrbovalni verigi in trgovini v visokošolsko izobraževanje* smo kot nadgradnjo obstoječemu sistemu preučili možnosti uporabe kreativnih, inovativnih pristopov za širjenje znanja o standardih, sledljivostiin učinkoviti preskrbovalni verigi med

študenti. Dodatne kompetence ter poznavanje delovanja preskrbovalnih verig s podporo standardov GS1 namreč študentom omogočajo konkurenčen vstop na trg dela.

V prispevku je opisan trenuten postopek izobraževanja o standardih GS1. Predstavljeni so nekateri inovativni pristopi k izobraževanju. Prikazana je prototipna rešitev, ki je nastala na osnovi analize obstoječega stanja.

2 METODOLOGIJA

S ciljem izdelati prototip rešitve inovativnega pristopa k izobraževanju o standardih GS1, smo analizirali obstoječ sistem izobraževanja. V analizo obstoječega stanja smo vključili tudi anketiranje študentov, ki so bili udeleženi pri izobraževanju o standardih GS1. S pomočjo opisne statistike smo interpretirali zbrane rezultate in jih analizirali. Preučili smo literaturo s področja inovativnih pristopov k izobraževanju, jih kratko predstavili ter analizirali njihove prednosti in slabosti. Na osnovi analiz smo za pripravo učnega okolja izbrali sistem Moodle ter s pomočjo vtičnikov izdelali prototip e-učilnice.

2.1 Analiza obstoječega stanja izobraževanja o standardih GS1

V sklopu certificiranja izobraževanje o standardih GS1 obsega več tematik, ki jih predavatelji predstavijo s kombinacijo predavanj in praktičnih primerov. V primeru izobraževanja, ki se je izvajal v 2. semestru študijskega leta 2019/20, so bili organizacija GS1 ter standardi GS1 študentom najprej predstavljeni na dvournem uvodnem predavanju. Pregled vsebin, ki so vključene v certificiranje, je mogoč v učbeniku Upravljanje globalnih preskrbovalnih verig [1]. Dodatno je študentom na voljo spletni delovni zvezek, s katerim lahko utrdijo znanje z vajami in vprašanji. Nekaj dni pred certificiranjem je potekal dvodnevni spletni seminar, na katerem so 3 predavatelji posamezne tematike predstavili še bolj podrobno ter jih podkrepili s konkretnimi primeri. Vsa predavanja so bila posneta in na voljo udeležencem za ponoven ogled do termina certificiranja.

Uvodno predavanje so najprej analizirale študentke, ki so bile vključene v projekt. Izpostavile so nekatere dobre značilnosti predavanja (npr. prikaz na konkretnih primerih, sodelovanje s publiko), pa tudi elemente predavanja, ki bi jih bilo mogoče izboljšati (npr. aktivno vključevanje študentov z mobilnimi napravami, reševanje izzivov v skupinah). Za 32 študentov, ki so se udeležili uvodnega predavanja, smo pripravili anketni vprašalnik, katerega namen je bil zbrati mnenja in povratne informacije o izvedbi predavanja. Odzvalo se je 23 študentov, ki v večini primerov pred predavanjem niso poznali organizacije GS1 Slovenija (61 %), jih je pa večina (78 %) že slišala za standarde GS1. Med anketiranimi študenti se jih je 18 odločilo za certificiranje, ker menijo da bodo s pridobljenim certifikatom bolje zaposljivi, ker jim je to priporočal profesor ali jih je prepričalo uvodno predavanje. Eden od ključnih dejavnikov pri njihovi odločitvi je tudi dejstvo, da je certificiranje zanje brez plačila. Študenti so ocenjevali tudi izvedbo uvodnega predavanja pri tem so kot najpomembnejše dejavnike dobrega predavanja izpostavili jasnost razlage, praktične primere in energičnost predavatelja. Študenti so na predavanju pogrešali informacije o tem, kako lahko uporabijo certifikat, kakšen je postopek obnavljanja certifikata ter katere vsebine so bolj in katere so manj pomembne za pripravo na certificiranje kar pa je posledica nekoliko skrajšanega uvodnega predavanja. Predavanje so si zapomnili po energičnosti predavatelja in sproščenem ozračju.

Anketiranci so izrazili tudi mnenje o različnih inovativnih pristopih k izobraževanju, med katerimi so kot bolj zanimive izbrali aplikacije za izvajanje kvizov preko mobilne naprave, prikaz v virtualni resničnosti, metode igrifikacije ter e-učilnico.

2.2 Izdelava prototipa spletne učilnice

V okviru projekta smo se odločili za izdelavo prototipa spletne učilnice. Med različnimi sistemi za podporo spletnega učenja smo izbrali okolje Moodle, ki s svojimi razširitvami ponuja zelo širok nabor možnosti inovativnega načina poučevanja. Moodle se že uporablja v akademskem okolju in je študentski populaciji poznan. Poleg osnovnih elementov, ki jih ponuja Moodle, kot je koledar, html okno in slovar, smo uporabili dva vtičnika, ki sta predstavljena v nadaljevanju.

Vtičnik H5P
Vtičnik H5P [3] je brezplačen dodatek za Moodle, ki omogoča izdelavo, deljenje in ponovno uporabo različnih interaktivnih HTML5 elementov. V spletno učilnico tako lahko vključimo igre, multimedijo, interaktivne predstavitve, kvize, drevesa odločanja, časovne trakove in podobno.

Vtičnik LevelUp!
Vtičnik LevelUp! [4] pa omogoča dodajanje elementov igrifikacije z zbiranjem točk za opravljene aktivnosti. Udeleženec izobraževanja z opravljanjem posameznih nalog in aktivnosti zbira točke. Na osnovi zbranih točk se premika po stopnjah usposobljenosti ter na ta način dobi povratno informacijo o svojem znanju in hkrati tudi tekmuje z ostalimi udeleženci izobraževanja.

3 INOVATIVNI PRISTOPI V IZOBRAŽEVANJU

Med inovativne pristope k izobraževanju lahko štejemo različne oblike poučevanja in učenja, kot so na primer obrnjeno učenje, študije primerov, problemsko zasnovano učenje in podobno. Eden od inovativnih pristopov je tudi izkustveno učenje, ki se uporablja v različnih situacijah.

V osnovnošolskem in srednješolskem izobraževanju se izkustveno učenje v večji meri nanaša na ekskurzije, projekte in podobne aktivnosti, medtem ko se pri izobraževanju odraslih izkustveno učenje običajno povezuje z uporabo predhodnega neformalnega znanja in izkušenj. Izkustveno učenje je vsako učenje, pri katerem je učenec v neposrednem stiku z resničnostjo, ki jo proučuje [5]. Kot eno od metod uspešnega učenja o preskrbovalnih verigah, izkustveno učenje predlaga tudi Weenk [6].

Na osnovi predhodnega študija inovativnih pristopov v izobraževanju smo v okviru ankete med udeleženci uvodnega predavanja zbrali mnenje o orodjih na področju izkustvenega učenja za katere študenti menijo, da so najbolj zanimivi.

3.1 Mobilne aplikacije

V spletnih trgovinah ponudnikov mobilnih aplikacij najdemo kar nekaj zanimivih možnosti, ki jih lahko v študijskem procesu uporabimo za interakcijo z udeleženci predavanj. Ne glede na to, da uporaba aplikacij zmoti tok predavanja, pa se v večji meri izkaže kot zelo uporabno za pridobivanje pozornosti slušateljev in spodbujanje medsebojne komunikacije o obravnavani tematiki [7]. Med aplikacijami za takojšen odziv v pedagoškem procesu se najpogosteje uporabljata aplikaciji Kahoot! [8] in Mentimeter [9].

3.2 Virtualna resničnost

Tako kot na vseh področjih, se tudi na področju usposabljanja in izobraževanja virtualna resničnost vedno bolj uveljavlja ne samo kot napredno orodje za igranje iger, pač pa tudi kot učinkovit pripomoček za učenje. Z leti razvoja tehnologija postaja bolj dostopna širokemu krogu uporabnikov, s tem pa narašča tudi število primerov uporabe in raziskav učinkovitosti uporabe virtualne resničnosti v izobraževanju. Ne glede na dostopnost tehnologije, pa zahtevnost priprave izobraževalnih vsebin v virtualni resničnosti nemalokrat zavira priložnosti za uporabo, s tem pa onemogoča raziskave, ki bi analizirale njene učinke v izobraževalnem procesu [10].

3.3 Igrifikacija

Sistem nagrajevanja oziroma učenje po principu računalniške igre, postaja v zadnjih letih zelo popularen način poučevanja digitalne generacije. Čeprav je primarni namen iger zabava, pa mnoge raziskave dokazujejo, da predstavljajo metode igrifikacije pomembno sodobno orodje, uporabno na marsikaterem področju [11]. Uporaba elementov igrifikacije pri poučevanju pripomore k učinkovitosti podajanja in utrjevanja študijske snovi [12].

3.4 E-učilnica

Med vsemi izpostavljenimi inovativnimi pristopi je e-učilnica koncept, ki je v izobraževalnem okolju prisoten najdlje, zato so tudi učinki uporabe e-učilnice najbolj raziskani. Čeprav so, kot navaja [13] študenti v nekaterih primerih še vedno bolj zadovoljni s tradicionalnim načinom poučevanja, pa je učinkovitost in zadovoljstvo z e-učilnico odvisno predvsem od pripravljenosti le-te. Tako lahko z določenimi elementi inovativnih pristopov, kot sta obrnjeno ali izkustveno učenje, popestrimo okolje e-učilnice. Med primeri dobrih praks inovativnih pristopov v e-učilnici tako najdemo igrifikacijo [14] ali predstavitev z interaktivnimi vsebinami [15].

Na osnovi raziskav različnih inovativnih pristopov k učenju smo se osredotočili na izkustveno učenje, način učenja, v katerega lahko vključimo različna orodja, ki omogočajo študentu bolj pristen stik s proučevano problematiko. Na osnovi navedenega smo izdelali prototipno rešitev.

4 PROTOTIPNA REŠITEV

Prototipna rešitev predstavlja predlog prenovljenega procesa izobraževanja o globalnih standardih GS1. Začetne ideje o uporabi virtualne resničnosti so se žal zaradi obsežnosti priprave in situacijo zaradi izrednih razmer, izkazale za neizvedljive. Projektna skupina se je tako osredotočila na rešitev, ki jo je bilo mogoče izvesti v času projekta in je hkrati vključevala različne inovativne pristope.

4.1 Nadgradnja uvodnega predavanja

Na podlagi odziva udeležencev uvodnega predavanja, smo pripravili posodobitev uvodnega predavanja, ki vključuje nadgradnjo predstavitve, predstavitev spletne učilnice ter uporabo aplikacije za takojšen odziv. Izsek posodobljene predstavitve za uvodno predavanje je prikazan na Sliki 1.

Slika 1. Posodobljena predstavitev na uvodnem predavanju.

Med aplikacijami za takojšen odziv, s katerimi poživimo diskusijo, predlagamo uporabo aplikacij Kahoot! (Slika 2) in Mentimeter (Slika 3).
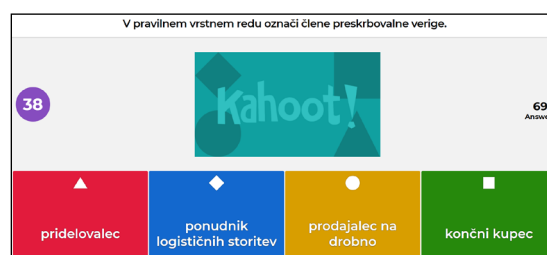
Slika 2. Primer vprašanja v aplikaciji Kahoot!
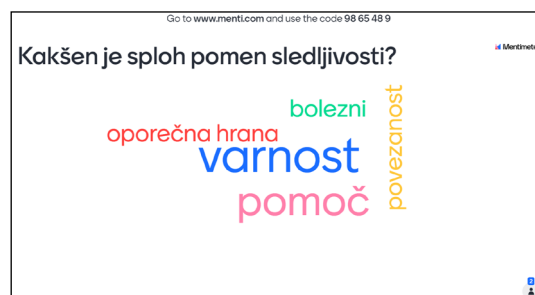
Slika 3. Primer vprašanja v aplikaciji Mentimeter

4.2 Prototip spletne učilnice

Za pripravo prototipa spletne učilnice smo uporabili odprtokodni sistem Moodle, ki je v slovenskem izobraževalnem prostoru zelo razširjen. Moodle ponuja veliko raznolikih elementov in vtičnikov, ki jih lahko uporabimo za vzpostavitev izobraževanja po metodologiji izkustvenega učenja. V prvi vrsti smo v spletno učilnico dodali koledar, na katerem lahko udeleženci spremljajo aktualne dogodke, ter povezavo na aktualne objave družbenega omrežja Twitter organizacije GS1.

Pri izdelavi prototipa smo se osredotočili na 3. poglavje v učbeniku Upravljanje globalnih preskrbovalnih verig z naslovom Sistem standardov GS1. Uporabili smo vtičnika H5P za interaktivno predstavitev vsebine ter LevelUp! za vzpostavitev

sistema igre v spletni učilnici. Za predstavitev zgodovine GS1 smo uporabili aktivnost časovni trak, ki je prikazan na Sliki 4.
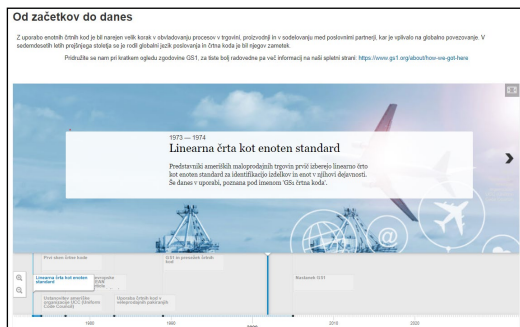
Slika 4. Časovni trak zgodovine GS1

S pomočjo aktivnosti interaktivna predstavitev smo pripravili predstavitev dela sistema GS1: Identifikacija enot (Slika 5).
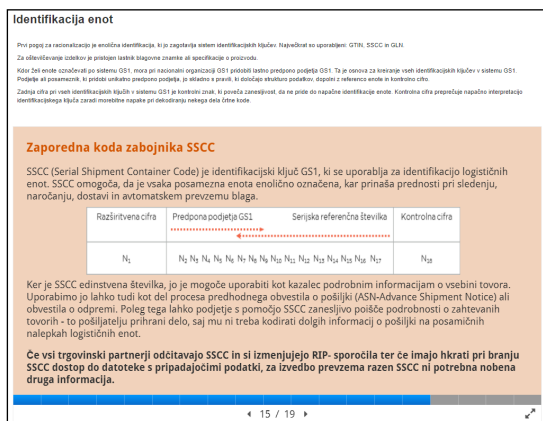
Slika 5. Interaktivna predstavitev

V podpoglavje o aplikacijskih identifikatorjih GS1 smo vključili sprotno preverjanje znanja, kar nam omogoča aktivnost stolpec (ang. Column), ki je predstavljen na Sliki 6.

Slika 6. Stolpec s sprotnim preverjanjem znanja

Kot način predstavitve nosilcev podatkov smo uporabili zvočni posnetek, ki si ga udeleženec izobraževanja lahko predvaja po potrebi. Za učenje o pravilni izbiri simbologije GS1 smo razvili drevo odločanja, ki na osnovi vprašanj (Slika 7) udeleženca pripelje do pravilne izbire simbologije (Slika 8).
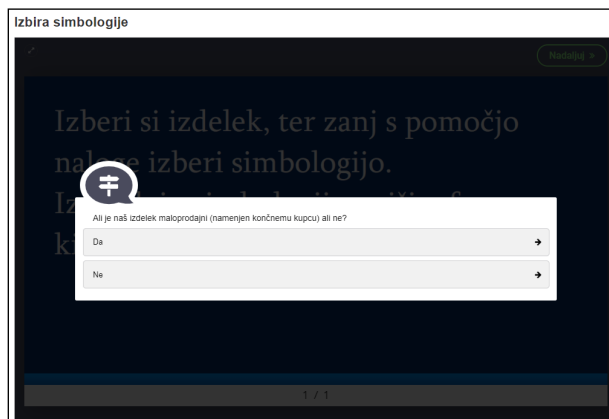
Slika 7. Vprašanje za izbor simbologije

Slika 8. Izbrana simobologija za določen izdelek

Sam postopek odločanja o izbiri simbologije je opredeljen vnaprej s pomočjo drevesa odločanja, ki je prikazano na Sliki 9.

Slika 9. Odločitveno drevo za izbor prave simbologije

Podobno kot za podpoglavje o aplikacijskih identifikatorjih GS1, smo tudi za označevanje enot pripravili stolpec s sprotnim preverjanjem znanja. Pri tematiki nameščanja črtne kode na enoto pa smo podoben način dela prikazali na malce drugačen način in sicer kot kviz z izbirnimi vprašanji (Slika 10).
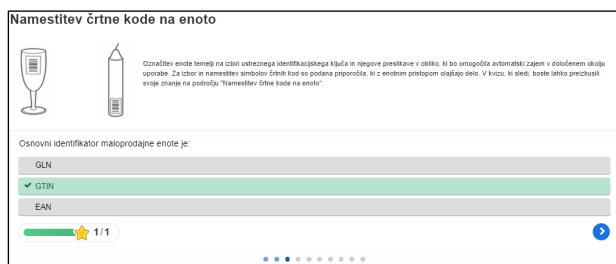
Slika 10. Kviz z izbirnimi vprašanji

Pri podpoglavju o standardih GS1 za elektronsko poslovanje smo za prikaz različnih možnosti prikazali shemo izmenjave podatkov znotraj preskrbovalne verige (Slika 11) ter jo obogatili z informativnimi napisi, ki se prikažejo, ko uporabnik izbere oznako za informacije na shemi (Slika 12).
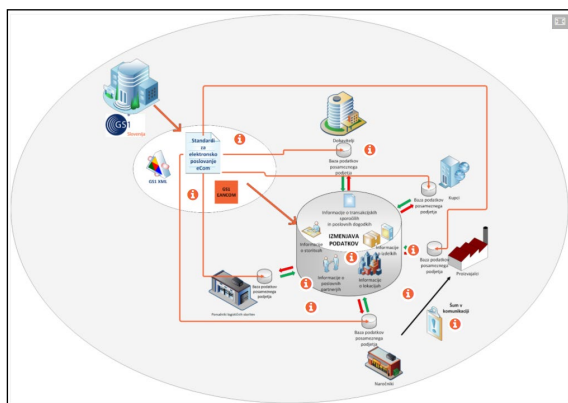
Slika 11. Shema za prikaz izmenjave podatkov
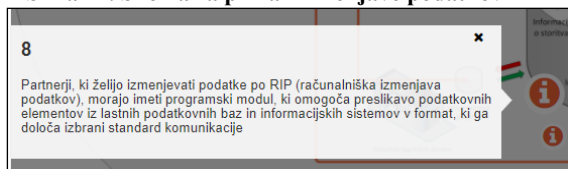
Slika 12. Informativni napis na shemi

S pomočjo sheme smo prikazali tudi vsebino podpoglavja o standardih GS1 za sinhronizacijo podatkov. Zaključno tematiko o prednostih uporabe standardov GS1 smo podkrepili z video vsebino, ki je vključena v spletno učilnico.

Kot zaključek izobraževanja v spletni učilnici smo za udeležence pripravili kviz z naključno izbranimi vprašanji, s čimer lahko udeleženci preverijo osvojeno znanje. V spletno učilnico smo dodali tudi element igrifikacije. Udeleženec s tem, ko si ogleduje in preskuša posamezne aktivnosti ter rešuje kvize, pridobiva točke, s katerimi napreduje po ocenjevalni lestvici.

Za prikaz dodatnih funkcionalnosti spletne učilnice Moodle smo pripravili še virtualni ogled skladišča, ki ga prikazuje Slika 13. S klikom se lahko premikamo po 360° sliki, poleg tega pa lahko pridobimo dodatne informacije o posameznem elementu na sliki.
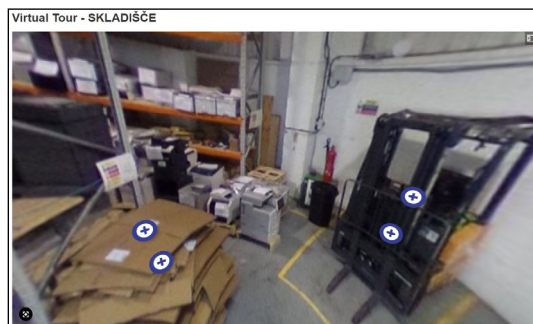
Slika 13. Virtualni ogled skladišča

Poleg vseh že prikazanih aktivnosti v spletni učilnici, ki so bile izdelane s pomočjo vtičnika H5P, smo v spletno učilnico vključili tudi slovar izrazov in kratic, ki je sicer ena od osnovnih aktivnosti v okolju Moodle. Naključen slovarski vnos se udeležencu izobraževanja prikazuje v bloku na desni strani spletne učilnice.

S pomočjo vtičnika LevelUp! smo pripravili tudi lestvico dosežkov posameznika v spletni učilnici. Ob vstopu v spletno učilnico »Novinec« po pridobitvi 20 točk napreduje v »Radovedneža«, sledi »Vajenec« s 50 točkami, »Pripravnik« z 90 točkami in »Kandidat za izpit« s 140 ali več točkami. Udeleženec lahko svoj napredek spremlja preko bloka na desni strani spletne učilnice (Slika 14), če želi pa se lahko primerja tudi z ostalimi udeleženci (Slika 15).
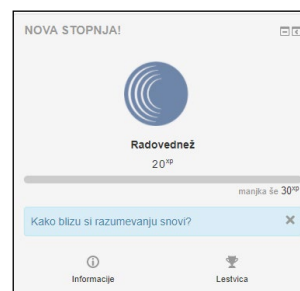
Slika 14. Pridobljena stopnja udeleženca

Slika 15. Lestvica najboljših udeležencev

5 ZAKLJUČEK

V okviru projekta *Inovativni pristopi k širjenju znanja o standardih, sledljivosti, preskrbovalni verigi in trgovini v visokošolsko izobraževanje* smo želeli poiskati in predlagati inovativno alternativo obstoječemu sistemu izobraževanja o standardih GS1. V prispevku smo predstavili rezultat večmesečnega dela, ki je obsegal analizo obstoječega stanja ter pripravo prototipa spletne učilnice. Organizaciji GS1 Slovenija smo predstavili predloge posodobitve uvodnega predavanja o organizaciji in sistemu certificiranja ter kot obogatitev izobraževalnih aktivnosti uporabo spletne učilnice, ki je danes vedno bolj aktualna oziroma brez nje skoraj ne gre več.Spletna učilnica razvita v okolju Moodle z uporabo vtičnikov H5P in

LevelUp! omogoča širok nabor možnosti, ki sledijo načelom izkustvenega učenja ter uporabljajo sodobne interaktivne elemente učenja. Udeleženec izobraževanja tako na izkustven način, s pomočjo različnih aktivnosti pridobiva znanje, pri tem pa sodeluje še v navideznem tekmovanju z ostalimi udeleženci. Koncept igrifikacije se izkaže še posebej koristen tudi pri oceni lastnega znanja, saj udeležencu izobraževanja prikazuje stopnje napredka. V svoji metaanalizi med najbolj temeljne elemente, ki so v več raziskavah izkazali največji učinek na proces učenja, uvršča ravno povratne informacije in podkrepitve [16]. Poleg prednosti, ki jih učno okolje prinaša za udeležence, Moodle ponuja tudi nekaj prednosti za predavatelje, saj lahko s hitrimi vpogledi v aktivnosti na spletni strani pridobijo vpogled v delo udeležencev. Tako je povratna informacija v obliki spremljanja napredka udeleženca zagotovljena tudi predavatelju. Adamič [17] pri tem poudarja trojno funkcijo povratne informacije: kontrolno, motivacijsko in regulacijsko. V okviru regulacijske funkcije lahko predavatelj lažje regulira učni proces, tako da vsebine dodaja, spreminja, diferencira in individualizira glede na viden napredek udeleženca .

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Lastna postavitev in uporaba spletne storitve za verzioniranje datotek

Our own layout and use of the file versioning web service

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POVZETEK

Na spletu obstaja množica spletnih storitev za shranjevanje datotek. Imenujemo jih spletni diski ali spletne datoteke ali datoteke v oblaku. Bistvo teh storitev je, da so datoteke ločene od naših naprav (računalnik, telefon, itn.) in tako neodvisne od izgube naprave (okvare, zastarelosti, kraje). Njihova lastnost je med drugim, da si datoteke lahko preprosto delimo med seboj. Ravno zadnje pa nujno potrebujemo pri pouku računalništva. Mi pa smo vzpostaviti svojo lastno spletno storitev imenovano Subversion, ki nam omogoča učinkovito izmenjavo računalniških datotek med učitelji in dijaki. Ima možnost nastavljanja pravic dostopa. Za posamezno uporabniško mapo sistem beleži revizijsko sled in tako lahko spremljamo napredek posameznega dijaka. Storitev je zelo agilna in ima prijazen uporabniški vmesnik. Med drugim se popolnoma izognemo spletnemu brskalniku, ker imamo datoteke fizično na disku računalnika. Tako tudi lažje urejamo in spreminjamo datoteke. Spletna storitev je odprtokodni in centraliziran sistem za verzioniranje datotek.

KLJUČNE BESEDE

SVN, spletna storitev, verzioniranje datotek, subversion

ABSTRACT

There are number of file storage services online. We call them web drives or web files or cloud files. The essence of these services is that the files are separate from our devices (computer, phone, etc.) and independent of the loss of the device (malfunction, out of date, theft). Their feature is, among other things, that the files can be easily shared with each other. Last advantage is needed in computer science lessons. We set up our own online service called Subversion, which allows us to efficiently share computer files between teachers and pupils. The service has the ability to set access rights. For an individual user folder, the system records an audit trail and that is why the progress of an individual student is easily monitored. The service

is very agile and has a friendly user interface. We completely avoid the web browser because we have the files physically in the device memory. This also makes it easier to edit and modify files. The web service is an open source and centralized file versioning system.

KEYWORDS

SVN, web service, file versioning, subversion

1 UVOD

Na spletu obstaja množica spletnih storitev za shranjevanje datotek. Z nadpomenko jih imenujemo spletni diski (ang. online drives), spletne datoteke (ang. online data storages) ali datoteke v oblaku (ang. cloud storages). V okviru teh storitev med drugim poznamo konkretne, kot so: Amazon Drive, Box, Citrix ShareFile, Hightail in MediaFire. Med najbolj množično uporabljenimi pa so: Dropbox, Google Drive, Microsoft OneDrive, Apple iCloud Drive in zadnje čase v porastu tudi Mega. Vse omenjene storitve smo spoznali in preizkusili. Za lastne potrebe pa izberemo samo eno izmed njih. Pametno pa je izbrati storitev, ki nam ponuja manj omejitev, to pa pomeni, čim več prostora za shranjevanje, neomejeno velikost ene datoteke in neomejen čas uporabe. V večini primerov bi hitro našli primerno ponudbo. Če se nam storitev dopade tudi v izgledu uporabniškega vmesnika, torej prijaznosti in dostopnosti, si ni težko izbrati enega izmed naštetih. Zelo priporočljivo bi bilo prebrati tudi pogoje uporabe. Torej, kje bodo shranjene datoteke, v kakšne namene lahko uporabijo statistiko in analizo naše uporabe, nam bodo glede na naše datoteke prikazovali prilagojene oglase, lahko naše fotografije postanejo last ponudnika ali pa jih celo lahko prodajo drugim osebam za potrebe oglasov. To so vedno zelo dolga besedila, ki ji velika večina ne bere in so preobsežna za povprečne uporabnike. Bistvo omenjenih spletnih storitev je, da imamo datoteke shranjene na varnem pred izgubo. Datoteke so ločene od naših naprav (računalnik, telefon itn.) in tako neodvisne od naprave (izgube, okvare, zastarelosti, kraje). Storitev je navidezno brezplačna, ker ne plačujemo mesečne naročnine, se nam pa prikazujejo oglasi in podobno. Individualnemu uporabniku bi opisana storitev zadovoljila osnovne potrebe po shranjevanju pomembnih dokumentov in fotografij ter zaščito pred izgubo le-teh.

Mi pa smo si postavili še višje cilje, kot je uporaba zgoraj opisanih spletnih storitev. Želeli smo vzpostaviti storitev, ki bi

nam omogočala kolaboracijo učiteljev in dijakov pri pouku računalništva. Torej učinkovito izmenjavo računalniških datotek med omenjenimi udeleženci. Najbolj pogoste datoteke, ki jih izmenjujemo med poukom, so opisi vaj, navodila nalog, napisani programi, izvorne programske datoteke, načrti podatkovnih baz, skripte za podatkovne baze, seminarske naloge, razpredelnice, slike itn. Vsi udeleženci bi pošiljali datoteke v storitev in jih pridobivali iz nje. V njej bi uporabljali tudi pravice dostopa, torej pravice branja in pisanja za izbrane mape. Med drugim smo želeli preko omenjene spletne storitve spremljati napredek posameznega dijaka, torej število rešenih in oddanih vaj, število načrtovanih podatkovnih baz, število oddanih programskih datotek itd. Odlično bi bilo, če bi za posamezno akcijo v sistemu vedeli, kdaj se je zgodila (datum in ura). Vseh naštetih funkcionalnosti pa nam v zgornjem odstavku omenjene storitve niso omogočile oziroma so bile pri uporabi zelo omejene. Med drugim smo si želeli izogniti delu z datotekami v spletnem brskalniku, ker bi jih radi imeli fizično pri sebi na napravi, saj imamo le v tem načinu dela popoln nadzor nad njimi.

Iz izkušenj, pridobljenih v industriji računalništva, smo dobili idejo, da bi si lahko pomagali s spletno storitvijo, imenovano verzioniranje datotek. Kot pravi O'Sullivan, nam ta sistem omogoča zelo enostaven vmesnik za skupno rabo, napredno dodeljevanje pravic, revizijo dogodkov, sočasno delo na istih datotekah in še veliko več. [4] Tako smo se odločili, da bomo namestili in začeli uporabljati lastni strežnik Apache Subversion, ki omogoča opisano storitev (v nadaljevanju SVN). [1]

2 NAMESTITEV STREŽNIKA

Za strežnik smo si izbrali običajni namizni računalnik s podpovprečno konfiguracijo: dvojedrni procesor, nekaj GB RAM-a in običajni trdi disk. Na njega smo namestili licenčni operacijski sistem Windows 10 Education (Slika 1). Postavili in priklopili smo ga v strežniško sobo in na omrežje tako, da je dobil javni IP naslov, saj mora biti storitev dostopna od kjerkoli. V lokalni domenski strežnik (DNS) smo vpisali novo domensko ime, tako da je naša storitev postala dostopna s spletnega naslova https://svn.sckr.si/.
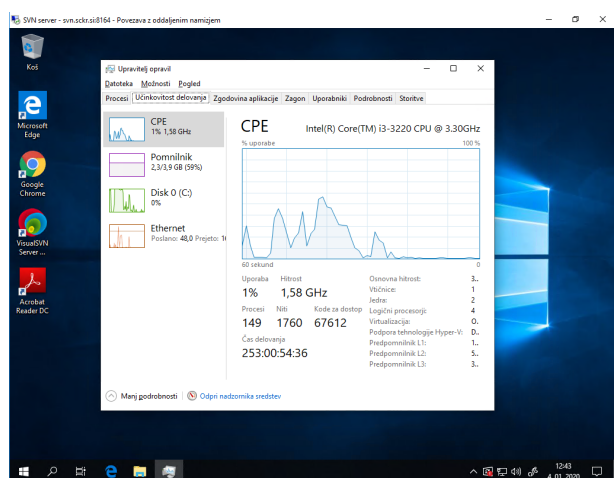
Slika 1: Število dni delovanja brez prekinitve

Potem pa je bilo potrebno v OS namestiti še SVN strežnik. Izvedb spletne storitve Apache Subversion je veliko. Posamezna izvedba je prilagojena za integracijo v specifični operacijski sistem. Izbrali smo VisualSVN Server, ker je najbolj enostaven in prilagojen za namestitev v operacijski sistem Windows (Slika 2). [2]
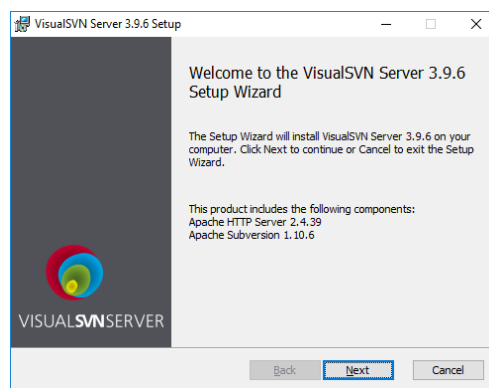
Slika 2: Namestitev serverja VisualSVN Server

Na tem mestu bi opozorili, da je verzija večja ali enaka 4.0 dobila nove licenčne pogoje in postala bolj omejena in neprimerna za uporabo velikega števila uporabnikov. V času namestitve še ni obstajala, v tem času pa je že izšla. Ima omejitev na 10 uporabnikov in posledično ni primerna za uporabo v šoli. Plačljiva verzija, ki nima omejitve števila uporabnikov, pa je zelo draga.

3 KONFIGURACIJA STREŽNIKA

VisualSVN Server ima zelo prijazen vmesnik za konfiguracijo (Slika 3). V njem smo ustvarili nove uporabnike, uporabniška gesla, uporabniške skupine, novo odlagališče (ang. repository name) in osnovno strukturo map.
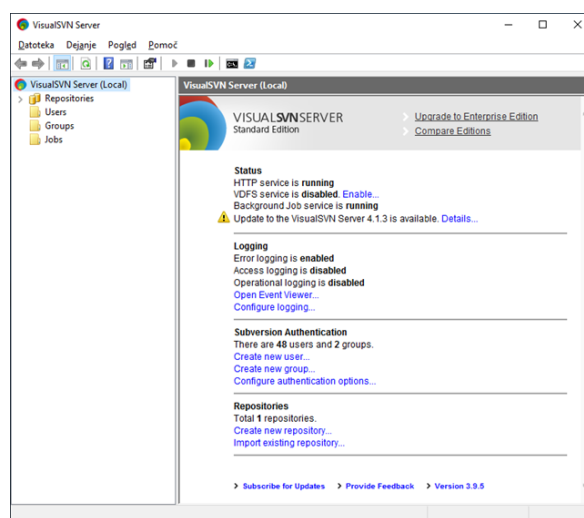
Slika 3: Konfiguracijski vmesnik VisualSVN Server

3.1 Ustvarjanje uporabnikov in skupin

Če želimo, da bodo vsi učitelji in dijaki lahko dostopali do storitve, moramo za vse ustvariti uporabniška imena in gesla. To storimo preko enostavnega vmesnika (Slika 4).
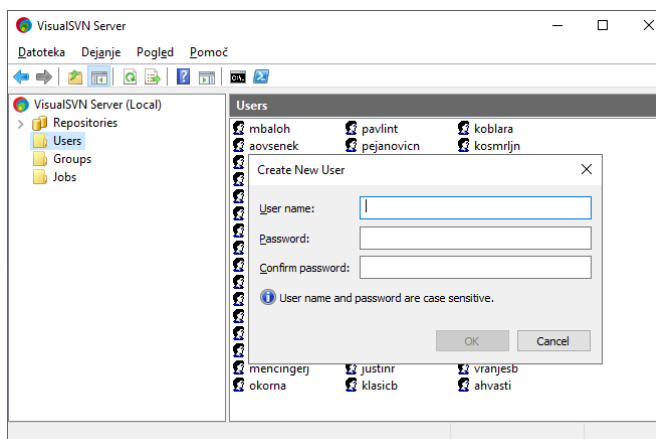
Slika 4: Ustvarjanje uporabnika

Za nastavljanje pravic je bilo bolj enostavno in smiselno določiti dve skupini uporabnikov: eno za vlogo učitelja in eno za dijaka. V vsako skupino smo dodali uporabnike (Slika 5).
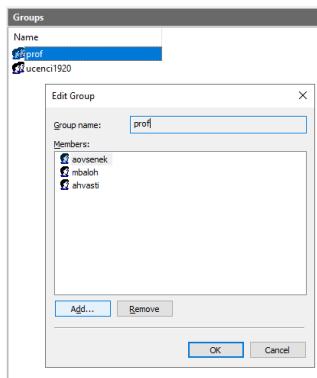
Slika 5: Ustvarjanje uporabniških skupin

3.2 Ustvarjanje odložišča

Preden sploh lahko začnemo uporabljati SVN datoteke, pa je potrebno ustvariti in poimenovati odložišče. Odložišče je mesto, kjer bomo hranili vse naše datoteke. Smiselno je za vsako generacijo dijakov ustvariti svoje odložišče. Ker je v tem primeru šlo za dijake »Računalniški tehnik – šolsko leto 2019/2020«, smo odložišče krajše poimenovali »RT1920«.

Obstajata dve vrsti odložišč. Mi smo ustvarili običajno, ki v ozadju uporablja en strežnik. Možno je ustvariti tudi razpršeno odložišče (ang. distributed repository), ki omogoča večje število strežnikov, lociranih po vsem svetu. Prva izbira je bila tudi bolj enostavna (Slika 6).
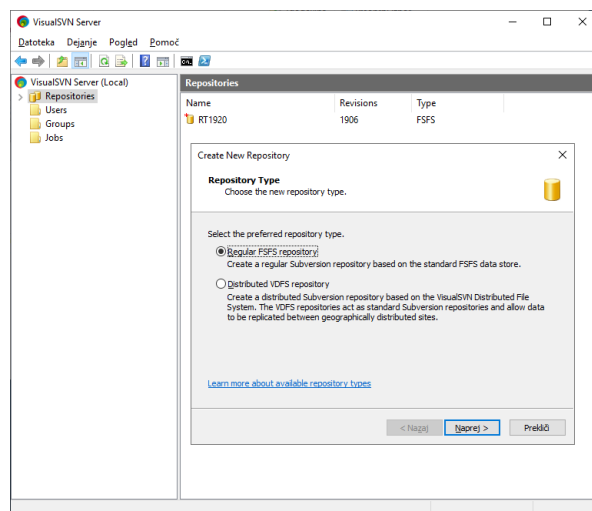
Slika 6: Ustvarjanje novega odložišč

4 DOSTOP IN UPORABA

Spletna storitev deluje na konceptu odjemalec – strežnik. Strežnik je podrobno opisan v prejšnjem poglavju. Odjemalec pa je predstavljen v nadaljevanju. Imenuje se TortoiseSVN (Slika 7) in je brezplačna programska oprema. [3] Omogoča dostop in uporabo Apache Subversion storitve, ne glede na platformo strežnika. Dobimo ga na spletnem naslovu https://tortoisesvn.net/. Od tam ga prenesemo in namestimo v svojo napravo.

Slika 7: Odjemalec za spletno storitev SVN

Po namestitvi v mapah raziskovalca, dobimo nove možnosti na desnem kliku miške (Slika 8).
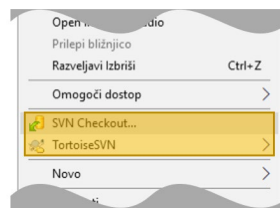
Slika 8: Nove možnosti na desnem kliku miške

4.1 Dostop do odložišča

Že na začetku smo strežniku določili spletni naslov https://svn.sckr.si/. Kasneje pa smo ustvarili še ime novega odložišča »RT1920«. Tako se ti dve imeni v storitvi SVN združita in dobimo spletni URL naslov za dostop do odložišča https://svn.sckr.si/svn/RT1920. Naslov uporabimo v odjemalcu TortoiseSVN. To naredimo z ukazom »SVN Checkout...« (Slika 9). Na disku se nam bo ustvarila nova mapa z imenom »RT1920«, ki jo kasneje lahko sinhroniziramo s SVN strežnikom.
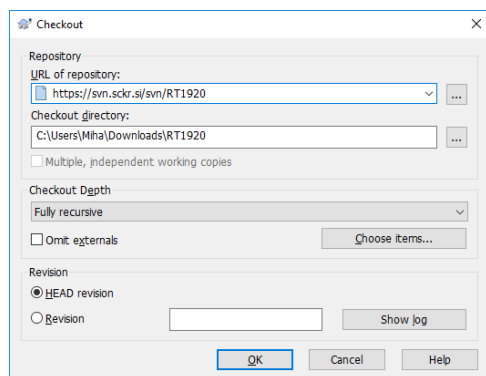
Slika 9: Poveži mapo na SVN repositorij

4.2 Delo v odložišču

V odložišču, ki se je naložil na naš računalnik, lahko urejamo datoteke kot običajno na disku računalnika. Ko delo zaključimo, spremembe pošljemo v strežnik (funkcija »commit«). Med delom lahko tudi prejemamo nove datoteke in spremembe obstoječih datotek, ki so jih v tem času ustvarili drugi uporabniki (funkcija »update«). Dve osnovni funkciji za delo z odložiščem se imenujeta »Commit« (pošlji spremembe v strežnik) in »Update« (prejmi novosti iz strežnika). Obe funkciji sta na izbiro z desnim klikom na katero koli SVN datoteko ali mapo (Slika 10).
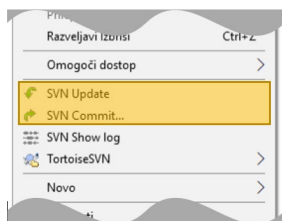
Slika 10: Funkciji »Commit« in »Update«

Funkcija »Commit« odpre pogovorno okno, v katerem pregledamo spremembe, ki jih želimo poslati v strežnik (spodnja polovica okna) in sporočilo, ki bi ga radi zapisali k tem spremembam (zgornja polovica okna) (Slika 11).
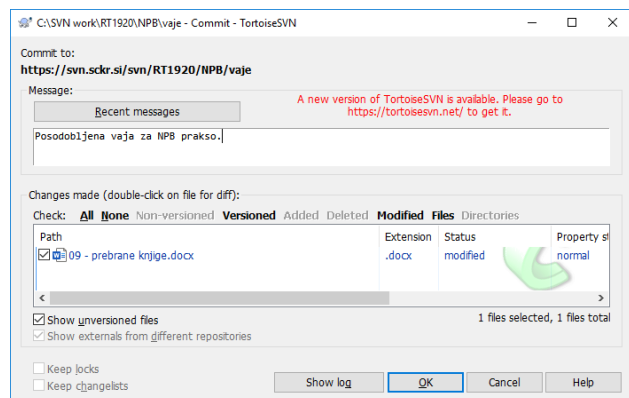
Slika 11: Pogovorno okno za izvedbo funkcije "Commit"

Funkcija »Update« odpre okno, v katerem vidimo vse novosti, ki smo jih prejeli iz strežnika (Slika 12).
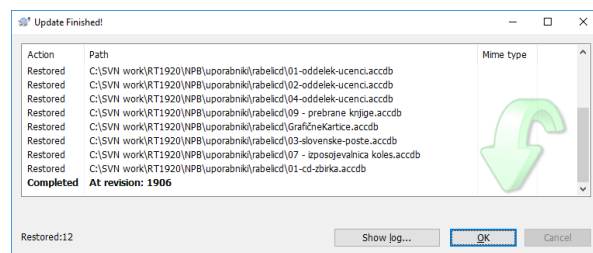
Slika 12: Okno za izpis informacij "Update"

Še bolj napredna funkcija pa je »Show log«, ki učitelju pokaže, katere vaje je dijak oddal, in to v časovni razpredelnici (Slika 13). Omenjena funkcija omogoča ogled zgodovine dela na posameznih mapah (uporabniške mape) ali na posameznih datotekah.
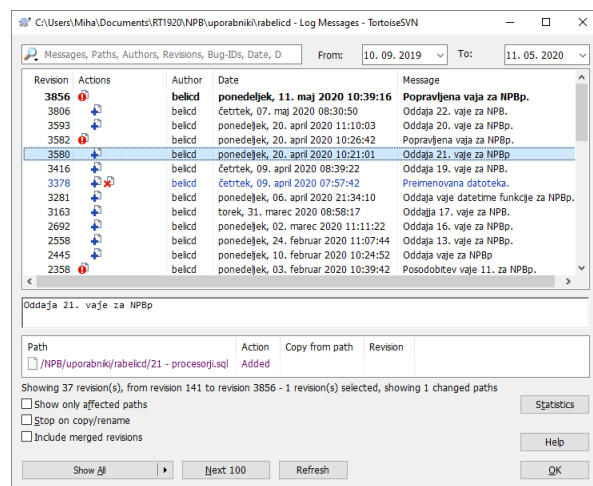
Slika 13: Ogled preteklega dela v uporabniški mapi

Obstaja pa še mnogo funkcij, ki jih je možno izvajati na mapah (povrni na revizijsko številko, povrni vse spremembe na revezijo strežnika, počisti lokalne spremembe itn). Obstajajo pa še napredne funkcije (Slika 14), ki jih je možno izvesti samo na posamezni datoteki (izbriši, preimenuj, zakleni). Za učitelja se je za zelo uporabno izkazala funkcija pregled sprememb datoteke (ang. Diff with privios version). Omogoča, da na posameznem dokumentu pogledamo zadnje opravljene spremembe. Tako lahko lažje ocenimo oddano nalogo in preverimo dijakov napredek.
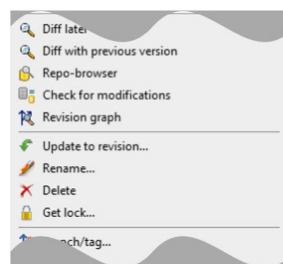
Slika 14: SVN funkcije na posamezni datoteki

5 ZAKLJUČEK

Delo učitelja in dijaka je z uporabo tehnologije Subversion bolj učinkovito, pregledno in ažurno. Za učitelja to pomeni večjo kontrolo pri izvajanju praktičnega pouka pri modulih računalništva. Pregledovanje oddanih datotek v uporabniških

mapah je zelo olajšano zaradi enostavnega prenosa datotek od dijaka do učitelja. Tako učitelj utemeljeno zahteva sprotno delo in pri pouku prakse je opazen bistveni napredek.

Za dijaka je prva prednost dostopnost do skupnih in lastnih datotek na enem mestu, torej so dostopne povsod, kjer obstaja internetna povezava. Če pa je predhodno odložišče že preneseno na lastno napravo, internetna povezava ni potrebna.

Druga prednost je, da ima dijak datoteke shranjene varno in enostavno. Žal dijaki dostikrat v časovni stiski uporabljajo neprimerne medije (USB ključ, neorganizirani spletni oblaki in e-pošta) in posledično izgubijo ali ne najdejo svojega dela. V našem primeru ni bilo zaznati teh težav.

Ena izmed pomembnih prednosti, ki se je izkazala v zadnjem času, je, da učitelji dijaku lahko pomagajo tudi na daljavo. V času korona virusa in dela od doma je bilo orodje nepogrešljivo.

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Pregled in primerjava spletnih storitev za shranjevanje datotek

Assessment and comparison of online file storage services

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POVZETEK

V prispevku so predstavljeni glavni ponudniki shranjevanja datotek na spletu. Z namenom izbire najboljših in najprimernejših med njimi, smo opravili primerjavo, pregled in oceno. Kriterij ocenjevanja temelji na podatkih, kot so: velikost prostora, omejitev velikosti ene datoteke in časovna omejitev uporabe. Ocena je bila izračunana po modelu največ prostora in čim manj omejitev oziroma čim več ugodnosti za čim manj denarja. Po tem kriteriju so se izkazali iCloud Drive, Google Drive, Microsoft OneDrive, Citrix ShareFile, MediaFire in Mega. Poleg glavnih tekmecev je v oceni tudi nekaj alternativnih ponudnikov. Nekatere storitve so se izkazale za zelo enakovredne, zato je končna odločitev uporabe vedno po izbiri uporabnika.

KLJUČNE BESEDE

Shranjevanje datotek, spletne storitve, oblačne storitve, pregled in primerjava

ABSTRACT

The article presents the main providers of online file storage. In order to select the best and most suitable among them, a comparison, review and evaluation were carried out. Evaluation criteria is based on data such as: maximum space, size limit of one file and time limit of use. The estimate was calculated according to the following model - largest space, least capacity limit and more benefits for less money. According to this criterion iCloud Drive, Google Drive, Microsoft OneDrive, Citrix ShareFile, MediaFire and Mega have proved to be the best. In addition to the main competitors, there are also some alternative providers presented. Some services have proved to be very equivalent, so the final decision is always the user's choice.

KEYWORDS

File storage, web services, cloud services, assessment and comparison

1 UVOD

V prispevku so predstavljeni glavni ponudniki shranjevanja datotek na spletu. Med njimi smo opravili primerjavo, pregled in oceno. Izbrani kriteriji ocenjevanja so: velikost prostora, omejitev velikosti ene datoteke in časovna omejitev uporabe. Ocena je izračunana po modelu največ prostora in čim manj omejitev oziroma čim več ugodnosti za čim manj denarja.

2 PROBLEMSKO STANJE

Najprej smo raziskali problemsko stanje na področju shranjevanja datotek. Rezultat vprašalnika o shranjevanju datotek je pokazal, da se velika večina datotek, ustvarjenih na tujih napravah (v službi, šoli, knjižnici), shrani kot priponko v e-pošto (76 %), zunanjo napravo (15 %) in v namensko storitev (9 %). Med drugim je bilo ugotovljeno, da dijaki na tujih napravah za shranjevanje datotek zelo veliko uporabljajo e-pošto, čeprav ni namenjena temu.

Doma pa datoteke (fotografije, pomembni dokumenti itd.), ki jih želijo imeti trajno shranjene, shranjujejo preveč razpršeno, in sicer v: osebni računalnik (77 %), namenske storitve (77 %), zunanje naprave (87 %) in druge medije (1 %). Torej, zaskrbljujoče je, da imajo pomembne datoteke shranjene v različnih medijih. Iz izkušenj vemo, da slabo organiziran sistem ne omogoča iskanja in posledično lahko prihaja do izgube datotek. Težje je tudi vzdrževati več sistemov, kot samo enega. Zgodi se, da nam en medij odpove in lahko izgubimo del dragocenega arhiva.

Drugi del vprašalnika je pokazal, da dijaki večinoma poznajo samo glavne ponudnike spletnih storitev shranjevanja: Google OneDrive (38 %), Dropbox (89 %) in Microsoft OneDrive (72 %). Med manj poznanimi so Apple iCloud (13 %), Box (2,5 %) in Mega (2,5 %). Ostalih spletnih ponudnikov, ki jih obravnavamo v tem prispevku, pa ne poznajo.

Tako smo naredili oceno in pregled spletnih storitev za shranjevanje datotek, da bi se dijaki v prihodnosti lažje odločali in izbirali ponudnike spletnih storitev, s katerim bi bili zadovoljni. Ključnega pomena je, da bi vse pomembne dokumente shranili na varen in organiziran način.

3 PREDSTAVITEV GLAVNIH PONUDNIKOV

V Tabeli 1 so objektivno predstavljeni glavni ponudniki spletnih storitev shranjevanja datotek. Vsaka storitev je predstavljena z imenom lastnika oz. razvijalca, s katerimi programskimi jeziki je ustvarjena, kdaj se je prvič pojavila na spletu in trenutnim številom uporabnikov na spletnem in mobilnem trgu. Poleg osnovnih podatkov pa so navedene še podprte platforme. Resni ponudniki podpirajo vse glavne platforme, kot so namizni računalniki Mac in Windows, mobilne naprave Android in iOS ter obvezno tudi dostop preko spletnega brskalnika (neodvisen od OS). Odstopanja so zelo majhna in so razvidna iz tabele. Če bi primerjali storitve po številu uporabnikov na spletnem in mobilnem trgu, bi se skupno na prvo mesto uvrstili Google Drive, Microsoft OneDrive in Apple iCloud (vsak po več kot 1 milijardo uporabnikov), na drugo mesto Dropbox (več kot 500 milijonov uporabnikov) in na tretje mesto Mega (več kot 50 milijonov uporabnikov).

Tabela 2: Predstavitev ponudnikov

Google Drive [1]	
Osnovni podatki	
Razvijalec	Google
Programski jeziki	Python, Objective-C
Datum prve izdaje	24. april 2012
Št. uporabnikov	> 1 milijarda
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Apple iCloud [2]	
Osnovni podatki	
Razvijalec	Apple Inc.
Programski jeziki	C, Objective-C
Datum prve izdaje	12. oktober 2011
Št. uporabnikov	> 1 milijarda
Podprti sistemi	
Spletni dostop	da
Android	ne
iOS	da
MacOS	da
Windows	da

MediFire [3]	
Osnovni podatki	
Razvijalec	MediaFire
Programski jeziki	Java, JavaScript, Objective-C, C++
Datum prve izdaje	september 2013
Št. uporabnikov	> 10 milijonov
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	ne
Windows	ne

Microsoft OneDrive [4]	
Osnovni podatki	
Razvijalec	**Microsoft**
Programski jeziki	**C#, Visual Basic**
Datum prve izdaje	**1. avgust 2007**
Št. uporabnikov	**> 1 milijarda**
Podprti sistemi	
Spletni dostop	**da**
Android	**da**
iOS	**da**
MacOS	**ne**
Windows	**da**

Mega [5]	
Osnovni podatki	
Razvijalec	Mega Ltd.
Programski jeziki	C++, JavaScript, Java, Objective-C
Datum prve izdaje	19. januar 2013
Št. uporabnikov	> 50 milijonov
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Dropbox [6]	
Osnovni podatki	
Razvijalci	Dropbox
Programski jeziki	Python, Go, TypeScript, Rust
Datum prve izdaje	september 2008
Št. uporabnikov	> 500 milijonov
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Amazon Drive [7]	
Osnovni podatki	
Razvijalci	Amazon Mobile LLC
Programski jeziki	HTML, CSS, JavaSript, PHP, Java, C#
Datum prve izdaje	29. marec 2011
Št. uporabnikov	> 1 milijon
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Box [8]	
Osnovni podatki	
Razvijalci	Box, Inc.
Programski jeziki	Java, XML, drugo
Datum prve izdaje	2005
Št. uporabnikov	> 10 milijonov
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Citrix ShareFile [9]	
Osnovni podatki	
Razvijalci	Citrix Systems, Inc.
Programski jeziki	ni podatka
Datum prve izdaje	november 2005
Št. uporabnikov	> 100 tisoč
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

Hightail [10]	
Osnovni podatki	
Razvijalci	Hightail (YouSendit Inc.)
Programski jeziki	ni podatka
Št. uporabnikov	> 50 tisoč
Datum prve izdaje	2004
Podprti sistemi	
Spletni dostop	da
Android	da
iOS	da
MacOS	da
Windows	da

4 PREGLED IN OCENA BREZPLAČNE PONUDBE SPLETNIH STORITEV

V Tabeli 2 je primerjava in ocena brezplačnih spletnih storitev. Pri primerjavi so bili vključeni naslednji kriteriji: velikost prostora, največja velikost ene datoteke in časovna omejitev brezplačne uporabe. V zadnjem stolpcu je dodeljena ocena, ki je višja, če ima storitev več prostora in manj omejitev. Brezplačne storitve, označene z modro bravo, so se izkazale za najboljše. Med njimi pa je daleč v ospredju spletna storitev Mega.

Tabela 3: Lestvica ocenjenih brezplačnih storitev

Ime	Velikost prostora	Velikost ene datoteke	Časovna omejitev	Ocena
Mega	50 GB	neomejeno	neomejeno	10
Google Drive	15 GB	neomejeno	neomejeno	9
MediaFire	10 GB	4 GB	neomejeno	8
Box	10 GB	250 MB	neomejeno	7
iCloud Drive	5 GB	ni podatka	neomejeno	6
Microsoft OneDrive	5 GB	neomejeno	neomejeno	5
Dropbox	2 GB	neomejeno	neomejeno	4
Hightail	2 GB	100 MB	7 dni	3
Citrix ShareFile	neomejeno	100 GB	30 dni	2
Amazon Drive	slike + 5 GB video	ni podatka	30 dni	1

5 PREGLED IN OCENA PLAČLJIVE PONUDBE SPLETNIH STORITEV

V Tabeli 3 je primerjava in ocena plačljivih spletnih storitev. Izbrani so bili naslednji kriteriji: velikost prostora, cena naročnine in število let obstoja podjetja. Slednje je pomembno, saj število let kaže na uspešnost in stabilnost podjetja, kar predstavlja večjo verjetnost, da bo podjetje delovalo še naprej. Naši podatki pa bodo v tem primeru ostali shranjeni na varnem.

Pri izračunu ocene smo najprej upoštevali velikost prostora in letno naročnino. Iz omenjenih podatkov smo izračunali ceno storitve na 1TB prostora. Tako smo ponudbe lažje primerjali. Ker pa cena in velikost še ne povesta vsega o kvaliteti, smo dodali še datum ustanovitve podjetja in iz njega izračunali število let obstoja.

Končna ocena je seštevek cene na 1TB prostora in število let uspešnega delovanja. V končni oceni smo želeli upoštevati tudi število zadovoljnih uporabnikov. Resničnost zadnjega podatek je zelo težko preveriti, tako da smo ga iz končne ocene in pregleda izključili.

Tabela 4: Lestvica ocenjenih plačljivih storitev

Ime	Velikost prostora	Letna naročni -na	Ustanovitev podjetja	Let obstoja podjetja	Ocena
Citrix ShareFile	neomejeno	600 $	1. 1. 1989	31	10
iCloud Drive	2 TB	120 $	1. 4. 1976	44	9
MS OneDrive	1 TB	69,99 $	4. 4. 1975	45	8
Amazon Drive	1 TB	59,99 $	5. 7. 1994	25	7
Google Drive	2 TB	110 $	4. 9. 1998	21	6
MediaFire	1 TB	45 $	20.10. 2006	13	5
Dropbox	2 TB	120 $	1. 6. 2007	13	4
Mega	4 TB	266 $	19. 1. 2013	7	3
Hightail	25 GB	180 $	1. 1. 2004	16	2
Box	100 GB	108 $	1. 6. 2005	15	1

Na prvo mesto se je uvrstil Citrix ShareFile, saj ima edini neomejeno velikost prostora in dolgo zgodovino izkušenj. Sicer pa so vsi ponudniki v zgornji polovici tabele vredni preizkušnje. Če pozabimo na Cistrix ShareFile in naredimo primerjavo samo po kriteriju cena na 1TB prostora, je na prvem mestu MediaFire (45 $), na drugem mestu Google Drive (55 $) in na tretjem mestu iCloud Drive skupaj z Amazon Drive (60 $).

6 KONČNA OCENA IN PREGLED BREZPLAČNIH IN PLAČLJIVIH SPLETNIH STORITEV

V končni lestvici smo združil pregled in oceno brezplačnih in plačljivih storitev. Večinoma uporabniki najprej izberejo brezplačne storitve. Kasneje, ko ugotovijo, da je storitev zelo uporabna in začne primanjkovati prostora, pa se odločijo za plačljivo storitev.

Torej, če razmišljamo za prihodnost, bomo verjetno vse pomembne datoteke (dokumente, slike, projekte ipd.) imeli shranjene v spletni storitvi. Mape in datoteke, shranjene pri prvem ponudniku, pa bomo redko selili k drugem, ker to od nas zahteva dodatne veščine, delo in čas. Iz naštetih razlogov smo naredili končno lestvico (Tabela 4) najboljših spletnih storitev kot združitev ocene iz Tabele 2 in Tabele 3.

Ocene Tabele 2 in Tabele 3 smo morali postaviti na skupni imenovalec, da se lahko oceni pravilno seštejeta. Tako smo najbolje ocenjeni storitvi dodelil 10 točk, najslabše ocenjeni pa 1 točko. Opaziti je, da se v 90 % ocenjenih storitev spremenila ponudba iz prehoda brezplačne na plačljivo storitev. Zato smo pri končni oceni upoštevali tudi ta argument. Če se je pri prehodu ponudba izboljšala, smo prišteli +1 točko, če se je poslabšala, smo odšteli -1, če pa se kvaliteta ponudbe ni spremenila, smo prišteli 0 (samo Dropbox).

Končna ocena je pokazala najbolj priporočljive ponudbe spletnih storitev v celoti. Kot vidimo, so si nekateri ponudniki tudi enakovredni in je izbira med njimi odločitev končnega uporabnika.

Tabela 5: Lestvica združenih ocen brezplačne in plačljive spletne storitve

Ime	Ocena brezplačne s.	Ocena plačljive s.	Pri prehodu	Končna ocena
iCloud Drive	6	9	+	16
Google Drive	9	6	-	14
MS OneDrive	5	8	+	14
Citrix ShareFile	2	10	+	13
MediaFire	8	5	-	12
Mega	10	3	-	12
Amazon Drive	1	7	+	9
Dropbox	4	4	0	8
Box	7	1	-	7
Hightail	3	2	-	4

7 ZAKLJUČEK

Kratko raziskavo pregleda in ocene spletnih storitev za shranjevanje datotek je smiselno predstaviti dijakom 1. letnikov srednješolskega izobraževanje pri predmetu informatike, saj je to pravi čas, da se odločijo, kje bi imeli dolgoročno shranjene pomembne datoteke. Sprva bi jih bilo smiselno ozavestiti, da so mediji, kot so USB ključi, SSD diski, telefoni in druge naprave, neprimerne za dolgoročno ali trajno shranjevanje datotek in da so ob izgubi naprave najbolj dragocene ravno datoteke, ki jih pa brez uporabe spletnih storitev ne moremo povrniti. Raziskava bo dijakom dala vpogled v osnovne podatke in vzbudila zanimanje za uporabo le-teh. Tako imajo na enem mestu pregledno predstavljene možnosti spletnih storitev.

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Usvajanje digitalnih kompetenc in dodatna pomoč učencu s posebnimi potrebami pri izobraževanju na daljavo

Acquisition of digital competencies and additional assistance to student with special needs in distance learning

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POVZETEK

V prispevku je predstavljena dodatna strokovna pomoč učencu v osnovni šoli v času izobraževanja na daljavo. Učenec je že v času izobraževanja v živo na šoli imel veliko pomanjkanje motivacije za šolsko delo, poleg tega pa ima zdravstvene težave, ki so zelo vplivale na njegovo uspešnost v šoli in življenju doma. Šolanje na daljavo je zanj predstavljalo velik izziv, saj se je moral digitalno opismeniti oziroma pridobiti nova znanja in digitalne kompetence za normalno spremljanje pouka. Kot izvajalka dodatne strokovne pomoči sem učencu pomagala, da je skozi pogovor, razlago in s spodbujanjem pridobil te veščine. Hkrati pa sem usmerjala njega in svetovala njegovim staršem, da je uspešno opravil šolske naloge in se dobro, brez večjih težav, vključil v šolanje na daljavo. Dodatno pomoč so učenec in starši sprejeli ter sodelovali. Učenec je tako pridobil zahtevane učne spretnosti in je dobro pripravljen na morebitno ponovno izobraževanje preko spleta.

KLJUČNE BESEDE

Usvajanje digitalnih kompetenc, otroci s posebnimi potrebami, šolanje na daljavo

ABSTRACT

This paper explores the case of supplementary professional support for a primary school student during distance learning. the student in question has already had a lack of motivation for schoolwork during his face to face learning, and has also faced health issues that were significantly affecting his performance at school and his home life . distance learning was a great challenge for him, as he had to become digitally literate and acquire new skills and competencies in order to follow the lessons. as a provider of additional professional support, i helped the student to gain those skills through conversation, explanation and encouragement, while at the same time guiding him and his parents so that he was able to successfully complete his school assignments and integrate in distance learning programme without any major issues. as a consequence of this additional support he and his family have received, the student now has required learning skills and is well prepared for any re-education online.

KEYWORDS

Acquisition of digital competencies, children with special needs, distance learning

1 UVOD

Sredi marca 2020 se je Slovenija zaradi razglašene epidemije čez noč odločila prekiniti redni pouk v šolah in prešla na šolanje na daljavo. Na to nihče ni bil pripravljen. Bile so narejene sicer nekatere grobe študije, kako naj bi potekal tak pouk, v eni od njih je avtor zapisal: » Tako bo potrebno še podrobneje analizirati učenje na daljavo kot učni proces (npr. izvore učenja, osnove pospešenega učenja, pogoje uspešnega učenja, etape v procesu učenja na daljavo), še podrobneje razdelati in definirati učna načela učenja na daljavo, metode in oblike učenja na daljavo, postopke izbire in razvrstitve učiva, notranjo in zunanjo organizacijo, preverjanje učnih uspehov in preprečevanje učnih neuspehov, ocenjevanje v procesu učenja na daljavo itd.« [1] Skratka, stvari niso bile dorečene in to je bil velik zalogaj tako za učitelje, kaj šele za učence, še posebej za učence s posebnimi potrebami, ki so zelo ranljive skupine in jim veliko pomeni osebni stik in osebna pomoč.

2 ZNAČILNOSTI UČENCA

Učenec je prišel na našo šolo ob koncu prvega vzgojno-izobraževalnega obdobja. Takrat ni kazal posebnosti, so se pa začele pojavljati v naslednjem razredu, ko je zaostajal z delom zlasti pri nalogah, kjer je bilo potrebno nekaj natančno narisati. Takrat je narisano nenehno radiral in nikoli ni bil zadovoljen z nastalim izdelkom. Kasneje se je njegovo vedenje stopnjevalo z umivanjem rok, ki je časovno zelo presegalo okvirje normalnega umivanja.

Težave so postale tako hude, da so zapolnile učenčev vsakdan. Svoj prosti čas je preživljal v samoti, kjer je lahko nemoteno opravljal svoja dejanja (si več ur umival roke)… Začel je veliko izostajati od pouka. Ko je bil v šoli, je njegovo vedenje začelo postajati moteče za delovanje razreda. Težko je shajal v komunikaciji z drugimi, zato so se začeli pojavljati konflikti med njim in sošolci. Tako so se poslabšali odnosi med vrstniki, kar je imelo za posledico slabše delovanje v šoli. Tudi doma so se pojavljale velike težave zlasti zaradi njegovih ritualov, pa tudi v komunikaciji in v odnosih z družinskimi člani. Starši so mu poiskali pomoč in ugotovili so mu obsesivno kompulzivno motnjo.

Pri obsesivno kompulzivni motnji (OKM) so prisotne misli vsiljivke (obsesije) in/ali prisilna dejanja (kompulzije). Obsesije so vsiljive, ponavljajoče misli, ki jih posameznik doživlja kot mučne (na primer obsesija pred okužbami). Kompulzija je neobvladljiva potreba po opravljanju neke dejavnosti ali giba. Kompulzivna dejanja ali rituali, ki se osebi vsiljujejo, so ponavljajoča in neprijetna. [2]

Učenec je dobil odločbo za otroke s posebnimi potrebami. V šoli sem mu pomagala kot izvajalka dodatne pomoči. Cilji so bili usmerjeni predvsem v socialne, komunikacijske in organizacijske veščine, saj je imel učenec na tem področju tudi največ težav. Kljub temu da je učenec veliko izostajal od pouka, je učno snov dokaj uspešno nadoknadil, saj učnih težav ni imel, snov in razlago pa si je zapomnil, če je le bil prisoten v šoli. Ostalo delo smo usmerjali in skušali realizirati znotraj ur dodatne strokovne pomoči.

Učenec je bil računalniško opismenjen na določenih področjih. Najbolj je obvladal igranje računalniških iger, saj je s tem doma preživel (pre)velik del prostega časa. Znal je napisati tudi kak wordov dokument, pri ostalih stvareh pa so mu pomagali družinski člani. Zato smo kot cilj v šoli dodali tudi digitalne kompetence, kjer smo poleg brskanja na spletu in iskanja informacij, veliko pozornost namenili tudi komuniciranju in sodelovanju preko računalnika - torej sporazumevanju z uporabo digitalnih tehnologij. Vendar, kot smo kasneje ugotovili, še veliko premalo.

3 IZOBRAŽEVANJE NA DALJAVO

Marca 2020 je v Sloveniji izbruhnil korona virus. Čez noč je bilo potrebno vzpostaviti stik na daljavo. Učenec je bil zelo vesel, ker je lahko ostal doma, socialna izolacija mu je v začetku zelo prijala.

Ker od učenca kljub veliki vztrajnosti ni bilo nobene povratne informacije, sem kontaktirala preko telefona njegovega očeta. Dogovorila sva se, da bom učencu pošiljala sporočila na elektronski naslov, prav tako pa njegovim staršem, da bodo seznanjeni s tem, kaj in kako poteka najino delo. Hkrati pa sem bila v navezi z učitelji, ki so mi posredovali povratne informacije tudi z njihove strani, kako se učenec odziva na njihove naloge. Težave so se pojavile že takoj. Najprej pri osnovni uporabi elektronske pošte, nato pa pri uporabi spletnih aplikacij. Učenec je potreboval veliko pomoči in vodenja, da se je znašel med poplavo podatkov in poiskal povezave, ki so se dotikale njegovega šolskega dela.

3.1 Usvajanje in uporaba spletnih orodij

3.1.1 Google Meet

Ker pogovori preko maila niso bili učinkoviti, sva se dogovorila, da se slišiva preko Google Meet-a. Tu sem za pomoč prosila dečkovega očeta, ki je učenca spomnil, da se ob pravem času priključi na povezavo oziroma priključi srečanju. Končno nama je uspelo, da sva vzpostavila stik preko računalnika in tako izkoristila možnost video srečanja (slika 1). Na najinih urah v živo sva se veliko pogovarjala. V začetku sva pregledala, preko katerih komunikacijskih kanalov bo v stiku z učitelji in učenci. Ugotovila sem, da mu delo in povezovanje preko računalnika, razen računalniških iger ne odgovarja. Na tem področju je bil praktično nepismen. Naredila sva načrt povezovanja s šolo.
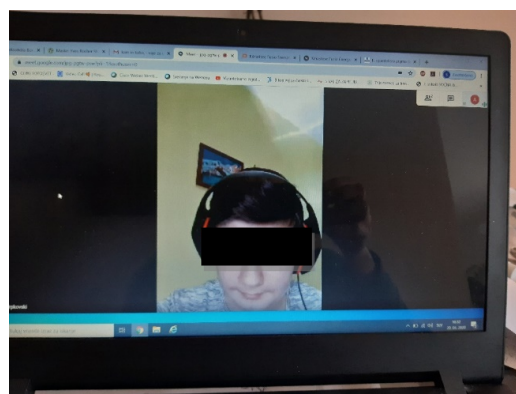
Slika 15. Pogovor z učencem

3.1.2 Spletna učilnica

Ko je učenec nekako usvojil komunikacijo in delovanje Google Meet-a, sem ga usmerila v spletne učilnice, v katerih je potekal pouk na naši šoli.

Njihov glavni namen je integracija tehnologij v skupek orodij, ki so razumljiva tako učencem kot učiteljem in jim tako olajšajo prenos znanja. [3]

Seznanil se je z delovanjem in uporabo le-teh in tako lahko sledil po posameznih predmetih navodilom in nalogam, ki so jih pripravljali učitelji.

3.1.3 Skype

Ker so imeli tedensko s sošolci razredne ure preko Skype-a, sem učenca seznanila z možnostjo namestitve programa na računalnik. Učenec je izkazoval velik odpor, ko bi moral v kakšno stvar vložiti trud in razmišljati, kako kaj deluje. Ta »borba« je trajala štiri tedne, ko se je končno sprijaznil, da se bo enkrat moral soočiti tudi s tem in uspelo mu je, da se je v petem tednu preko Skype-a povezal z razredničarko in sošolci na razredni uri. Seveda so bile tukaj del odpora tudi njegove težave z OKM, saj je na kameri želel izgledati brezhibno, zato se je včasih odločil, da kamere sploh ne bo uporabljal.

3.2 Ure dodatne strokovne pomoči preko spleta

Ko je učenec usvojil osnovna orodja, s katerimi se je lahko vključeval v učni proces na daljavo, sem lahko del ur izkoristila tudi za usvajanje ciljev, ki jih usvajava tudi v šoli, le da tokrat na daljavo, a vseeno »v ŽIVO«. Z učencem sva se pogovorila o virusu, o strahu in tesnobi, ki ga doživlja ob tem še posebej on, ki ima še dodatne težave v zvezi z OKM. Govorila sva o empatiji,

usmerila sem ga v to, da sva se pogovarjala o tem, kaj se dejansko dogaja.

Strukturiranje dneva:

Pomembno je bilo, da sva strukturirala dan. V času rednega izobraževanja v šoli je imel učence s časom že tako velike težave. Zdaj pa je bilo potrebno natančno določiti potek dneva: čas za obroke, higieno in počitek, delo za šolo, domača opravila ter prosti čas. Pomembno je bilo tudi vključiti telesno aktivnost.

Z učencem sva skupaj sestavila in napisala urnik. Tukaj sem predvsem želela pomagati staršem, saj kot je navedeno pri Svetovalnem centru za otroke, mladostnike in starše »Otrokom z dobrimi delovnimi in učnimi navadami to ne bo nič novega, če pa je otrok bil do sedaj premalo organiziran in samostojen ter navajen, da ga motivirajo drugi, pa bo v strukturo dneva potrebno vnesti več napora. [4]

Načrtovanje učenja:

Učenec je imel že prej zelo slabe delovne navade. Učil se je le pred testi, a še to občasno. Prednost je bila ta, da če je le bil v šoli, si je zapomnil veliko stvari, zdaj pa je bila situacija zelo drugačna. Pretirano rad je igral igrice in na tem področju je bil odličen. Ostale IKT veščine pa mu niso bile tako blizu, zato je čutil do tega še posebej velik odpor. Dogovorila sva se, katere predmete bo v spletnih učilnicah najprej opravil in katere si lahko pusti za kasnejši čas ali razdeli na posamezne dele. S tem sva razvijala veščine samoregulacije, hkrati pa je učenec spoznaval osnovno uporabo spletnih učilnic. Naučila sva se prijaviti v spletne učilnice, ob tem sva se pogovorila tudi o pomembnosti gesla. Kako mora biti geslo sestavljeno in zakaj je dobro, da je geslo zapleteno, pa vendarle takšno, da si ga lahko zapomnimo.

Prosti čas:

Tukaj se je pojavljal še posebej velik izziv za motiviranje učenca. Ves prosti čas je želel porabiti za igranje igric, iz sobe se pravzaprav ni premaknil. Ob najinih spletnih srečanjih sva poiskala na Youtube video posnetek razgibavanja za hrbtenico in sproščanja in naredila nekaj vaj, nato pa načrtovala prosti čas z družinskimi člani. Kot eno od nalog si je izbral nalogo, da bo z babico pripravil oziroma se naučil pripravljati njegovo najljubšo jed. To nalogo sva časovno opredelila tako, da jo je moral opraviti do konca šolanja na daljavo.

Komunikacijske veščine:

Druženje s prijatelji je bilo prej zaradi njegove diagnoze zelo oteženo, saj je nenehno prihajalo do konfliktnih situacij. Zdaj je to potekalo izključno preko socialnih omrežij. V začetku je bilo komuniciranje omejeno le na druženje skozi igranje iger. Po svetovanju staršem pa so se kasneje učenci res začeli povezovati ne samo v igricah, ampak so se začeli pogovarjati tudi o nalogah, kako je kdo kaj naredil. Vzpostavljala se je medvrstniška pomoč. Tukaj sem lahko realizirala enega od pomembnih ciljev, ki sem si jih zastavila v individualiziranem programu, in sicer razvijanje socialnih in komunikacijskih veščin. Učenci so si med seboj ustvarili skupine, preko katerih so sodelovali in si pomagali. Najina naloga je bila, učenca s posebnimi potrebami čim bolje vključiti v te skupine. Tako sem ga preusmerila iz igranja iger na medvrstniško sodelovanje.

4 VEŠČINE VZGOJE NA DALJAVO – POMOČ IN SVETOVANJE STARŠEM

Šolajoči se na domu potrebuje nadzor, usmerjanje, spodbudo in podporo ter pozitivno pozornost za dobro opravljeno delo. [5]

Starši so se veliko obračali po pomoč in nasvet v šolo, saj so sedaj s težavami ostali sami med štirimi stenami, dnevi pa so bili predlogi, časa preveč. Nenehno so bili skupaj, zato je med njimi prihajalo tudi do nerazumevanja, do konfliktnih situacij in starši so prosili za nasvete. Tako sem na nek način izvaja dodatno strokovno pomoč na daljavo tudi staršem.

Glavno navodilo staršem preko elektronske pošte, pa tudi preko telefona je bilo, da so v zvezi s situacijo glede korona virusa umirjeni v vseh pogledih, da bo otroku lažje.

Svetovala sem jim za različna področja učenčevega funkcioniranja doma:

Druženje s prijatelji preko spleta:

Staršem sem svetovala, da je potrebno prosti čas na računalniku smiselno omejiti na določen čas, saj so imeli že v preteklosti velike probleme z vzpostavljanjem nadzora nad zaslonsko tehnologijo. V začetku so imeli s tem velike težave. Kasneje je učenec del časa pred računalnikom namenil tudi šolskemu delu. Moj nasvet staršem je bil, naj spodbujajo otroka, da če kaj ne ve za šolo, naj najprej vpraša svojega sošolca za pomoč in tako se bodo bolj povezali.

Otrokov prosti čas:

Največ sem usmerjala starše, kako naj vodijo otroka, da bo koristno preživel prosti čas in da ne bo hotel samo igrati igric. Predlagala sem jim, da skupaj z otrokom počnejo stvari, za katere je prej zmanjkalo časa. Lahko se igrajo razne družabne igre, lahko rišejo stripe, morda je tudi čas za učenje kuhanja (slika 2)… Ker je učenec bil najraje pred računalnikom, sem mu predlagala, da skupaj z družino raziščejo različne uporabne spletne aplikacije. Staršem sem svetovala, naj pustijo otroku, da tudi on predlaga dejavnost in jo vodi. Naj takrat starši ne dajejo predlogov, ne kritizirajo njegovih odločitev, lahko pa ga pohvalijo za njegovo izvirnost in kreativnost. Tako se je učenec seznanil z aplikacijo za izdelovanje fotoknjig in to je postala njegova zaposlitev za kar precej popoldnevov.

Slika 16. Prosti čas v času šolanja na daljavo

5 ZAKLJUČEK

Naš skupni trud, trud staršev in šole ter usmerjanje učenčeve aktivnosti v njegovo dobro je v času šolanja na domu obrodil sadove. Učenec je usvojil osnovna orodja in se digitalno opismenil do te mere, da je dokaj tekoče opravljal svoje šolske zadolžitve, pa tudi stanje doma se je dokaj normaliziralo. Zapiranje med štiri stene, odvisnost od računalnikih igric in nerazumevanje med družinskimi člani je počasi izginilo. Učenec je začel komunicirati z domačimi in z njimi preživel tudi nekaj prostega časa. Domači so ga tudi spodbudili, da je izpolnil nalogo, ki sva si jo zadala pri uri dodatne strokovne pomoči na daljavo, da ga babica nauči pripraviti njegovo najljubšo jed. Učenec, ki so ga še pred tedni komaj zvabili iz svoje sobe na večerjo z družino, drugače je ure in ure preživel v svoji sobi, je tokrat presenetil.

S svojo babico je pripravil njegovo najljubšo jed. In zadovoljen nasmeh na njegovem licu pove več kot tisoč besed.

Tedni v času korone so bili za vse družine preizkus kvalitete odnosov, sposobnosti obvladovanja, potrpežljivosti in tolerance vseh družinskih članov. Tej družini je tokrat uspelo.

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Učenje angleščine z uporabo spletnega orodja Quizlet

Learning English by using Quizlet

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POVZETEK

Razvoj sodobne tehnologije prinaša spremembe tudi v izobraževanju, saj si v šolah pouka brez računalnika skorajda ne moremo predstavljati. Pri poučevanju tujih jezikov se nam ponuja veliko možnosti za popestritev pouka z uporabo različnih spletnih orodij. Eno izmed orodij, ki omogoča zabavno učenje jezika, je Quizlet. Uporabimo ga lahko predvsem za predstavitev novega besedišča učencem ter za utrjevanje že znanega besedišča. Učenci lahko to orodje uporabljajo za povsem samostojno učenje doma, zato se je za uporabno izkazalo tudi v obdobju šolanja na daljavo.

KLJUČNE BESEDE

Quizlet, spletno učno orodje, učenje besedišča, tuji jeziki

ABSTRACT

Due to the development of modern technology and its influence on education, it is almost impossible to imagine school lessons nowadays without the use of ICT. Foreign languages teachers can choose from a variety of online learning tools to make the lessons more diverse. The aim of this article is to present one of such online tools, Quizlet. Quizlet is primarily used for vocabulary learning and it makes learning a foreign language more enjoyable and interesting. Students can also use it at home for independent studying and because of that, it proved to be of great use during the period of distance learning.

KEYWORDS

Quizlet, online learning tool, vocabulary learning, foreign languages

1 UVOD

Tekoče izražanje v tujem jeziku je odvisno predvsem od človekovega besednega zaklada. Poznavanje slovničnih pravil je sicer pomembno, a brez širokega nabora besedišča je včasih težko sestaviti smiselno poved. Največ besed lahko spoznamo z branjem različnih besedil, saj so besede v besedilu povezane v smiselno celoto, zato lažje razumemo njihov pomen in si jih tudi hitreje zapomnimo. Današnji najstniki pa žal niso preveč navdušeni nad branjem. Namesto knjig jih ves čas obkrožajo računalniki in pametni telefoni, zato jih lahko z vključevanjem elementov IKT v pouk dodatno motiviramo za delo. Z različnimi spletnimi orodji jim lahko ustvarimo zanimive možnosti za spoznavanje novega besedišča oz. fraz, za širjenje besednega zaklada ter tudi za utrjevanje že znanih besed na zabaven način.

2 QUIZLET

Quizlet je eno izmed spletnih orodij, ki ga lahko s pridom uporabimo pri pouku tujih jezikov, predvsem za učenje besedišča. Učenci se s pomočjo kartic ('flashcards') učijo besed oz. jih utrjujejo. Uporabljajo ga lahko samostojno doma, delo s tem orodjem pa je možno vključiti tudi v redne ure pouka (uro npr. izvedemo v računalniški učilnici). V razredu ga lahko uporabimo kot uvodno motivacijo ob začetku ure, za ponavljanje besedišča ob koncu učne enote ali ugotavljanje predznanja pred novo učno enoto. Poleg učenja besedišča omogoča tudi utrjevanje slovnice.

Orodje nam ponuja dve glavni možnosti. Prva je, da na spletni strani https://quizlet.com/en-gb izberemo zavihek 'Search' (iskanje) in pregledamo bazo nalog, ki so jih ustvarili drugi uporabniki ter kakšno izmed njih rešimo. Če smo prijavljeni v Quizlet, lahko naloge, ki so nam všeč, shranimo med svoje gradivo. Pri vseh nalogah je na voljo tudi gumb 'Customise' (slika 1), ki nam omogoča, da naloge, ki so jih ustvarili drugi uporabniki, predelamo oz. popravimo, dodamo nove primere ali določene primere odstranimo.

Druga možnost, ki jo nudi Quizlet, pa je ustvarjanje lastnega gradiva – zavihek 'Create'. [1]
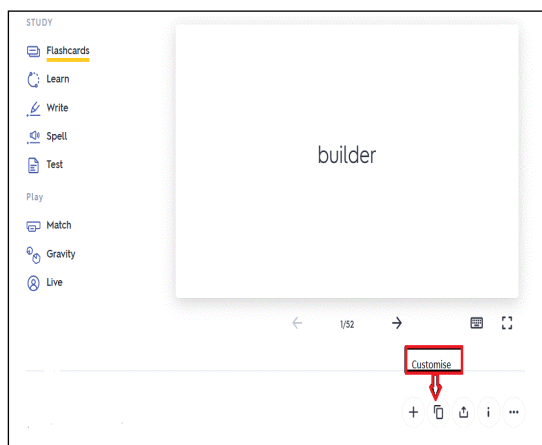
Slika 1. Gumb 'Customise', ki omogoča predelavo naloge (VIR: lasten, zajem zaslonske slike)

Slika 2. Prva stran kartice s slikovno iztočnico in prevodom (VIR: lasten, zajem zaslonske slike)

Slika 3. Druga stran kartice z angleško besedo (VIR: lasten, zajem zaslonske slike)

3 USTVARJANJE NALOG

Če želimo ustvariti naloge, se moramo na spletni strani https://quizlet.com/en-gb najprej registrirati. Nato v zgornjem levem kotu izberemo možnost 'Create' (ustvari). Nalogi, ki jo želimo kreirati, določimo naslov, lahko pa dodamo tudi kratek opis. Nastavimo, kdo lahko dostopa do naloge ('visitable to') ter uredimo pravice urejanja naloge ('editable by').

V stolpec 'Term' vnesemo besedo ali frazo, za katero želimo, da se jo učenci naučijo oz. jo utrdijo, v desni stolpec 'Definition' pa vnesemo iztočnico, na podlagi katere morajo učenci ugotoviti pravo besedo. Ta iztočnica je lahko slovenski prevod, slika, angleška razlaga besede … Če želimo dodati slikovno iztočnico, moramo v stolpcu 'Definition' izbrati gumb 'Image'. Odpre se nam nabor sličic, med katerimi eno izberemo.

Ob koncu pritisnemo gumb 'Create' ter ustvarjeno nalogo po želji delimo z drugimi. Za uspešno dokončanje naloge je potrebno vnesti vsaj dve besedi.

4 AKTIVNOSTI ZNOTRAJ NALOG

Ko vnesemo izbrano besedišče in pritisnemo gumb 'Create', Quizlet iz vnesenih besed oblikuje različne aktivnosti. Izbiramo lahko med karticami za učenje, nalogami za utrjevanje zapisa besed, nalogami za preverjanje znanja na različne načine ter igrami za utrjevanje. Obstaja tudi možnost povezovanja igralcev v skupine.

4.1 Zavihek 'Flashcards'

Zavihek 'Flashcards' omogoča učencem pregled in spoznavanje izbranega besedišča s pomočjo dvostranskih kartic. Najprej je prikazana tista stran kartice, ki ponuja slikovno iztočnico, slovenski prevod oz. angleško razlago (slika 2). Če učenci pritisnejo na kartico, se le-ta obrne in prikaže se beseda, za katero želimo, da se jo naučijo (slika 3). Ob tem slišijo tudi izgovorjavo besede. Če želijo besedo slišati še enkrat, pritisnejo ikono zvočnika v zgornjem desnem kotu kartice. S puščicama levo in desno, ki sta pod kartico, se premikajo skozi celotno besedišče.
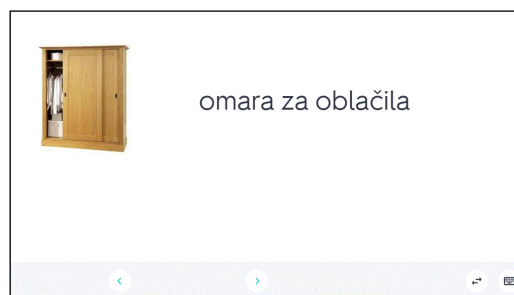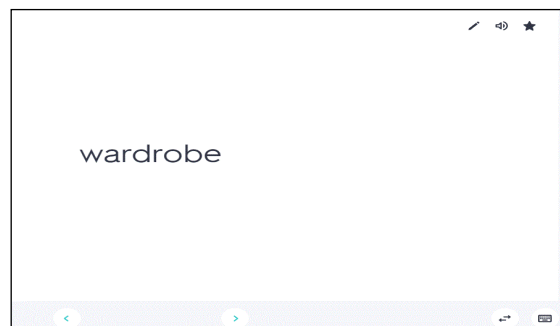
4.2 Zavihek 'Learn'

Zavihek 'Learn' ni več namenjen spoznavanju besed, temveč učenju. Iz celotnega nabora besedišča računalnik naključno izbere 7 enot in preverja razumevanje ter pravilen zapis besed. Ob sliki, prevodu oz. razlagi ponudi štiri možne odgovore, izmed katerih učenci izberejo pravilnega (slika 4) ali pa od njih zahteva, da besedo pravilno zapišejo. Učenci o pravilnosti odgovora dobijo takojšnjo povratno informacijo.
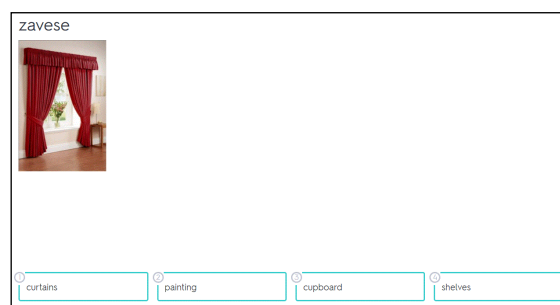
Slika 4. Primer kartice v zavihku 'Learn' (VIR: lasten, zajem zaslonske slike)

4.3 Zavihek 'Write'

Zavihek 'Write' je namenjen utrjevanju pisanja in črkovanja. Na podlagi besedne ali slikovne iztočnice morajo učenci besedo zapisati (slika 5). Takoj dobijo povratno informacijo o pravilnosti zapisa. Če je zapis napačen, se jim prikaže pravilen zapis, ob tem pa slišijo tudi izgovorjavo besede. Če učenci ne vedo odgovora, si lahko pomagajo z gumbom 'Answer' (odgovor). Prikaže se jim pravilna beseda, ki pa jo morajo prepisati, če želijo nadaljevati z delom.

Slika 5. Primer kartice v zavihku 'Write' (VIR: lasten, zajem zaslonske slike)

4.4 Zavihek 'Spell'

Zavihek 'Spell' je zelo podoben prejšnjemu, dodana je le še zvočna podoba besede. Učenci vidijo slikovno oz. besedno iztočnico ter slišijo izgovorjavo besede, nato pa morajo besedo pravilno zapisati. Če se pri zapisu zmotijo, jih spletno orodje opozori na napako in pokaže, kako napako popraviti.

4.5 Zavihek 'Test'

Ta zavihek preverja znanje učencev z različnimi nalogami (slika 6) in nudi takojšnjo povratno informacijo o njihovem znanju.
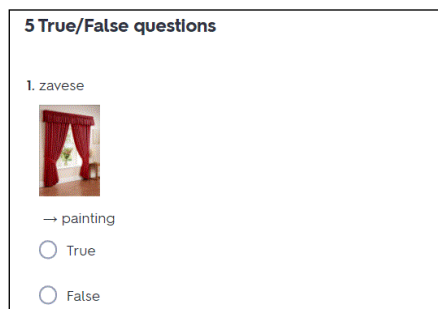
Slika 6. Primer naloge v zavihku 'Test' (VIR: lasten, zajem zaslonske slike)

4.6 Igri za utrjevanje znanja

Quizlet vsebuje tudi dve zabavni igri za utrjevanje besedišča, 'Match' (povezovanje parov) ter 'Gravity'.

Pri igri 'Match' morajo učenci poiskati pare, ob tem pa računalnik meri, kako hitro jim bo to uspelo (slika 7).

Igra 'Gravity' od učencev zahteva, da zapišejo pravilno besedo, preden bo Zemljo zadel asteroid. S pravilnimi odgovori učenci zbirajo točke in napredujejo iz nižje na višjo stopnjo igre (slika 8).

Merjenje časa in zbiranje točk učence precej motivirata, saj med seboj radi tekmujejo in se trudijo doseči čim boljši rezultat.
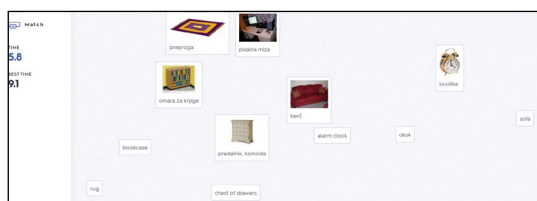
Slika 7. Primer igre 'Match' (VIR: lasten, zajem zaslonske slike)
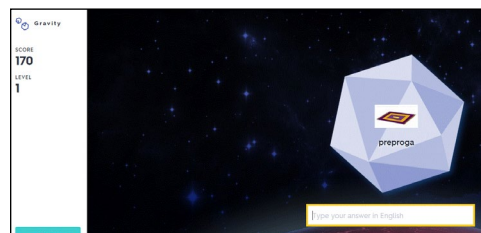
Slika 8. Primer igre 'Gravity' (VIR: lasten, zajem zaslonske slike)

4.7 Quizlet Live

Spletno orodje ponuja tudi možnost Quizlet Live, kjer učenci tekmujejo med seboj v poznavanju besedišča. Učenci se prijavijo v Quizlet Live s kodo in svojim imenom, nato pa jih računalnik naključno razdeli v skupine. Za tekmovanje med skupinami morajo biti v Quizlet prijavljeni vsaj štirje učenci, da lahko poteka tekma med dvojicama. Več kot je prijavljenih učencev, več skupin se tvori. Vsi učenci v skupini morajo sodelovati pri odgovarjanju na vprašanja, saj drugače ne morejo uspešno zaključiti naloge. Vsak učenec ima namreč le del odgovorov, le eden v skupini pa ima pravi odgovor. Učenci morajo znotraj skupine dobro sodelovati med seboj, hkrati pa tekmujejo proti drugim skupinam.

5 PREDNOSTI QUIZLETA

Ena izmed glavnih prednosti tega orodja je, da lahko učitelj na dokaj hiter in preprost način svojim učencem ustvari zanimive naloge za utrjevanje točno tistega besedišča, ki ga pri pouku z njimi obravnava. Z reševanjem teh nalog se lahko učenci doma samostojno pripravljajo tudi na ocenjevanje znanja. Učitelj jim lahko pripravi še dodatne naloge za širjenje besednega zaklada.

Orodje je možno uporabljati v različnih razredih, z različno starimi učenci. Količino besedišča in zahtevnost nalog prilagodimo glede na razred in predznanje otrok. Za mlajše učence pripravimo preprostejše naloge, kjer morajo povezati sličico z ustrezno besedo v tujem jeziku ali slovensko besedo z angleško (npr. slon – elephant). Za starejše učence ustvarimo težje naloge, ki od njih zahtevajo, da povežejo pojme in definicije (npr. waterfall – water, especially from a river or stream, dropping from a higher to a lower point).

Orodje lahko uporabimo tudi pri delu z nadarjenimi učenci, saj jih lahko prosimo, da pripravijo kakšno nalogo za svoje sošolce.

Učenci si lahko s pomočjo tega orodja sami ustvarijo svoj slovarček oz. seznam besed z definicijami, ki jih morajo znati.

Quizlet je možno uporabiti tudi za utrjevanje nepravilnih glagolov ter različnih slovničnih struktur. Ena izmed možnosti je, da pripravimo tip naloge, kjer je potrebno glagol v oklepaju postaviti v ustrezen čas (t. i. 'gap fill'). S tem učenci vadijo rabo časov.

6 ZAKLJUČEK

Quizlet se je meni osebno izkazal za zelo uporabno orodje. Po eni strani je zelo preprost za uporabo, po drugi pa učencem omogoča zabavno učenje jezika. Quizlet uporabljam v vseh razredih, ki jih poučujem. V prejšnjih letih sem učencem pripravljala naloge, da so lahko doma na drugačen način utrjevali

učno snov. Občasno so naloge reševali tudi v šoli v računalniški učilnici. V letošnjem šolskem letu pa sem ga uporabljala tudi med obdobjem poučevanja na daljavo. Učencem sem na ta način predstavila novo besedišče. S pomočjo slikovnih kartic so se najprej seznanili z besedami, ob tem so slišali tudi pravilno izgovorjavo, nato pa so lahko reševali še naloge za utrjevanje. Ob povratku učencev v šole se je izkazalo, da so snov dokaj uspešno predelali.

Priprava nalog učitelju sicer vzame nekaj časa, vendar pa pester nabor aktivnosti učencem omogoča učenje jezika na zabaven in zanimiv način ter jim omogoča boljše pomnjenje snovi.

VIR

[1] Spletno orodje Quizlet
https://quizlet.com/en-gb (pridobljeno 20. 8. 2020)

Razvoj krmilnika za upravljanje senčil

Development of a controller for window blinds management

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POVZETEK

V prispevku smo obravnavali probleme senčil in njihovo krmiljenje preko mobilne naprave ali tablice. Podjetje ADC sistemi d.o.o. združuje tradicionalno upravljanje senčil s stikali z novitetami na področju IoT. Časi se spreminjajo z temu pa tudi naš način življenja in kjer je čas denar, smo omogočili, da obstoječe sisteme lahko nadgradimo in jih upravljamo z telefonom, in to združeno. Sistem je primeren tako za nadogradnjo obstoječih sistemov in to brez dodatnih gradbenih del, kot tudi za novogradnje. Poleg vsega naštetega stranka lahko upravlja senčila tudi z daljincem in tako je paket popoln. Stranka tako ni v dilemi, kateri sistem je boljši, kaj je bolj primerno. Z ADC sistemi stranka dobi popolni nadzor nad svojimi senčili. V prispevku smo predstavili model, ki omogoča varnost, zanesljivost, enostavnost in bo podprl zahteve strank.

Z razvojem tehnologije se beleži porast IoT v vseh oblikah, zato v zadnjem času vse več ljudi poizkuša uporabljati stortive interneta v oblaku. Namen IoT-ja je avtomatizirati procese, ki so del vsakdanja. V praksi je najbolj pogost način IoT-ja krmiljenje električnih elementov preko posameznih krmilnikov.

Prispevek obravnava probleme krimljenja senčil in njihovih implementacij. Ljudje se vse bolj zavedajo pomena interneta in prednosti, ki jih ponuja. Sodobna informacijsko-komunikacijska tehnologija omogoča nove možnosti uporabe pametnih naprav, hkrati pa se je strojna oprema v zadnjem času močno pocenila.

Namen prispevka je razsikati, enostavno opisati in predstaviti prednosti in slabosti ADC krmilnikov, ter jih implementirati na sisteme senčenja pri podjetju Roltek d.o.o.. Cilj prispevka je analizirati ter teoretično in praktično utemeljiti stroškovno ugoden in učinkovit krmilni sistem za potrebe krmiljenja senčil. V prispevku je predstavljena tudi realizacija ADC krmilnika za potrebe proizvajalcev senčil.

Pri pisanju prispevka smo se osredotočili na analizio primarnih in sekundarnih virov, s primerjalno analizo konkurenčnih izdelkov in študijo primera, kjer smo na podlagi kritične analize zbranih podatkov podali konno oceno.

Med seboj smo primerjali sisteme za krmiljenje senčil različnih produktov (Sonfy, Fibaro, BleBox, Zamel, Elero itd…). Na podlagi analize smo izbrane rešitve implementirali na testno okolje. Ob implementaciji smo odkrili veliko napak, ki jih redko zalsedimo v teoriji. Implementacija vsakega krmilnika je zgodba zase.

KLJUČNE BESEDE

IoT, krmilnik, senčila, WIFI

ABSTRACT

In the article we discussed the problems of window shades and how to control them remotely by means of a mobile device or tablet. ADC sistemi d.o.o. combines the traditional controlling of window shades with switches, with the novelties of IoT. As our lives get drastically changed by new technology and our time becomes more and more valuable, saving time on mundane tasks becomes very important. That's why our solution allows existing systems to be easily upgraded and controlled remotely, effectively saving you time and therefor money. The solution can be used to upgrade existing systems with no additional construction work but it can also be installed in new buildings. Besides the ability to control devices via your mobile device or tablet, the solution also offers a remote, so all grounds are covered and the customer needn't worry, about getting the best system for their use case, as the solution allows their preferences to be respected. With ADC sistemi the customer gets total control over their window shades. In the article we presented a model which allows for security, reliability, simplicity and supporting the needs of customers.

With technological advancement IoT is growing in all directions, and recently more and more people are trying to use cloud services. The purpose of IoT is to automate everyday processes. In practice the most common example of IoT is controlling electrical components with individual controllers.

The article talks about the problems of systems controlling window shades and implementing such systems. People are becoming more and more aware of the internet and the advantages it offers. Modern information and communications technology allows for new uses of smart devices, while also drastically decreasing their cost.

The purpose of the article is to research, simply describe and present the advantages and disadvantages of ADC controllers and to implement them with window shading systems of the company Rolte d.o.o.. The goal of this article is to analyze, theoretically and practically, a cost effective and powerful controller solution for the needs of controlling window shades. The article also desribes the realization of the ADC controller for the requirements of the manufacturers of window shades.

When writing the article, focus was put on the analysis of primary and secondary sources, with comparative analysis of competeing products and a study of a concrete example, where a final score was derived from the critical analysis of collected data.

We compared different solutions for controlling window shades (Sonfy, Fibaro, BleBox, Zamel, Elero, etc.). Based on the analysis selected solutions were implemented in a test environment. During implementation we discovered many shortcomins, which are rarely talked about in theory. The implementation of every controller is a story in of it self.

KEYWORDS

IoT, controller, blinds, WIFI

1   UVOD

Prvi produkt je nastal kot plod doktorske naloge. Želja oziroma cilj je bil podpreti IoT tehnologije (ang. Internet of Things), ki se je nadgradila v lasten razvoj programske in strojne opreme. ADC vmesnik za mobilno upravljanje senčil je tako postal prvi produkt podjetja, ki se je razširil v mobilno upravljanje električnih naprav (rolete, senčila, tende, garažna vrata…). Pri razvoju produkta je sodelovalo več kot 30 oseb iz različnih strok. Z svojim znanjem so sodelovale tudi fakultete in sicer Fakulteta za organizacijske vede, Fakulteta za elektrotehniko in Fakulteta za računalništvo.

Strojna oprema je v celoti razvita v Sloveniji in s pomočjo partnerski podjetij tudi narejena v Sloveniji. S tem sledimo visokim zahtevam Evropskih standardov in kvalitete. Vmesnik je testiran v laboratoriju na Fakulteti za organizacijske vede na več kot 1.000.000 premikov, kar v praksi pomeni, če bi v povprečju vsak dan naredili 10 premikov z roletami, bi imeli vmesnik več kot 273 let.

Za celoviti spekter ponudbe smo v celoti razvili tudi programsko opremo v Sloveniji. To nam je ključno, da imamo možnost razvijanja in posodabljanja programske opreme – aplikacij, kar nam prinaša še dodatno konkurenčno prednost. Hitro odzivnost na potrebe tržišča, vsa navodila in aplikacije v slovenskem jeziku.

2   METODOLOGIJA
2.1   Opredelitev problema
Svet v katerem živimo se hitro spreminja s temu pa tudi naše navade, postopki, vrednote, okolje, ljudje itd. Tehnologija je v vseh segmentih našega življenja. Način življenja, ki smo g a uporabljali še do nedavnega je zastarel in ne daje več željenih rezultatov. Spremembe, ki smo jim priča iz dneva v dan so usmerjene v sodobno tehnologijo in avtomatizacijo posameznih procesov. Ljudje se vse bolj zanašamo na tehnologijo.

Obravnavali bomo uporabo IoT tehnologije za krmiljenje senčil. Tukaj se pogosto pojavljajo etična vprašanja kot so:
1.   varstvo osebnih podatkov,
2.   možnosti zlorabe teh podatkov,
3.   nedovoljeni vpogled nepooblaščenim oseba,
4.   nadzor in kršenje pravic do zasebnosti.

IoT tehnologija na ljudi vpliva blagodejno saj ima na ljudi v psihološkem smislu (občutek varnosti) dober vpliv. Poleg nadzora senčil nam IoT ponuja ogromno drugih možnosti npr. glasovno upravljanje itd.

V zadnjih letih je IoT mnogo napredoval, saj se iz dneva v dan izpopolnjuje in nadgrajuje. Nadzorovanje naprav preko interneta je najbolj razširjena metoda nadzorovanja. Poleg krmilnikov poznamo tudi druge proizvode, ki se uporabljajo za krmiljenje senčil (fizično stikalo, daljinec itd…).

ADC krmilniki se iz dneva v dan vedno bolj razvijajo in njihova uporaba narašča. Vedno znova nadgradimo programsko opremo, ki omogoča, da z malo znanja lahko popolnoma nadziramo lasten sistem.

2.2   Cilj
Cilj prispevka je predstaviti rešitev, ki bo olajšala krmiljenje senčil, omogočila večjo varnost sistema, prav tako pa olajšala delo proizvajalcem in kupcem. Poleg večje varnosti sistema vdor v sistem je skoraj nemogoč. S tem pa so zaščitene tudi stranke, saj jim varnost in enostaven uporabniški vmesnik zagotovi kakovost, ki so jo plačale. Olajšano je tudi dodajanje novih naprav, ki je popolnoma avtomatizirano, saj se osebni podatki hranijo v oblaku in do njih ne more nihče dostopati razen uporabnika. ADC sistem je kompatibilen z vsemi obstoječimi sistemi senčenja, saj predstavlja zanesljiv, varen, pregleden in učinkovit sistem za mobilno upravljanje senčil.

2.3   Predpostavke in omejitve
V prispevku kot predpostavko navajamo zlorabo osebnih podatkov, nenapovedano opazovanje, nadzor krmiljenja senčil in kršenje pravic do zasebnosti. Zelo velik problem je, da zloraba ni nikoli odkrita oziroma traja zelo dolgo časa, zato lahko pričakujemo, da se bodo ta dejanja v prihodnosti še vedno dogajala. V vsakdanjem življenju se srečujemo z novimi oblikami zlorab, ki nam škodujejo. Predpostavimo lahko, da na podlagi prejšnjih ugotovitev postavimo model, ki bo temeljil na mobilnem krmiljenju senčil in bo primeren za proizvajalce senčil.

Glavna omejitev prispevka bo najti podjetje, ki bo želelo sodelovati in odgovarjati na vprašanja, ki jih večina proizvajalcev senčil ne želi javno razkriti, ker to smatrajo za poslovno skrivnost. Kot omejitev pa lahko izpostavimo obseg ter zapletenost implementacije ADC krmilnika v obstoječe sisteme senčil.

2.4   Predvidene metode raziskovanja
Pregledali bomo literature po različnih svetovnih bazah kot so Web of Science, Scopus, Google Scholar in Research Gate. Literaturo bomo iskali z ključnimi besedami skill acquisition: IoT, Controller, blinds; ter z različnimi kombinacijami omenjenih ključnih besed.

Kontaktirali bomo proizvajalca senčil Roltek d.o.o., kjer bomo z njimi opravili intervju in preučili sisteme senčil, ki jih imajo proizvajalci. Na podlagi kritičnega pregleda sekundarnih virov bomo ugotovili, katere zahteve in potrebe imajo

proizvajalci senčil in katere zahteve in potrebe imajo potrošniki, da bodo kar se da enostavno upravljali senčila in imeli popolni nadzro nad sistemov.

V praktičnem delu raziskave bomo nalogo razdelili na dva dela in sicer:

1. praktični prikaz implementacije ADC krmilnika na obstoječi sistem senčil podjetja Roltek;
2. postaviti model z ADC krmilniki, ki bo podpora informacijskim sistemom senčil z namenom ustvariti nov tehnološki ekosistem na področju upravljanja senčil.

3 REZULTATI

Z majhno ekipo iz različnih področji, od strojne do programske opreme, smo leta 2017 začeli z razvijanjem rešitve za krmiljenje senčili. Po nekaj mesecih preučevanja obstoječih rešitev smo bili pripravljeni, da naredimo pomembne odločitve glede izbire tehnologij. Odločili smo se, da bo naša rešitev delovala preko WiFi-ja, saj bo le tako lahko naprava res povezana s celotnim internetom in jo bomo lahko krmilili iz kjerkoli, dokler bomo imeli internetno povezavo [2] [3] [4]. S to izbiro smo se prav tako odrešili potrebe po dragem zvezdišču (ang. hub), ki predstavlja dodatni strošek, kar je bila v naših očeh velika prednost. Prav tako nas je ta odločitev pripeljala do zelo enostavnega procesa konfiguracije; napravi je potrebno le omogočiti dostop do brezžičnega omrežja z internetnim dostopom, nato pa lahko za vso nadaljnjo konfiguracijo poskrbi naprava sama oziroma celoten proces je avtomatiziran. Po tem smo se odločili zgraditi prvi prototip. Tekom razvoja programske opreme, ki teče na mikro kontrolerju smo naleteli na mnoge težave in nova vprašanja, na katera prej nismo pomislili:

- Kako komunicirati z napravami, ki niso v dosegu mreže?

- Kako omejiti dostop do posameznih naprav?

- Kako overiti uporabnika in mu omogočiti dostop do naprav, saj so naprave imele povezavo do interneta, vendar je bilo do njih, brez njihovega ip naslova težko dostopati?

- Kako zagotoviti zanesljivost in varnost sistema?

- Kako povezati mikro krmilnik z obstoječimi sistemi senčenja?

Vprašanja so nas vodila k ustvarjanju centralnega strežnika, s katerim bi komunicirale vse naprave. Tako bi lahko vedno imeli povezavo do vsake naprave in omejili dostop do njih, saj bi morali vsi ukazi potovati preko strežnika, ki bi uporabnike overil in avtoriziral. S to odločitvjo je sicer lokalno krmiljenje preko brezžične mreže postalo nemogoče, saj nismo mogli neposredno komunicirati s krmilnikom, a je bila dodana varnost več kot vredna te izgube. Postavitev strežnika je bila prav tako zahteven podvig, saj nihče v ekipi ni dobro poznal strežniške tehnologije. Po nekaj tednih je bil postavljen naš prvi strežnik in razvoj se je lahko nadaljeval. Z nadaljnjim razvojem pa so prišli novi problemi, naša naprava je bila namreč popolnoma neoperabilna, kadar ni imela internetnega dostopa. Našemu produktu smo dodali možnost krmiljenja s stikalom, kar se je izkazalo za zelo zaželeno funkcionalnost pri bodočih kupcih.

Z delujočim prototipom in strežnikom smo se sedaj obrnili k razvoju aplikacije, s katero bi končni uporabnik lahko krmilil naše naprave. Iz dosedanjih raziskav ostalih rešitev, smo ugotovili, da aplikacije drugih ponudnikov niso vedno najbolj enostavne za uporabo. Torej je bil naš cilj dobro razumljen, razviti bi morali aplikacijo, ki je enostavna za uporabo vendar v ta namen ne zanemari funkcionalnosti.

Seznam naprav
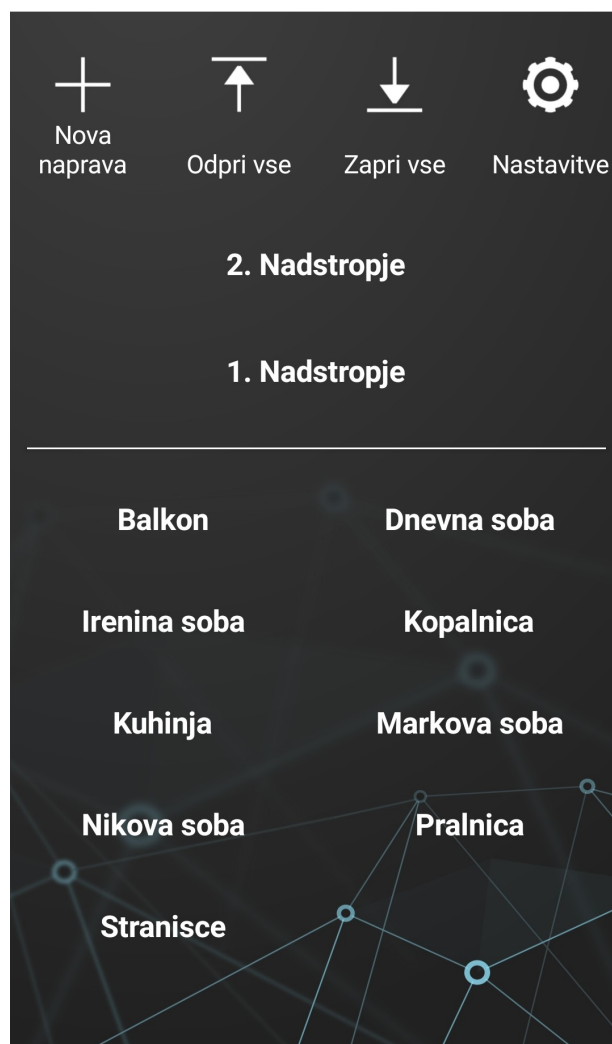
Slika 1: Seznam senčil v aplikaciji ADC

Tekom razvoja aplikacije (slika 1) smo po večih revizijah izpopolnili fizično napravo in program, ki je tekel na njej. Naprava je sedaj imela mnoge funkcionalosti, nekatere si na začetku, sploh nismo mogli zamisliti. Napravam smo dodali zmožnost širjenja WiFi omrežja in se tako rešili problemov z napravami, ki niso bile v dosegu obstoječega WiFi omrežja. Napravam smo prav tako, dodali urnik, s pomočjo katerega so lahko, ob v naprej določenih časih, same odprle oziroma zaprle senčila. Iz urnika smo prav tako razvili naključno premikanje, ki lahko odvrne morebitne vlomilce, kadar se za daljši čas ne zadržujemo v bližini stanovanja. Vsako napravo lahko dvignemo na željeno pozicijo, ki je prikazana grafično v obliki senčila in v odstotkih (slika 2).

Naš strežnik, ki je bil prvotno zasnovan le za kontrolo naprav, je moral z aplikacijo prav tako rasti. Kasneje je postala aplikacija tako zahtevna, da se je začel razvoj novega strežnika, ki bi skrbel le za komunikacijo med strežnikom za naprave ter aplikacijo. Z novim strežnikom, pa so prišle nove priložnosti. Iz dosedanjega razvoja smo se namreč veliko naučili. Na novem strežniku smo zelo izboljšali varnost, poenostavili notranjo uporabo in omogočili dostop do uporabnikovih naprav tudi drugim storitvam, ki jih pooblasti uporabnik. Tako bo v prihodnosti mogoče naprave krmiliti tudi z glasovnimi ukazi preko sistemov kot so Google Assistant, Siri, Neo, Eon, Alexa ... in jih vključiti v mnoge druge storitve.

Danes, 3 leta od začetka razvoja rešitve, rešitev še vedno ni popolna. Vedno se najde nova funkcionalnost, ki jo uporabniki želijo, vendar rešitev stoji na močnih temeljih, kar nam omogoča njeno širitev v skoraj katero koli smer. Brez daljšega obdobja razvoja, bi rešitev morda prav tako obstajala, vendar bi bila njena prihodnost nejasna. Zmožnost širjenja rešitve, sledenje najnovejšim razvojem in obvladovanje že obstoječe tehnologije, nas privedejo do zelo močnega produkta. Zelo pomembna pa je tudi ekipa in medsebojni odnosi, ki se razvijajta tekom razvoja.

Zavedamo se, da je danes vedno bolj pomembna komponenta čas, čas je denar. Kar v praksi največkrat pomeni manj je več, manj kompleksni stvari, več razumljivosti. S tem duhom tudi gradimo celotni koncept ADC sistemov, na razumljivosti in enostavnosti. Modul je majhnih dimenzij z namenom vgradnje v ozadje električne doze, kar stranki omogoča hitri priklop brez dodatnih gradbenih del. Kdor že uporablja stikala za upravljanje senčil se enostavno v ozadje električne doze namesti še modul in je stvar urejena. Modul je enostaven za priklop v električno omrežje, saj priklopimo napajanje modula, priklopimo senčilo in stvar deluje. Prav tako lahko priklopimo tudi fizično tipalo oziroma stikalo . Na modulu so slikovna navodila v standardni obliki kar vsak mojster, ki se spozna na električna omrežja lahko priklopi brez dodatnih navodil. Seveda smo navodila tudi pripravili, ki zajemajo manj kot 1 stran in še to v slikovni obliki z dodanim tekstom.

Aplikacija je v celoti v Slovenskem jeziku omogoča pa tudi svetovne jezike (Angleščino, Nemščino, Italijanščino, Srbščino, Hrvaščino). V aplikaciji so slikovni prikazi narejeni tako, da že iz slike razločimo roleto ali žaluzijo in tudi senčenost žaluzije. V ozadju pa opazujemo tudi vreme, ki ga napoveduje OpenWeather API. Aplikacija se naloži na pametni telefon na način kot večina aplikacij. Možnih je več poti do aplikacije, najbolj priporočamo, da obiščete našo spletno stran (www.adcsistemi.si) kjer se nahaja povezava do aplikacije. Lahko pa aplikacijo naložite tudi preko Trgovina Play ali App Store. Ko je aplikacija naložena nas tako imenovani čarovnik vodi skozi prijavo računa v ADC sistemu, kar lahko opravi vsak, ki je vešč telefonov. Ko imamo kreiran uporabniški račun lahko pričnemo z dodajanjem modulov na obstoječi sistem senčil. Aplikacija nas vodi skozi postopek spoznavanja, lahko pa prepustimo mojstrom - monterjem senčil, da opravijo inštalacijo v celoti. Po opravljenem procesu dodajanja naprave se zabava začne. Senčila upravljamo s telefonom. Poleg klasičnih uporabniških funkciji, kot so dvig, spust, delni spust senčil imamo možnost ustvariti si različne scenarije, časovni zamik premika senčil, funkcija dvig senčil ob sončnem vzhodu, kar aplikacija sama zazna, kdaj je to na lokaciji hiše, spust ob sončnem zahodu, ali pa naključno premikanje senčil (s tem vtis, da je nekdo doma - namen, da odvrnemo

nepridiprave pred vlomom). Vse to je možno upravljati tudi preko našega spletnega portala, ki je dostopen na naši spletni strani. Tako lahko naš sistem upravljamo z:

1. pametnim telefonom,

2. tablico,

3. spletni portal,

4. fizično stikalo.

← **Kuhinja**
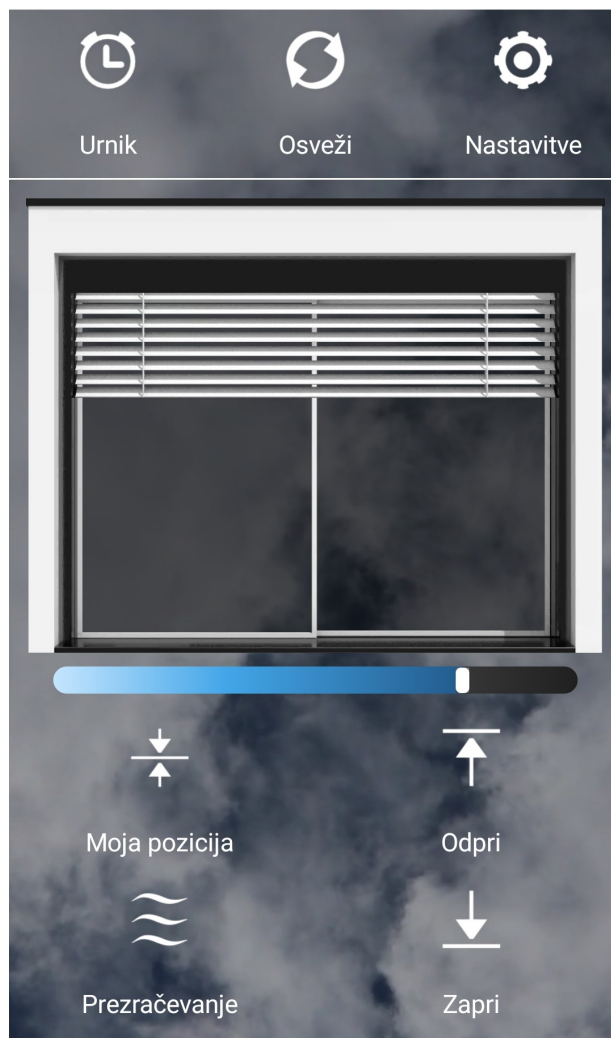
Slika 2: Krmiljene posameznega senčila

V podjetju ADC sistemi se zavedamo, da je za uspešno zgodbo o uspehu potrebno sodelovanje s trgom, zato tudi sodelujemo z monterji senčil. Za njih imamo pripravljeno predstavitev izdelkov in izobraževanje priklopa sistema. Ker je priklop modula enostaven, ne potrebujemo dolgih izobraževanj za monterje, v večini primerov samo predstavitev. Razumljivost in enostavnost aplikacije pa tudi omogoča izvedbo kratkega izpopolnjevanja znanja. Vse skupaj je tako enostavno, da temu ne moremo niti reči izobraževanje, bolj izpopolnjevanje znanja na drugačnost.

4 DISKUSIJA

Ob implementaciji ADC krmilnikov so se pojavile določene težave, ki jih nismo predvideli v začetku razvoja. Pri idejnem razvoju ADC krmilnika so se oprli predvsem na teorijo, vendar smo ob implementaciji ugotovili, da se teorija in praksa razlikujeta in nekaterih težav ob sami implementaciji v teoriji nismo zasledili.

Ob priklopu ADC krmilnika smo natelteli na težavo, saj je bilo premalo priključkov in nismo mogli prikklopiti motor senčila in pa fizično stikalo. Nato smo z podjetjem Wurth Elektronika našli terminal, ki ima dovolj priključkov za priklop celotnega sistema.

Pri določitvi položaja senčila smo imeli ogromno problemov, saj nismo mogli določiti natančnega položaja. Prvotno smo merili celoten čas dviga in spusta senčil in glede na čas določili natančen položaj. Vendar ta čas se je zaokroževal in vsaka nadaljna akcija je bila napačna in ta odstopanja so bila vedno večja in večja. Problem smo rešili tako, da smo v vezje vgradili senzor toka, ki nadzira premik senčila. In dokler se senčilo premika senzor toka zazna električni tok in na podlagi našega algoritma določi točen položaj senčila. Prav tako lahko z pomočjo senzorja toka ugotovimo, ali je senčilo spuščeno ali dvignjeno in pri uporabi fizičnega stikala lahko ugotovimo, kdaj je fizično stikalo prenehalo upravljati senčilo.

Pri določenih krmilnikih smo naleteli na težavo z omrežno povezavo. Povezava med krmilnikom in domačo mrežo je bila izredno slaba. Več kot 20 krmilnikov smo testirali in pri vseh so bile neke skrite napake. Nakar smo kontaktirali proizvajalca krmilnikov in jih opozorili na napake in jim posredovali naše rezultate. Proizvajalec je preučil naše rezultate in nam sporočil, da so skoraj vsi krmilniki bile kopije in da niso to njihovi krmilniki ampak kopije ostalih kitajskih podjetij. Poslali so nam njihove prave krmilnike in takrat se je kar nekaj napak odpravilo. Tudi povezave z mrežo so se same odpravile.

Ugotovili smo tudi pomankljivost, in sicer ko je sistem že deloval, smo našli "mrtve kote", ki jih naš krmilnik ni pokril, pa čeprav smo predvidevali da jih bo. Torej v teh kotih ni bila dovolj močna povezava domačega omrežja in našega krmilnika. Problem smo rešili z postavitvijo pametnega WIFI-ja. Vsak ADC krmilnik je lahko tudi dostopna točka in deli internetni signal naprej. To pomeni, da ni več mrtvih točk in stranki ni potrebno kupiti dodatnega ojačevalca WIFI signala.

Vsak dodatni krmilnik posledično povzroči povečanje količine prenosa podatkov. Več krmilnikov zagotavlja več API klicev. Zato smo skupaj z podjetjem DHH d.o.o. postavili strežnik in hitrost internetne povezave tako, da zadovoljimo vse potrebe in želje naših strank.

Fizična zaščita ADC krmilnika je zelo pomembna. Dostop mora biti omogočen samo določenim osebam, ki imajo znanje iz elektrotehnike.

Med testiranjem ADC krmilnika je prišlo do padca internetne povezave in tako do celotnega izpada ADC sistema. Kasneje smo ugotovili, da so bila kriva vzdrževalna dela, ki jih opravljalo podjetje Telekom d.d. Če ADC krmilniki komunicirajo v oblaku preko internetne povezave, potem je v tistem času, ko se opravljajo vzdrževalna Telekomova dela, sistem praktično mrtev. Še vedno pa senčila lahko upravljamo preko fizičnih stikal, saj za upravljanje le teh ne potrebujemo internetne povezave.

Na DHCP-ju moramo urediti IP naslove, saj ob daljšem izpadu elektrike seja poteče in se IP naslovi med seboj lahko zamenjajo, tako da v sistemu dobijo druga imena. Za rešitev enostavno nastavimo statične IP-je in nimamo nobenih problemov s tem.

Podjetje Roltek d.o.o. [1] nam je omogočilo celoten vpogled v sisteme senčil. Kot največji proizvajalec senčil smo od njih dobili informacije iz prve roke. Velikokrat so nam pomagali tako z nasveti, opremo, sistemi in pa tudi pri razvoju krmilnika. Predstavili so nam sodobne rešitve za krmiljenje senčil, ki so trenutno na trgu. Z njihovo pomočjo se je razvil ADC krmilnik do te mere, da je danes najsodobnejši krmilnik za krmiljenje senčil, kjer strankam zagotavlja varnost in enostavnost [5].

5 ZAKLJUČEK

Z napredkom tehnologije se je izbljaša tudi IoT tehnologija ki je postala boljša in cenovno dostopnejša večjemu številu ljudi. IoT nas spremlja na vsakem koraku npr. v službi, v trgovini, domofonih, šolah, letališčih in tudi doma.

Poznamo več vrst krmilnikov. Ko smo prebrskali nekaj različne strokovne literature, smo ugotovili, da je krmilnikov izredno veliko in se med seboj razlikujejo po ceni, velikosti, zmogljivosti, tehnologiji itd.

Najboljša podjetja na področju senčil nam ponujajo veliko sistemo za krmiljenje senčil od klasičnih sistemov, do sistemov z daljinskim upravljanjem in mobilnimi sistemi, kjer so krmilniki preko radijskega signala povezavni v dodatno centralno enoto. Naš model je postavljen sodobno in poleg interneta za delovanje ne potrebujemo ničesar.

ADC krmilniki so v Sloveniji za potrebe upravljanja senčil relativno novi, kljub temu pa se že nezadržano pričenjajo uveljavljati, največkrat v kombinaciji z senčili, ki se upravljajo preko fizičnih stikal.

Iz predpostavljene realizacije ADC sistema za potrebe krmiljenja senčil je razvidno, da omenjena tehnologija poleg svoje praktične vrednosti, ki se izraža predvsem v bistveno kakovostnejšemu WIFI signal, v sodobni izvedvi strojne opreme, z možnostjo dostopa do nastavitev omrežnih naprav na daljavo ter v prihranku instalacij, saj za svoje delovanje internetno povezavo brez vsakršnih dodatnih centralnih enot ali zvezdišč.

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Šolsko delo na daljavo v osnovni šoli

Distance learning in primary school

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POVZETEK

Sredi marca 2020 so osnovne šole zaprle šolska vrata in nihče ni vedel za kako dolgo. Občutki vsakega izmed nas so bili različni, a zaskrbljenost je naraščala. Kako sedaj? Vrženi smo bili iz cone udobja v neznano. Občutek varnosti je zamenjal občutek negotovosti. Postavljeni smo bili pred dejstvo, da bo pouk potekal zelo drugače. Spoprijeti smo se morali z novim načinom dela, ki je marsikomu povzročal velike težave. Če smo do sedaj imeli odpor do računalnika, smo ga lahko zdaj imeli še bolj, saj se nihče ni zavedal, kaj bo to potegnilo za seboj. Ure in ure sedenja pred računalnikom, ure in ure dela z računalnikom. Celotno delo je bilo treba spremeniti in prilagoditi. A rezultati niso nič kaj vzpodbudni. To je bilo težko delo za učitelje kot za učence in njihove starše. Pouk na daljavo je relativno dobra rešitev v stiski, a ne za daljše obdobje. Povečujejo se razlike v znanju in socialne razlike. A pouk ni le pridobivanje znanja. Primanjkljaj se je čutil prav tako v socialnih interakcijah. Kljub vsem težavam, ki smo jih pri delu na daljavo imeli, smo se marsikaj naučili, saj smo razvijali digitalne kompetence, ki so sredstvo za vseživljenjsko izobraževanje.

KLJUČNE BESEDE

Računalnik, pouk na daljavo, znanje, socialne interakcije, digitalne kompetence

ABSTRACT

In mid-March 2020, schools closed their doors, and nobody knew how long they would have to stay closed. Everyone's feelings were different, but the feeling of concern kept growing. What now? We were taken out of our comfort zone into the unknown. The feeling of safety was replaced by the feeling of uncertainty. We were faced with the fact that classes would need to take on a very different format. We had to deal with a new way of working, which caused problems for many. If any of us had had an aversion to using computers before, this aversion became even more prominent now, since no one was aware of what this situation would entail; hours and hours of sitting in front of a computer, and hours and hours of working on a computer. Our whole work method had to be changed and adapted. But the results are not very encouraging. It was hard work for the teachers as well as for the students and their parents. Distance learning is a relatively good solution in times of need, but not for long periods of time. Differences in the students' knowledge and their social differences are increasing. Teaching is not only about gaining knowledge. The students' are lacking in social interactions. Despite all the difficulties we encountered in working remotely, we learned a lot, and we developed digital competencies that are a means of lifelong learning.

KEYWORDS

Computer, distance learning, knowledge, social interactions, digital competency

1 UVOD

Ko smo 13. marca 2020 poslali učence domov, si niti v sanjah nismo predstavljali, kaj nas je doletelo. Zadnji dan so prišli le tisti, ki niso imeli varstva ali so želeli še zadnji dan videti sošolce. Tudi učitelji in drugi delavci šole nismo vedeli, kaj nas čaka. Naše življenje in delo se je zelo spremenilo. Znašli smo se doma sami ali v krogu družine in za računalnikom. Kolikokrat smo ostali brez internetne povezave? Brez računalnika in interneta učitelji nismo mogli delati. Nihče ni pričakoval, da se bo šolsko leto odvijalo brez šolskih klopi in učilnic. Začeli smo delati od doma, na svojih računalnikih. Redki so tisti učitelji na naši šoli, ki so dobili službene računalnike. Kako težko je šele bilo družinam doma z več otroki. Koliko je bilo takih, ki so imeli doma samo en računalnik. Kako so zmogli delo tisti starši, ki so imeli enega ali dva otroka na 1. vzgojno izobraževalnem obdobju in drugega ali tretjega otroka na 2. ali 3. obdobju. Koliko otrok je bilo takih, ki so mislili, da so to zanje počitnice? Koliko je bilo takih, ki jim starši niso zmogli ali znali pomagati? Starši so postali podaljšana roka učitelja. Prav gotovo je bilo lažje tistim učencem, kjer so starši izobraženi in je socialna slika dobra.

Ker sem zaposlena kot knjižničarka, sem za nekaj ur hodila v službo in vnašala knjige v sistem Cobiss. Ko sem prišla domov, pa se je začelo še delo za slovenščino. Poučevala sem eno heterogeno skupino v 9. razredu. Po dveh tednih in več, ko sem se pogovarjala s sodelavkami, nisem mogla razumeti, zakaj si želijo nazaj v šolo. Seveda, sama hodila sem vsak dan v službo, one ne. Imela sem samo eno skupino, sodelavke, ki so učile slovenski jezik od 6. do 9. razreda in s tem po sto in več učencev. Naši računalniki so pregorevali. Za devetošolce je bilo lažje, ko so se konec maja vrnili v šolo. Tudi učiteljice so prišle za eno uro pouka v šolo in nato za ostale delale naprej od doma.

2 DELO NA SPLETU

Naše delo se je preselilo na splet. Goethe je nekoč zapisal: » Le dve poti vodita do pomembnega cilja in do izvajanja velikih stvari: moč in vztrajnost…« Postali smo močni in vztrajni, da smo lahko z nepopustljivo in strogo voljo peljali stvari naprej. Naša šola uporablja Arnesove storitve: Arnes pošto, Arnes splet, Arnes spletne učilnice. Naše delo na spletu ne bi mogli dobro opravljati brez naših računalničark, ki sta z nami delili, kar so nam na Arnesu pripravili za lažje delo s spletnimi učilnicami. To so uporabniški vodiči in video vodiči. Učiteljica računalništva je pripravila podrobna navodila, kako učenci dostopajo do spletne učilnice in kako oddajo nalogo v spletni učilnici. Tako so učenci prejemali gradivo v spletnih učilnicah, v stiku z učitelji pa so bili preko elektronske pošte, telefona, eAsistenta, video konferenc. V pomoč pri delu na daljavo smo se obračali na sodelavce, vodstvo šole in na računalničarki. Tako je tekla interakcija med učiteljem, učenci in tudi s starši. Viden problem, ki se je pojavil, so bile različne video konference. Učitelji, ki so jih uporabljali za stik z učenci, so uporabljali vsak svojo (Teams, CiscoWebex, Google Meets, …), kar je lahko bilo za starše stresno.

Na naši šoli smo se pred več kot desetimi leti začeli ukvarjati s spletnimi učilnicami. Vsak predmet je izdelal svojo spletno učilnico in vanjo naložil nekaj snovi za pouk. Učiteljice od 1. do 5. razreda so pripravile učilnice za svoj razred. Za pouk slovenskega jezika se je s tem podrobneje ukvarjala sodelavka, ki je ob pomoči druge sodelavke (ta je prišla začasno iz druge šole) uspešno naložila nekaj učnih snovi za pomoč pri izvajanju pouka. Pripravili sta učilnice od 6. do 9. razreda. Ko nas je začasna sodelavka zapustila, je kolegica slavistka, že vse obvladala in nadaljevala z začetim delom. Tako smo lahko tudi ostale slovenistke s pridom uporabile snovi, ki so bile naložene. Drugi dve slovenistki sta s spletnimi učilnicami bolj malo ukvarjali. Sama se tudi nisem, saj sem zaposlena v knjižnici. Moje delo v tem času je potekalo vsak dan po nekaj ur v šoli, kjer sem vnašala knjige v sistem Cobiss.

V času dela na daljavo smo bile vse štiri postavljene pred dejstvo, da bo treba drugače delati. S sodelavkami smo se poenotile in strinjale, da naložimo tedensko delo. Za prvi teden je kolegica – začetnica spletnih učilnic uporabila že naloženo snov Power Pointu – Ponovitev književnih obdobij za 9. razred. Ker ostale učijo še 6. ,7. in 8. razred, so morale tudi za njih pripraviti delo. Začelo se je brskanje, iskanje, izbiranje informacij ter hkrati shranjevanje in priklic informacij [2]. Vsak razred so posebej nagovorile z vzpodbudnimi besedami. Vedele smo, da bodo učenci potrebovali prvi teden za vpis v spletne učilnice več časa in navodil. Seveda so hitri in vestni učenci to hitro osvojili in se redno prijavljali ter delali. Drugi, spet so si vzeli nekaj časa in počasi prihajali vanje. In tretji so bili taki, ki so zelo poredkoma vstopali v učilnice in zelo malo delali. Tudi za naslednji teden je kolegica naložila delo - reševanje NPZ-ja. Tu so se vsaj nekateri učenci lotili reševanja in preverili svoje usvojeno znanje. V tretjem tednu smo se dogovorile, da začnemo tam, kjer se je končala snov v šoli, torej pri priredno zloženi povedi [3]. To snov so učenci usvajali preko Rokusovega delovnega zvezka. Začele smo torej ustvarjati vsebine, ki so učencem olajšale delo. Dobili so natančna in jasna navodila, da so lahko razumeli posamezno snov pri jezikovnem pouku. Potem so po navodilih zapisali novo snov v zvezek, si pri tem pomagali z delovnim zvezkom in nadaljevali z reševanjem podobnih nalog.

Tako smo postopoma začele nalagati novo snov. Pazile smo, da dela ni bilo preveč. Ker so kolegice učile več razredov, so se naučile prej nalagati snov kot jaz. Tudi mene je čakalo, da

poskusim. Seveda smo se prej vedno dogovorile, kaj bo obravnavana snov in katera bo naložila za posamezni razred. Ker sem učila le 9. razred, sem se ob pomoči kolegice hitro naučila, kako naložiti snov oziroma mapo, v kateri so navodila, naloge za utrjevanje in rešitve. Po nekaj tednih slovnice smo želele razbiti monotono delo z delovnikom in začele razmišljati o branju knjige za domače branje. Imele smo težavo, saj si učenci niso pravi čas izposodili knjigo. Ta tehnični problem smo rešile tako, da sem knjigo optično prebrala. Druga kolegica je pripravila navodila. Poslala mi je navodila in mi naročila, naj dodam še kakšno sliko. Tako sem prvič priložila tudi sliko. Tako smo na nov, izviren način pripravile domače branje.

S pomočjo računalničarke sem pripravila tudi spletno učilnico za knjižnico, ki je prej še nisem imela. Vanjo so lahko učenci od 6. do 9. razreda nalagali svoje zapise o prebranih knjigah za bralno značko. Veliko učencev je vsaj vstopilo vanjo in malo pogledalo, kako deluje. Pogumnejši so vanjo pridno nalagali svoje zapise o prebranem.

3 KOMUNIKACIJA Z UČENCI

Gospod ravnatelj nas je v soboto, 14. 3. 2020 prebudil z vzpodbudnim mailom, da v ponedeljek začenjamo z izobraževanjem na daljavo. Med drugim je zapisal, da se na takšno izobraževanje nismo pripravljali, ampak naj vseeno poskusimo biti fleksibilni, kreativni in da se bomo učili sproti. To bomo učili tudi naše učence, kot na primer fleksibilnost, odgovornost, kreativnost, kritično razmišljanje, sodelovanje in še kaj. Prosil nas je, naj v začetku ne pretiravamo z nalogami. Prvi teden naj bo namenjen spoznavanju z novim okoljem. Naj normalno zadihajo tudi učenci. V prvem tednu nam je dal za nalogo, naj preverimo, koliko učencev dostopa do učilnic, kje so težave pri tistih, ki se ne oglašajo in kako jim lahko pomagamo. Svetoval nam je naj uporabljamo elektronsko pošto kot komunikacijsko orodje. Imajo jo vsi učenci od 4. razreda naprej. Pri ostalih naj učitelji uporabljajo eAsistent kot orodje za komunikacijo s starši. Svetoval nam je, naj bo prvi teden tak spoznavni teden, kjer se bomo tudi mi spoprijateljili z novim načinom dela.

Tako so prvi dnevi potekali v iskanju kontaktov z učenci in njihovi starši in vstopanju v spletne učilnice. Z delom na daljavo smo začeli razvijati tudi digitalne kompetence, in sicer interakcijo prek tehnologij, izmenjavo informacij in vsebin [2]. Tu sta bili v veliko pomoč naši računalničarki. Starši so pri mlajših učencih potrebovali tehnično pomoč. Tu smo se še enkrat srečali z varovanjem osebnih podatkov oziroma digitalno identiteto. Ne smemo pozabiti na razlike v izobrazbenih, kulturnih in drugih ozadjih učencev. Prav tako so imeli razredniki dodatno obremenitev, kajti morali so vstopiti v kontakt s starši, katerih učenci se niso odzivali. Sodelavka je na zadnji konferenci v svojem poročilu izjavila dobro misel: » Učitelj ne postaneš le zato, da učiš, ampak skozi učenje vzgajam še marsikaj drugega, vsega ostalega za življenje. «

Kakšen je bil odziv učencev moje skupine?

Prvi teden sem jih pustila čisto na miru in samo opazovala njihove prijave v spletne učilnice. Že v prvih 14 dneh smo s strani računalničarke dobili tabelo v Onedrivu po razredih, za vse predmete, v katero smo vnašali učenčeve odzive. Učenci so v navodilih dobili navodila, da svoje delo poslikajo in nam pošljejo na mail. Delovni in marljivi učenci so to storili včasih že prvi dan. Ostali pa v teku tedna. Nekaj je bilo takih, ki niso redno pošiljali svojega dela. Imela sem tudi primer učenca, ki je ostal neodziven. Odziven pa je bil pri zgodovini, ker ga je zelo

zanimala. Poseben je bil tudi učenec, ki tudi pri rednih urah ni veliko naredil. Svoje delo je znal strniti v dve povedi. Na začetku se nekaj tednov ni oglasil, potem pa je imel izgovor, da mi ne more poslikati svojega dela, ker mu na telefonu ne dela fotoaparat. Ker poznam njegovega dve leti starejšega brata, sem mu svetovala, naj poskusi z bratovim. Potem se nekaj tednov spet ni oglasil. Učenka Romkinja je prav tako ostala neodzivna. Ona ni znala niti uporabljati maila. Za pomoč sem prosila njeno sošolko, naj ji pomaga. Proti koncu ji je uspelo prijaviti se v spletno učilnico in mi napisati kratek mail, da nekaj dela. Ker je že prej imela učne težave, ji je to, da je ostala doma zelo odgovarjalo. Razredniki so spremljali odzivnost učencev in o neodzivnosti obveščali ali klicali starše.

Ko se je začelo pošiljanje dela učencem na mail, se je začel drugi del našega dela. Ta del se je raztegnil čez cel dan in tudi v večerne ure in te prisilil, da si bil učencem ves čas na razpolago. Pregledati je bilo treba naloge, ki so jih rešili in jim poslati povratne informacije. Pri odgovarjanju na njihovo pošto sem vsakega vljudno ogovorila, zapisala nekaj spodbudnih povedi ali besed in dala informacije o njihovem delu. Učenci, ki niso redno oddajali nalog, so bili po navadi tisti, ki imajo tudi težave s komunikacijo. To sem opazila pri njihovih sporočilih, ki so bila kratka in jedrnata (slika 1). Na srečo niso poslali sporočil, kot si jih pišejo med seboj in so slovnično nepravilna. Pri učencih, ki so sproti oddajali, so bili takšni, ki so v množici podatkov znali izlušiti ključne informacije (slika 2), jih sintetizirati in uporabiti v novih pomenih. Opazila sem, da so taki bili vztrajni pri vseh predmetih in so si znali delo razporediti, da jim je delo lepo teklo (slika 3). Niso spali do 12.00, ampak so začeli z delom zjutraj, kot bi bili v šoli. Popoldne so lahko bili prosti. Učenci, ki si takšnega urnika niso zastavili in niso sproti oddajali nalog, se jim je delo nabiralo, tudi za več tednov. Takšni bi potrebovali nadzor staršev. Če je bilo v družini več otrok, so starši morali pomagati in delati z mlajšim in zato so od starejšega pričakovali, da zmore sam. Tako so morali prevzeti odgovornost za svoje znanje in se pri tem svobodno odločali. Vendar vsi tega ne znajo oziroma ne zmorejo.

S tem, ko smo bili učencem ves čas na razpolago za odgovarjanje na njihove poslane naloge, se je naš delovnik zelo zelo raztegnil. Zavedamo se, da je bilo veliko individualnega pristopa – telefon, elektronska pošta, eAsistent, video konference. Ker vsega o učencih v tem času ne vemo, smo jim dajali spodbude, jih tolažili. Ne vemo ali imajo vsi varno okolje, so morda lačni? Veliko srčnosti, topline bi potrebovali takšni učenci.
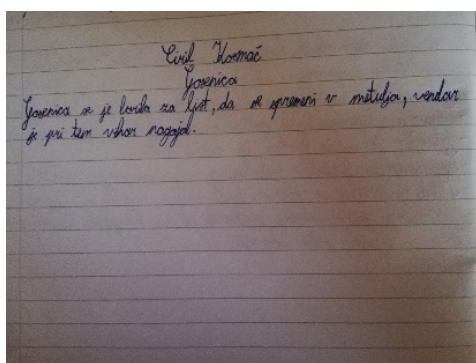
Slika 1. Primer dela učenca
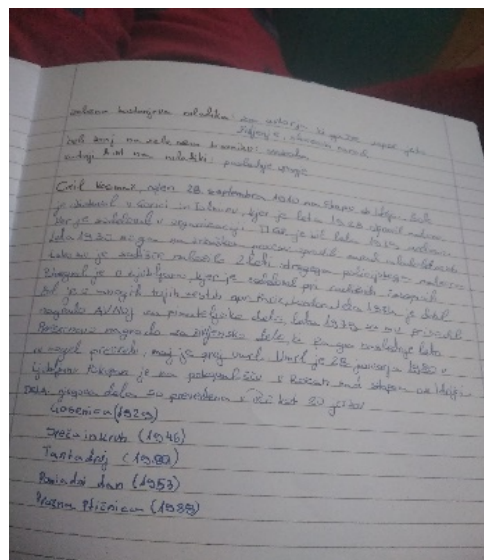
Slika 2. Primer dela učenca
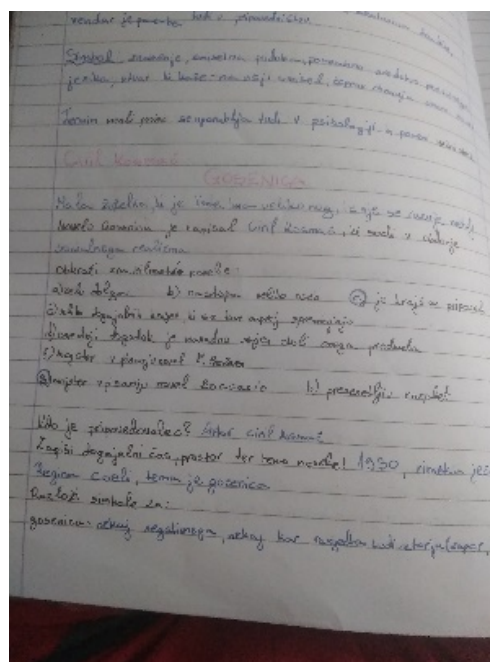
Slika 3. Primer dela učenca

Tako se je tudi vso njihovo delo preselilo na računalnik. Koliko smo jih prej odvračali od tega, so sedaj bili primorani sedeti pri računalniku in delati vse predmete. Ne vem, če so po nekaj urnem sedenju še imeli voljo do njihovih računalniških igric. Predvidevam, da je bilo tega sedaj manj. Za tiste, ki niso imeli preveč nadzora svojih staršev, so verjetno izkoristili in namesto šolskega dela igrali igrice. Taki so tudi neredno ali zelo malo oddajali svoje delo.

A učenci so pogrešali stik s sošolci, prijatelji, razlago snovi, debato, tudi učitelje, razredničarko. Primanjkljaj se je kazal v socialnih interakcijah (topli, iskreni medosebni odnosi so manjkali vsem). Vsi vemo, da je opremljenost z računalniki premalo. Potrebno je računalnik znati tudi uporabljati.

4 DAN DEJAVNOSTI PREKO SPLETA

Da smo vsaj malce razbili naporne delovne tedne, smo razmislili o dnevih dejavnosti. Stališče vodstva šole glede tega je bilo, da je najbolj smiselno izvesti kulturni dan, zato nam je poslalo nekaj idej in tem. Znotraj aktivov smo se pogovorili, izbrali tematiko, pripravili dejavnosti. Kulturni dan smo izvedli 23. 4. 2020. Za vsako izobraževalno obdobje je bil določen vodja, ki si je izbral ožji tim in skupaj pripravil navodila za učence in učitelje. Izbrali so ustrezne vsebine, gradiva, vse to naložili v spletne učilnice, se dogovorili o načinu analize dneva in podajanja povratnih informacij učencev. Nabor vsebin za učence od 6. do 9. razreda je zajemal: ogled filma (po lastni izbiri, slovenskega filma ali Pay it Forward) ali ogled predstav Lutkovnega gledališča Ljubljana Vihar v glavi, Tajno društvo PGC) ali ogled virtualnih razstav, učne ure, dokumentarnih filmov. Pri vsaki vsebini so bile navedeni tudi predlogi za dejavnosti, ki si jo izbere učenec sam. Dejavnosti je lahko zapisal, posnel avdio ali video, izdelal PPT predstavitev, narisal strip… Izbrano dejavnost so naložili v spletno učilnico dan dejavnosti pod svoj razred do določenega datuma. Drugi njihove naloge je obsegal izpolnjevanje ankete kulturnega dne. Razredniki so v oddaji nalog za svoj razred prebrali in pregledali njihovo delo, zapisali komentarje in ocenili z opravil ali ni opravil. Kot sorazrednik sem imela vpogled v oddajo nalog 9. c, komentarje in ocene je opravila razredničarka. Tudi tu smo z reševanjem problema ustvarjalno rabili tehnologijo [2].

5 ZAKLJUČEK

To šolsko leto je bilo zelo naporno tako za učitelje na eni strani in učence ter njihove starše na drugi strani. Vsi učitelji se zavedamo, da smo delali veliko več kot kdajkoli. Obremenitve so bile tako velike, da so si učitelji želeli nazaj v učilnice. Čeprav smo trdo delali, vemo, da to obdobje lahko z visoko oceno ovrednotimo le po svojem vloženem trudu, trudu staršev in otrok, verjetno pa ne tudi po usvojenem znanju učencev. Zavedamo se, da vrzeli v znanju bodo. Na mestu je izjava dr. Zdenka Medveša, da izobraževanje na daljavo ne more doseči tempa, širine in globine rednega izobraževanja [1].

Psihoterapevt Miha Kramli, ki je strokovnjak za kemične in nekemične odvisnosti, predvsem za odvisnosti od novih tehnologij, poudarja, da je internet koristna stvar, ki

omogoča napredek, a je lahko tudi past. Sprašujem se ali bo računalnik postal učencev obvezen pripomoček?

In kakšni so rezultati? Ker so to bili devetošolci, kjer je bilo prej veliko ponavljanja snovi pred epidemijo, utrjevanja in delno že nekaj priprav na NPZ-je, velikih vrzeli v znanju slovenskega jezika ne bo. Nova snov, ki so jo predelali na daljavo je bila priredno zložena poved, ki ni preveč zahtevna. Prav tako ne gre le za znanje in kritično razmišljanje, ampak tudi za oblikovanje mlade osebnosti kot celote. Znanje je res pomembno, a v življenju so pomembne še druge sposobnosti, veščine, interakcije.

Zaključila bi z pomembno mislijo sodelavke, da učitelj ni le podajalec učne snovi, je tudi vzgojitelj, svetovalec, mentor, opora v stiski in še marsikaj, in da je še kako pomembna gradnja odnosov. A jeseni bo slika lahko spet drugačna. Zato se bomo nanjo bolje pripravili z novimi spletnimi izobraževanji. Dogovorili se bomo, da poenotimo video konference in da vsi uporabljamo isto. Slovenistke smo prišle do spoznanja, da bo treba razmisliti, kako bodo učenci še kaj prebrali. Vsi se zavedamo, da je pomen tehnologije v našem vsakdanjiku vse večji in večji, zato tudi digitalne spretnosti postajajo vse bolj prisotne in pomembnejše.

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Poustvarjanje Povodnega moža z animacijo

The re-creation of The Water Man (Povodni mož) with animation

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POVZETEK

Danes živimo v dobi, kjer se dnevno srečujemo z animacijo, saj je ta narejena tako, da privabi. Njena vabljivost je lahko odlično sredstvo za izobraževanje. V prispevku predstavljam, kako smo se je lotili v tretjem razredu na temo Prešernovega Povodnega moža. Zgodba je posneta v stop motion tehniki, postopku, pri katerem se s serijo fotografij posname film. Scena in liki so izdelani iz kock Lego, kar še dodatno spodbudi mlajše otroke za ogled posnetega filma. Uporabna je kot didaktični material v šoli.

KLJUČNE BESEDE

Animirani film, stop motion, lego animacija, balada Povodni mož

ABSTRACT

We live in an age where we encounter animation on a daily basis due to its wide appeal. This also makes it an excellent means for education. This article presents the use of animation in the third grade of primary school. The theme that is presented is France Prešeren's poem The Water Man (Povodni mož). The story was filmed in the stop motion technique, a procedure in which a film is recorded with the aid of a series of photographs. The scene and the characters are built from Lego bricks, which further motivates young children to watch the movie that was recorded. The story is wholly useful as didactic material in school.

KEYWORDS

Animated film, stop motion, Lego animation, ballad The Water Man (Povodni mož)

1 UVOD

Z animiranimi filmi se v današnjem času otroci srečajo že zelo zgodaj. Njihov svet jim pogosto predstavlja del preživljanja prostega časa. Naloga nas odraslih je, da jih v ta svet navideznega oživljanja lutk, predmetov ali risanih figur vpeljemo čimbolj načrtno in premišljeno.

2 ANIMIRANI FILM PRI POUKU

Že od nekdaj me je svet animiranega filma privlačil.

Pri pouku sem sprva uporabljala animirani film le kot motivacijsko sredstvo. Z razvojem, dostopnostjo ter s pravim izborom kvalitetnega materiala pa vedno pogosteje tudi v učne namene.

Na področje ustvarjanja animiranih filmov se nisem nikoli spustila, saj nisem imela dovolj potrebnega znanja, zato sem se vključila v delavnico ustvarjanja animiranega filma v okviru Art kino mreže Slovenije. V njenem sklopu sem dobila osnovna znanja o ustvarjanju animiranega filma. Pridobljeno zanje o tovrstni tematiki sem poglobila s prebiranjem priročnikov in literature. To mi je dalo zagon, da poskusim predstaviti animirani film učencem tudi z vidika lastnega ustvarjanja.

3 NASTAJANJE ANIMIRANEGA FILMA

3. 1 Idejna zasnova in izbor tehnike

Na začetku so bili učenci seznanjeni z osnovami animiranega filma. Učenci so že poznali slikofrc ali listanko. Pogledali smo se nekaj kvalitetnih kratkih animiranih filmov z različnimi tehnikami. Z razgovorom in ogledovanjem gradiva o različnih vrstah animacije sem želela vzpodbuditi in usmerjati učence na poti kakovostnega sprejemanja filmske umetnosti, da o njej razmišljajo in so tudi sami ustvarjalni.

Učenci so se navdušili in se želeli z mojo pomočjo preizkusiti v animiranju.

Najprej je bilo treba določiti zgodbo, ki bi jo animirali. Po razgovoru z učenci je bila izbrana zgodba o prevzetni Urški iz Prešernove balade Povodni mož. Tej odločitvi je botrovalo več dejavnikov. Prvi je bil prihajajoči kulturni praznik, 8. februar, in priprava proslave. Menili smo, da bi jo lahko popestrili s poustvarjanjem Povodnega moža v obliki animacije. Za to besedilo so se učenci poenotili, ker so ga že natančno poznali iz 2. razreda.

Najprej sem z učenci obnovila vsebine v okviru pouka slovenščine in pesnitev spremenila v prozno besedilo. To je potekalo frontalno z razgovorom.

Naslednji korak je bila delitev zgodbe po delčkih. Ob listanju slikanice smo zgodbo povzemali po delih. Nastajali so prizori, ki so kasneje služili pri animaciji. Pri tem smo zapisovali besedilo, kaj se v posameznem prizoru dogaja. Zgodbo smo razdelili na štirinajst kratkih delov.

Učenci so se dogovorili, kdo bo bral posamezen del.

Sledil je izbor tehnike.

Ker sem se z ustvarjanjem animacije srečala prvič, nisem vedela, katero tehniko bi izbrali. Ob iskanju različnih posnetkov s spleta so mi učenci pokazali svoje priljubljene videoposnetke. Ogromno jih je bilo narejenih v Lego stop motion animaciji. Ta sodi v kategorijo tako imenovanih »brickfilmov«.

Pri tem so plastični gradniki ali kocke lego sredstvo za izdelavo likov in scene.

Od tu dalje izbira tehnike ni bila več pod vprašajem. Prednost kock Lego, kot osnovnega pripomočka za izdelavo posameznih situacij, je bila logična izbira zaradi njihove dostopnosti. Otroci so jih imeli doma ogromno, pa tudi v moji domači hiši se jih je našlo kar nekaj primernih za izdelavo likov in postavitev scene.

3.2 Postavitev scene

Postavitev scene je zahtevala veliko organizacijskega dela. Učenci so bili precej neučakani, saj so vsi želeli pri tem sodelovati. Tako smo si za ustvarjanje vzeli več časa, kot sem ga sprva načrtovala. Učenci so ustvarili več možnih prizorišč, nato pa smo združili posamezne izvirne ideje. Vendar so bile omejitve s številom kock in velikostjo snemalnega prostora, zato smo sceno zelo poenostavili, saj ni bila bistvena za razumevanje dogajanja.

Kasneje smo ugotovili, da je zelo pomembno, da je scena stabilna in da se sredi snemanja ne premika. V določenih delih pozornemu opazovalcu ne uide premikanje objektov, ki bi morali biti pri miru iz kadra v kader.

Postaviti smo jo morali tako, da smo lahko snemali s fotoaparatom.

Ozadje trga, kjer se je odvijala osrednja zgodba, smo prelepili z nevtralnim modrim papirjem. Dogajanje se vrti le na enem prizorišču, kar je izvedbo olajšalo.

3.3 Priprava likov

Z učenci smo poiskali med lego figurami take, ki so ustrezale glavnim in stranskim osebam zgodbe. Na srečo so v industriji pred nedavnim izšle lego kocke takšne serije, ki smo jih lahko uporabili.

Vendar pa so karakteristike figur lego omejene z izražanjem čustev in na to je bilo treba biti pozoren pri snemanju. Objekti nudijo nekoliko okornejše animiranje, saj se je potrebno prilagajati njihov konstrukciji.

Izbira likov je pogojevala tudi izbiro raznih dodatkov za figure, ki bi dodatno prikazovala avtentičnost zgodbe, seveda pa je bil nabor omejen.

3.4 Prostor za zajem slike in oprema

Priprava prostora za snemanje: sestavila sem preprosto mizo za animacijo in jo osvetlila. (slika 1) Vso tehnično opremo sem dobro pritrdila, da bi se svetloba čim manj spreminjala. Uporabila sem dva reflektorja in osebni računalnik.

Zajem fotografij je potrebno opraviti v čim krajšem možnem času, da bi se svetloba čim manj spreminjala. Popolne zatemnitve v razredu namreč ni mogoče doseči. Iskanje pravih reflektorjev za osvetljevanje scenskega prostora mi je predstavljal enega večjih problemov in popolne rešitve kljub popravkom do konca nisem našla. V drugem delu sem pri zajemu dodala močan reflektor, ki je sicer svetlobo prostora izboljšal, hkrati pa je bil

tudi nevaren, saj bi se lahko kdo od animatorjev pri dotiku spekel. Na srečo takšnih incidentov ni bilo.

Zajem fotografij smo opravili s prenosnim računalnikom. Pomembna lastnost, ki je pogojevala izbiro tega prenosnika je bila vgrajena kamera. Ta je omogočala fotografiranje spredaj in zadaj. Prenosnik je bilo lažje pritrditi kot tablični računalnik ali telefon.
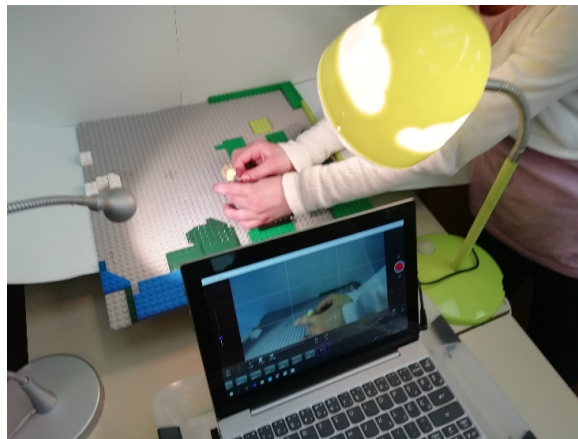
Slika 1. Priprava prostora za snemanje.
(Vir: B. Gabrijelčič)

3.5 Animiranje s pomočjo računalnika

Animirali smo v tehniki stop animacije, snemanje sličice za sličico. Snemali smo do 15 sličic na sekundo. (slika 2) Gib, za katerega smo želeli, da ga naš lik naredi v filmu, smo razdelili v več majhnih premikov. Vsak takšen premik smo fotografirali. Figure smo premikali počasi, sliko za sliko in sproti preverjali njihovo postavitev v dogajanju. Nekatere prizore smo morali zaradi napak večkrat ponoviti in ponovno posneti. Zaradi omejitev s časom in neizkušenostjo smo nekatere prizore iz scenarija sproti dopolnili in poenostavili.

Slika 2. Zajem fotografij. (Vir: B. Gabrijelčič)

Učence sem razdelila v manjše skupine, da so animirali Premike likov smo določili na podlagi zgodbe. Pri animiranju sem učence spodbujala k ustvarjalnosti, iskanju rešitev in sledila njihovim idejam pri prikazu dogodkov. Pri tem je bila potrebna uskladitev in dobro timsko delo udeležencev. Pri snemanju so si učenci v skupini, ki je bila na vrsti, razdelili vloge. Dva v skupini

sta animirala in skrbela za opremo, tretji je opravljal zajem slike preko prenosnega računalnika. Sama sem skrbela za koordinacijo. Vsak del so se skupine menjale, ker se vsi učenci želeli priti na vrsto.

Učenci so spoznali, da je samo snemanje zamudno in lahko zahteva veliko časa. Ob zaključku snemanja smo bili že vsi pošteno izmučeni.

Učence sem vključila še v izbiro glasbe, v izdelavo uvodnega dela ter vmesnega dela z nevihto.

S posamezniki je bilo potrebno posneti pripovedni del. To smo storili kar preko diktafona na prenosnem računalniku. Uporabili smo slušalke z mikrofonom, da je bil zvok čistejši.

To smo opravili v naslednjih dneh. Uvodni del in del z nevihto je posnet s telefonom in z drugačne perspektive. (slika 3) Pritrjen je bil med dvema reflektorjema s tlorisnim pogledom. Slike so zajete postopoma, z dodajanjem kock. Ob neprekinjenem predvajanju zaporedja fotografij se je ustvarila iluzija gibanja.

Slika 3. Nastajanje uvodnega dela. (Vir: B. Gabrijelčič)

3.6 Montaža

Ustvarjanje animacije, ki ga je bilo treba zaključiti z obdelavo in dodajanjem zvoka, sem opravila sama. Zajete sličice sem izvozila iz programa Stop motion Studio. Pri izbiri programa za montažo sem se odločila za program Animotica. To je enostaven, brezplačen program. Z majhnim doplačilom sem pridobila dodatne možnosti in izbris njihovega logotipa na končnem izdelku.

Pri združevanju zajetih sličic in posameznega prebranega odseka sem morala slediti času trajanja prebranega. Če je bil prebrani del daljši in je sličic primanjkovalo, sem jih podvojila. Paziti je bilo treba na popolno ujemanje prebranega in animacije.

Uvodna špica je trajala 14, vmesni del z nevihto pa 7 sekund. Končni izdelek je tako dolg 2 minuti in 21 sekund.

4 OGLED FILMA OB KULTURNEM PRAZNIKU

Animirani film je bil prikazan kot del proslave ob kulturnem prazniku za učence prve triade. (slika 4) Odziv je bil pozitiven. Tako učitelji kot učenci so pohvalili animacijo, predvsem pa to, da so ga delali mlajši učenci. Učencem je bila všeč predvsem animacija iz lego gradnikov in figuric. Učitelji so opazili podrobnosti, npr. pomežik Prešerna v uvodnem delu, plapolanje ogrinjala pri Povodnem možu in skok ribe v reko v zaključku.

Slika 4. Predvajanje animiranega filma. (Vir: B. Gabrijelčič)

5 ZAKLJUČEK

Učenci so se z ustvarjanjem lastnega animiranega filma zelo zabavali, hkrati pa so bili tudi presenečeni nad tem, koliko časa vzame snemanje posameznih prizorov. Sam projekt je bil tudi zame velik izziv, saj pred tem še nisem opravila celotnega postopka od začetnega načrtovanja do končnega produkta filma. Potrebnega je bilo veliko sprotnega reševanja situacij in iznajdljivosti – pomanjkanje opreme, omejeno tehnično znanje povprečne uporabnice IKT opreme. Ob snemanju sem dobila največ znanja prav s prakso.

Končni izdelek še zdaleč ni vrhunsko delo, je pa odličen izdelek za učence na tej starostni stopnji.

Nekatere prizore bi lahko ob izboljšani svetlobi ali premiku scene posneli ponovno, vendar zaradi napornosti snemanja in pomanjkanju časa tega nisem želela narediti.

Sicer pa cilj ni bil izdelati popoln animirani film, temveč doživeti izkušnjo lastne animacije, ki je bila močna in nepozabna.

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Z IKT in dnevom dejavnosti do animiranega filma

With ICT and activity day to animated film

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POVZETEK

V šoli nam kronično primankuje časa za dejavnosti, kjer so učenci bolj aktivni, motivirani in kjer izkazujejo svojo kreativnost. Nekoliko več časa imamo, ko organiziramo dneve dejavnosti. Namen prispevka je prikazati primer dneva dejavnosti v 2. razredu (kulturnega dneva - pustovanje) z uporabo IKT tehnologije in učencem pripraviti zanimivejši in bolj ustvarjalen pouk.

Delo z IKT tehnologijo in ustvarjanje animiranega filma se je izkazalo kot zanimiva popestritev klasičnega pouka. Vloga učitelja je bila spremenjena, saj je deloval kot svetovalec in usmerjevalec. Učenci so bili aktivni, za delo motivirani, uporaba IKT pa je pripomogla k bolj dinamičnemu učenju in k trajnejšemu ter kvalitetnejšemu znanju.

KLJUČNE BESEDE

Osnovna šola, dnevi dejavnosti, kulturni dan, pustovanje, animirani film, IKT

ABSTRACT

At school, we chronically lack time for activities during which students are more active, motivated and where they show their creativity. We have somewhat more time when we organize activity days. The purpose of this paper is to show an example of an activity day in the 2nd grade (cultural day - carnival) using ICT technology and to prepare more interesting and creative lessons for students.

Working with ICT technology and creating an animated film was proved to be an interesting enrichment of classical lessons. The role of the teacher was changed because he only acted as a counsellor and a facilitator. Students were active, motivated for work, and the use of ICT contributed to more dynamic learning, longer lasting and better knowledge.

KEYWORDS

Elementary school, activity days, cultural day, carnival, animated film, ICT

1 UVOD

Učenci si skozi osnovnošolsko izobrazbo pridobivajo temeljna znanja, spretnosti in izkušnje na najrazličnejših področjih. Učitelj je v tem obdobju zelo pomemben. Učencem mora vsebine približati, jih zanje motivirati, pouk pa organizirati tako, da so učenci čimbolj aktivni. Skozi pestro, zanimivo izkušnjo si učenci snov lažje zapomnijo. Take oblike dela zahtevajo od učitelja veliko priprav, zato se pri tradicionalnem pouku aktivnih dejavnosti manj poslužujejo. Tudi uporaba IKT tehnologije v prevem in drugem razredu je za učitelja izziv. Učenci se sicer s sodobno tehnologijo srečujejo, a so pri uporabljanju manj samostojni. Pri uporabi IKT tehnologije v šoli potrebujejo učitelja, da jih usmerja, jim pomaga. Ker je učencev veliko, učitelj pa en sam, morajo biti učenci potrpežljivi, učitelj pa potrebuje več časa, da pomaga vsem, ki potrebujejo pomoč.

Pri dnevih dejavnostih imamo več časa. Prav zaradi tega razloga sem se odločila, da bom v kulturni dan vključila uporabo IKT tehnologije. Poleg tega pa je pri dnevih dejavnosti več izkustvenega učenja, učenci so bolj motivirani in aktivni.

2 DNEVI DEJAVNOSTI V OSNOVNI ŠOLI

Dnevi dejavnosti so del obveznega programa osnovne šole, ki medpredmetno povezujejo discipline in predmetna področja, vključena v predmetnik osnovne šole. Potekajo v skladu z letnem delovnem načrtu šole, ki določa njihovo vsebino in organizacijsko izvedbo (Ministerstvo za šolstvo in špor, 2011).

Dnevi dejavnosti spodbujajo učenčevo ustvarjalnost, radovednost, samoiniciativnost ter jih usmerjajo v samostojno reševanje problemov tako, da jih usposabljajo za samostojno opazovanje in pridobivanje izkušenj ter znanja (prav tam). Učenci ob teh dejavnostih znanje različnih področij med seboj povezujejo v celoto.

Med dneve dejavnosti spadajo :
- **kulturni dnevi,**
- **naravoslovni dnevi,**
- **tehniški dnevi,**
- **športni dnevi.**

V šolskem letu je 15 dni dejavnosti. Posamezni dan dejavnosti se izvede v obsegu 5 pedagoških ur. Deleži posameznih sklopov dejavnosti se spreminja na podlagi upoštevanja razvoja otrok ter zastopanosti predmetnega področja v predmetniku osnovne šole.

V 1. in 2. razredu imamo 3 naravoslovne dneve, 3 tehniške dneve, 5 športnih dnevov in 4 kulturne dneve.

2.1 CILJI DNI DEJAVNOSTI

Clji dni dejavnosti so predvsem omogočiti učencem:

- utrjevanje in povezovanje znanja, pridobljenega pri posameznih predmetih in predmetnih področjih,
- uporabljanje tega znanja,
- nadgrajevanje znanja s praktičnim učenjem v kontekstu medsebojnega sodelovanja in odzivanja na aktualne dogodke v ožjem in širšem družbenem okolju.

Cilji naravoslovnih dni

Pri naravoslovnih dneh prevladujejo aktivnosti z naravoslovnega področja, tako da učenci dopolnjujejo in poglabljajo že pridobljeno znanje iz rednega pouka in ga povezujejo v nove kombinacije. Medtem razvijajo svoje kritično mišljejenje in spoznavajo metode in tehnike raziskovalnega dela (ternsko delo, laboratorijsko itd.). Poudarek je tudi na doživljanju narave, spoznavanju sestavin okolja, razumevanju sobivanja človeka in narave ter zavedanje pomena varovanja okolja. [2]

Cilji tehniški dni

Ob tehniških dnevih učenci izdelujejo različne izdelke in ob tem razvijajo še mnoge druge spretnosti in sposobnosti. Iščejo tehniške probleme v svojem okolju in oblikujejo rešitve. Razvija se pozitiven odnos do tehniških dosežkov, ob oblikovanju razstav pa učenci izmenjujejo ideje in skušajo ob uporabi informacijske tehnologije izboljšati obstoječe tehniške rešitve. [2]

Cilji športnih dni

Športni dnevi zadovoljujejo potrebe in interese po gibanju, ustvarjalnosti, sprostitvi in razvedrilu. Ob tem se krepi medsebojno sodelovanje, razvija se spoštovanje do tujih in lastnih dosežkov, učvrstijo pa se tudi športne navade, kar je za razvoj človega zelo pomembno. Prav tako se seznanijo z različnimi športnimi dejavnostmi in z oblikami športa v protem času. [2]

Cilji kulturnih dni

Kulturni dnevi se povezujejo s kulturnimi dogodki in vsebinami s kulturnega področja, pa tudi vrednote človeške družbe. Učenci se ob izvajanju kulturnih dni izražajo, so aktivni, dejavnost načrtujejo in jo sprejemajo. Ob tem razvijajo lastno ustvarjalnost in sposobnost dojemanja na področju družbenih ved in jezikoslovja, razvijajo lastno doživljanje umetniške besede, barve, oblike, zvoka ali giba. [2]

3 ANIMIRANI FILM

Otroci se z animiranimi filmi srečujejo že zelo zgodaj in vsepovsod, tako v domačem kot v šolskem okolju. Zaradi celostne čutne, čustvene in miselne podobe ter predvsem zaradi privlačnosti animiranega filma za otroke je lahko domiseln in učinkovit učni pripomoček. Filmska vzgoja je vključena tudi v učni načrt. Je močno motivacijsko sredstvo, s katerim dosežemo veliko učnih ciljev iz učnega načrta za različne predmete.

Animacija je tisto področje, ki pokriva in povezuje vsa likovna področja, opredeljena v učnem načrtu za likovno vzgojo v osnovni šoli: risbo, slikarstvo, grafiko, kiparstvo, prostorsko oblikovanje. Širok je tudi razpon medpredmetnega povezovanja,

in sicer z glasbo, matematiko, slovenščino, športom, spoznavanjem okolja...

S filmom učenci pridobijo marsikatero znanje na bolj dinamičen, zanimiv in s tem bolj obstojen način, učenci pa se ob tem zabavajo in sprostijo. Filmska vzgoja je pomembna za izobrazbo mladih v teh časih, ko prevladujejo vizualne informacije. [1]

4 Z IKT IN DNEVOM DEJAVNOSTI DO ANIMIRANEGA FILMA

Tako IKT kot dnevi dejavnosti kot animirani film zahtevajo od učitelja več priprave, časa za dejavnot ter dobro organizacijo pri samem procesu dela. Pri organizaciji kulturnega dne z naslovom Pustovanje se mi je zdela idealna priložnost, da povežem vsa tri področja.

4.1 PRIPRAVA KULTURNEGA DNE – PUSTOVANJE

Dnevi dejavnosti so del obveznega programa osnovne šole. Potekajo po letnem delovnem načrtu (LDN), ki določa njihov vsebino in organizacijsko izvedbo. V aktivih jih načrtujemo že na začetku šolskega leta. Organizacija teh dni zahteva dogovarjanje in usklajevanje tudi z morebitnimi zunanjimi izvajalci, organizacijo prevoza, določitev ustreznega normativnega števila spremljevalcev, pripravo varnostnega načrta, pripravo dejavnosti, potek dneva...

Učenci se pustovanja zelo veselijo. V šolo pridejo oblečeni v pustno masko in se v njihovo masko vživijo. Na naši šoli damo povdarek na ta slovenski običaj, zato načrtujemo pustovanje kot dan dejavnosti - kulturni dan. V šolskem letu 2018/19 smo se učiteljice v aktivu 2. razreda odločile, da bomo v sklopu kulturnega dne ustvarili animirani film, saj sam proces ustvarjanja vzame veliko časa in si ga pri klasičnem pouku ne vzamemo.

4.2 PRIPRAVA ANIMIRANEGA FILMA IN DELA Z IKT

Pred samo izvedbo kulturnega dne sem morala razmisliti, s kakšno tehniko animiranega filma bomo ustvarjali. Ker bodo učenci oblečeni v pustne maske, sem se odločila, da bomo uporabili tehniko stop animacija - "piksilacija".

4.2.1 STOP ANIMACIJA ANIMACIJA ZAUSTAVLJENIH GIBOV – »STOP MOTION« ANIMACIJA

Stop animacija je tehnika animacije, ki prikazuje nežive predmete v gibanju. Ob neprekinjenem predvajanju zaporedja fotografij, se ustvari iluzija gibanja. Predmete za vsak posnetek posebej previdno premikamo v želene položaje, ki jih, predvajane v zaporedju, vidimo kot gibajoče. Pomembno je, da si pri montaži slike sledijo v pravilnem sosledju. To gibanje v realnosti ne obstaja zares in ga dojemamo kot popolno fikcijo. Proces nastajanja stop motion animacije je počasen in zahteva ogromno mero potrpežljivosti in energije.

Poznamo več tipov stop animacij. Običajno jih delimo glede na material iz katerega so izdelani liki in scena. Ti predmeti so lahko izdelani iz gline, plastelina, lesa, žice, tkanine itd. Velikokrat so liki lutke ali marionete, gre za takoimenovano

lutkovno animacijo. Tehnika z glino in plastelinom se imenuje "clay animation", stop motion iz lego kock "brickfilm". Kadar pa gre za posnetke živih objektov-ljudi in animiranje neživih; torej da za vsak majhen premik posnemamo fotografijo in potem v videu dobimo učinek nadrealističnega gibanja, imenjujemo " pixilation ". [3]

4.2.2 PRIPRAVA NA USTVARJANJE ANIMIRANEGA FILMA

PRIPRAVA SCENARIJA IN SCENE

Pred nastajanjem animiranega filma je potrebno razmišljati tudi o korakih izdelave. Izbrati moramo zgodbo. Odločila sem se, da si bodo zgodbo – scenarij učenci sami izmislili že nekaj dni pred kulturnim dnem, saj je bilo treba razmisliti o sceni, ki se jo običajno izdela ročno in je potrebno pripraviti materiale ter orodja. Sceno so učenci pripravili pri likovni umetnosti.

PRIPRAVA SNEMANJA

Za snemanje potrebujemo dovolj velik prostor, zato je bila učilnica primerna, le nekoliko jo je bilo preurediti. Razmisiti je bilo treba tudi o osvetlitvi, saj snemanje potrebuje tudi primerno luč, katere svetloba bo ves čas enaka, da se tekom filma ne spreminja. Seveda je bilo potrebno razmišljati o potrebni IKT tehnologiji, ki smo jo potrebovali za snemanje in montažo animiranega filma. Za snemanje smo imeli digitalni fotoaparat. Del nujne opreme je bil tudi stativ, saj se med snemanjem kamera ni smela premikati.

Učenci stari 7 let še nimajo veliko izkušenj s tako obliko dela. Učitelj se mora pred dajsvnostjo dobro organizacijsko pripraviti. Predvidevala sem, da bodo učenci imeli nekaj težav s premiki in bom sama morala biti usmerjevalec pri premikih živih objektov - učencev, zato sem za pomoč pri snemanju prosila dijakinjo likovne gimnazije.

PRIPRAVA MONTAŽE

Slikovne posnetke in zvok v določeno zaporedje poveže montaža. Montaža je ustvarjalni, tehnični in miselni proces, ki film poveže v celoto. Sama montaža bi zahtevala večjo organizacijsko težavo, zato sem za pomoč prosila dijaka računalniške srednje šole. Za montažo animacijskega filma je potreboval računalnik, posnetke - fotografije in program Movie maker.

4.3 IZVEDBA KULTURNEGA DNE

Posamezni dan dejavnosti se izvede v obsegu 5 pedagoških ur, zato je tudi kulturni dan trajal 5 šolskih ur.

Potek dneva dejavnosti:
1.   šolska ura: **Predstavitev pustnih mask in pogovor.**
     Učenci so se ob prihodu v šolo najprej predstavili kot pustne maske. Nato smo se pogovorili o nastajanju animiranega filma in poteku kulturnega dne. Sledil je še pogovor o zgodbi animiranega filma.
2.   šolska ura: **Priprava scene.**
     Učenci so pripravli sceno, ki so jo imeli že izdelano. Rekvizite so usmerili v učilnico. (Slika 1)

     Sledila je malica.
3. in 4. šolska ura: **Snemanje.**

Med snemanjem je bilo na sceni manjša skupina učencev. Ostali učenci so dobili zaposlitve, ki so jih zmogli sami opraviti. Učenci so pokazali zanimanje za fotografiranje in so lahko tudi sami posneli fotografije. (Slika 2, 3 in 4)
5. šolska ura: Pustni sprevod po kraju.

Slika 1. »Scena«. Foto: V. Gulin, 2019.

Slika 2. »Snemanje«. Foto: V. Gulin, 2019.

Slika 3. »Snemanje«. Foto: V. Gulin, 2019.

Slika 4. »Snemanje«. Foto: V. Gulin, 2019.

4.4 MONTAŽA

Posnete fotografije smo prenesli na računalnik, na katerem se je delala montaža. S programom Movie maker smo sličice združili v video zapis, dodali smo zvočni zapis – glasbo, uvodno in zaključno špico.

5 ZAKLJUČEK

Sodobno učenje zahteva uporabo informacijsko-komunikacijske tehnologije (IKT) v vseh fazah vzgojno-izobraževalnega procesa, tudi pri najmljaših učencih. Eden izmed pomembnih razlogov za uvajanje IKT v pouk, je zagotovo ta, da smo del informacijske družbe, otroci pa so sve bolj izpostavljeni IKT vplivom. Glavni namen uporabe IKT pri pouku je motiviranje učencev za učenje in delo pri pouku.

Koliko bodo IKT, film in podobna učna sredstva prisotni v šoli je v veliki meri odvisno od učitelja. Če bo imel učitelj željo, voljo, domišljijo, da se loteva novosti, da bo dobil »čas«, ki jih ta sredstva potrebujejo, potem bodo IKT, film lahko odlično učno sredstvo, da bo pouk bolj dinamičen in zanimiv.

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Mednarodni tabori računalništva in komunikacije za slepe in slabovidne (ICC)

International camps on computers and communication for visually impaired (ICC)

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POVZETEK

Tabori računalništva in komunikacije za slepe in slabovidne (ICC), ki jih po celi Evropi organizira Univerza v Linzu skupaj z lokalnim organizatorjem, so zelo dobra mešanica učenja, druženja in zabave. Tekom let me je zanimalo, kako udeležba vpliva na naše slepe in slabovidne mladostnike ter zakaj tabori tako dobro delujejo že 25 let.

KLJUČNE BESEDE

Dostopnost/podporna tehnologija, slepi in slabovidni, socializacija, mednarodni tabori

ABSTRACT

The international camps on communication and computers for the blind and partially sighted (ICC), organized all over Europe by the University of Linz together with a local organizer, are a very good mix of learning, socializing and having fun.

Over the years, I have been interested in how participation affects our visually impaired adolescents and why camps have been doing so well for the last 25 years.

KEYWORDS

Accesibility/assistive technology, visually impaired, social contact, international camps

1 UVOD

Članek ni strogo znanstveno zasnovan, saj ne sledi povsem znanstveni shemi problem–hipoteza–eksperimentiranje–potrditev / ovržba hipoteze, prav tako so rezultati pogojno kvantitativno merljivi (opravljeni so bili intervjuji). Kot problem članka lahko vidimo predvsem socialno vključenost slepih in slabovidnih v vsakdanjem življenju ("... raziskave pa so pokazale, da je prisotnost okvare vida pomemben napovednik težav v socialnih odnosih ..." [1]), prav tako pa sledenje ladostnikov najnovejši IK tehnologiji. Kot eksperimentiranje predpostavimo udeležbo na taboru – metoda dela je torej opazovanje z udeležbo.

Po 100 letih šolanja slepih in slabovidnih v Sloveniji [2], le-ti vsekakor niso več tako zapostavljeni kot v preteklih stoletjih, vseeno pa jih na njihovi življenjski poti čaka še kar nekaj ovir. Mogoče sta dve izmed ključnih – družabno življenje in sledenje hitro napredujoči tehnologiji.

Vsako poletje v drugi evropski državi že 25 let potekajo desetdnevni mednarodni tabori računalništva in komunikacije (ICC camps), ki se trudijo, da mladim ravno na teh dveh področjih ponudijo čim več. Tabori so domiseln kolaž počitnikovanja, računalniških in socialnih delavnic, prostočasnih aktivnosti in druženja.

2 DOSTOPNOST ZA SLEPE IN SLABOVIDNE IN ICC TABORI

Louis Braille je pisavo za slepe izumil v 20. letih 19. stol. in s tem omogočil integracijo slepih otrok v šolski sistem. V 20. stol. so bile že po celem svetu razvite posebne šole, zavodi, ki so v enakovrednih ali prilagojenih programih izobraževale slepe in slabovidne učence.
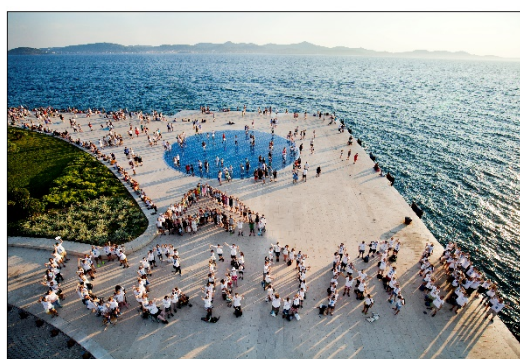
Slika 17. Zaključna slika udeležencev v Zadru

S hitrim razvojem osebnih računalnikov v zadnji četrtini 20. stol. so bili šolarji z okvaro vidne funkcije zopet v težkem položaju, saj prve tehnološke rešitve niso bile prijazne za uporabnike s posebnimi potrebami. Konec 80. let so se že razvijali prvi bralniki zaslona, npr. JAWS v Ameriki. Vzporedno so se vzpostavljali tudi povečevalniki zaslonske slike in druga

podporna tehnologija. Da bi omogočili stik z najnovejšo tehnologijo tudi mladim z okvaro vidne funkcije, so na univerzi v Linzu že leta 1993 organizirali prvi tabor računalništva in komunikacije (ICC camp) [3].

Od takrat se je v 18 evropskih državah zvrstilo že 26 taborov (samo dvakrat, leta 2008 in 2020, je bil tabor odpovedan) za mlade med 16 in 20 letom. Tabora se udeležujejo mladostniki iz vse Evrope, občasno pa se pridejo tudi posamezne skupine iz drugih kontinentov (npr. zadnja leta prihaja ekipa iz Japonske).

3 STRUKTURA TABORA

3.1 Glavni noti tabora

Če je bil tabor vzpostavljen z idejo, da slepi in slabovidni mladi potrebujejo hiter stik s podporno tehnologijo za njihove potrebe, pa se je kmalu izkazalo, da tako kot večinski populaciji v šolah, tudi njim primankuje predvsem zdravo druženje, izmenjava izkušenj s sovrstniki iz drugih držav, urjenje povsem vsakodnevnih veščin, preprosta zabava.

Shema tabora se je glede na potrebe, želje, mladostnikov prilagajala in usklajevala tekom let, danes je urnik desetdnevnega tabora približno tak, kot ga prikazuje slika 2. Seveda se urnik in predvsem vsebine iz leta v leto dopolnjujejo, nadgrajujejo, spreminjajo.

Schedule (Example)	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
08 - 08.30		Break fast	Break fast	Break fast		Break fast	Break fast	Break fast	Break fast	
09 - 12.00		Intro WS	WS	WS		WS	free activity	WS	WS	
12 - 13.30	Arrival	Lunch	Lunch	Lunch	Excursion	Lunch	Lunch	Lunch	Lunch	Departure
14 - 17.00		WS	WS	WS		WS	WS	WS	free activity	
17 - 19.00		Dinner	Dinner	Dinner		Dinner	Dinner	Dinner	Dinner	
19 - 22.00	Welcome	Evening program	Evening program	Evening program	Evening program	Evening program	Evening program	Evening program	Evening program	Farewell

Slika 18. Urnik 10-dnevnega tabora

3.2 IKT vsebine

Stik z najnovejšo podporno tehnologijo, spletno dostopnostjo, obvladovanjem računalniških orodij ... je še vedno ena od dveh prioritet taborov. Najpomembnejše IKT vsebine so:

- bralniki zaslona in sintetizatorji govora (JAWS, SuperNova, NVDA, Orca, podpora v i-phonih, androidih ...):
- povečevalniki zaslona (ZoomText, SuperNova, Windows-ove nastavitve, nastavitve pametnih telefonov ...);
- spletna dostopnost;
- socialna omrežja;
- dostopen software na računalnikih, tablicah in pametnih telefonih (mešalniki zvoka, pretvorniki med različnimi oblikami datotek, aplikacije za prepozvanje predmetov, slik, barv ..., aplikacije za lažji vsakdan, igre ...);

- obvladovanje osnovnih računalniških programov (pisanje življenjepisa, MS Office, delo s pdf dokumenti ...);
- osnove različnih programskih jezikov.

Občasno delavnice pripravijo tudi lokalni tehnologi/znanstveniki. Tako so bili npr. v Angliji gostje razvijalci Microsoft-a, na univerzi v Dresdnu so slepi lahko prizkusili robota - psa vodiča, podobne dodatne vsebine so na sporedu skoraj vsako leto.

3.3 Druženje, zabava, prosti čas, vsakdanje veščine

Čez skoraj 3 desetletja prakse se je na taborih potrdila preprosta "zdravo-razumska" misel, da je IKT seveda sijajno orodje, vendar le-to.

O odnosu tehnologoje in vsakdanjega življenja razmišlja npr. Gorazd Kocijančič: "Znanstveno pojmovanje stvarnosti in tehnološko obvladovanje sveta nam v tej sferi [vrednot] ne more pomagati, ker gre pri njej za območje našega primarnega življenjskega sveta in prvotnih danosti naših čutov in doživetij. Znanost iz tega sveta vedno izrašča kot nekaj drugotnega, kot koristna abstrakcija in osiromašitev. Pozivi k temu, naj znova uveljavimo etiko in vrednote, so prazni, ker etika ni projekt, ni si je mogoče izmisliti kot kakšne nove mode." [4]

Ljudje smo poklicani predvsem v odnos (npr. dr. Urša Zabukovec: "... kazen doživljamo že zdaj za naše neizpolnjevanje tega, k čemur smo poklicani, se pravi, za neudejanjanje dejavne ljubezni, odnosov ..." [5]), kar danes občasno ob poudarjanju znanstvenega napredka pozabljamo.

Udeleževanje organiziranih prireditev prav gotovo še ni odnos, je pa stopnica pri pridobivanju socialnih veščin, ki lahko pripeljejo na začetek nekega odnosa. ("Največja učitelja na tem področju [socialnih veščin] sta številost in kvaliteta izkušenj v družbi ..."[6])

Mladi med poletnimi počitnicami uživajo predvsem v druženju. Tekom let so tudi šolski sistemi posameznih držav ujeli korak z novimi podpornimi tehnologijami, tako da je trenutno glavna vrednost taborov predvsem človeško druženje. Nekaj časa je tem temam namenjeno že v dnevnih delavnicah (nacionalne kuhinje, pogovorne skupine, filozofski krožki, predstavljanje sebe, učenje tujih jezikov, ženske teme, orientacija, skrb za pse vodiče ...), ostalo pa v večernih aktivnostih (jam sessions, zmenkarije, športne igre, ogledi mesta ...), večerni zabavi, celodnevni ekskurziji in spontanemu druženju prek celega tabora.

Dodatna vrednost za udeležece je tudi angleščina, ki je uradni jezik vseh taborov. Marsikateri mladostnik ima tu prvo priliko, da večdnevno temeljito preizkusi svoje znanje angleščine in drugih tujih jezikov v sproščenem vzdušju, brez pritiska morebitnega ocenjevanja. Po učilnici, hodnikih in v okolici stavb vse dni žubori deset in več jezikov.

Prednost taborov ICC je tudi njegova organizacija. Razvili so se na pobudo posameznih ozaveščenih posameznikov, vsako leto na novo pa nastaja kot preplet mladih, učiteljev, tehničnih poklicev, psihologov, sorodnikov.

4   ICC SLOVENIJA 2021

V Sloveniji smo ICC tabor organizirali že leta 2001 v Škofji Loki, sedaj pa je vrsta spet prišla na nas. Naslednje leto naj bi od 14. do 23. julija v Kranju gostili približno 70 slepih in slabovidnih mladostnikov ter njihovih spremljevalcev. Organizacija taborov je že utečena, veliko priprav, proračuna pa pade na lokalnega organizatorja. Tabor je tudi priložnost, da se lokalna in državna javnost dodatno ozavesti o posebnih potrebah, s katerimi se soočajo posamezniki. Inkluzivni proces (vključevanje vseh posameznikov s posebnimi potrebami, motnjami) ni vezan samo na leta šolanja ali državne ustanove. Koliko bomo vključujoča družba, bo odvisno predvsem od tega, kako se bomo povezovali izven sistemov, v vsakdanjem življenju.

Letos je bil tabor na Portugalskem po 12 letih prvič odpovedan zaradi pandemije, seveda je veliko vprašajev zaradi le-tega tudi za naslednje leto, vendar se že dogovarjamo, da bi v primeru ponovne odpovedi vsaj del tabora izvedli na daljavo.

Eden od namenov članka je tudi povabiti morebitne partnerje s kakršnimikoli idejami, da se pridružijo projektu. Tudi iz organizacijskega vidika so tabori zelo raznovrsten mozaik - turizma, pedagogike, podpornih strategij, tehnologije, športnih dejavnosti ... Pri organizaciji bomo sodelovali z občino Kranj, Društvom slepih in slabovidnih Slovenije, različnimi podjetji, TIC Kranj, Gimnazijo Kranj, Javnim zavodom Ratitiovec, Slovensko filantropijo, veseli pa bomo tudi vseh drugih.

5   PRVOOSEBNE IZKUŠNJE

Slovenske dijake in študente spremljam po Evropi že od leta 2013 (Latvija, Nizizemska, Nemčija, Belgija, Hrvaška, Velika Britanija). Čeprav so tabori mišljeni za enkraten obisk, se večina udeležencev pri nas in po Evropi vrača po večkrat - dvakrat, trikrat ali celo štirikrat, nekateri ponovno prihajajo tudi kot soorganizatorji, pripravljajo svoje delavnice ali samo obiščejo stare prijatelje. Ravno neposredne prvoosebne izkušnje in zgodbe so najboljši dokaz, da tabori zares delujejo, tako v smislu učenja kot druženja. Slovenski študent se je na ICC taboru spoznal s poljskim dekletom; ko je končal magistrski študij, se je preselil v Varšavo, se poročil in dela v podružnici Apple-a za dostopnost njihovih storitev.

Ne bom navajal še drugih "novičarskih" zgodb, naj ena zadošča za poduarek, da tabori v malem in velikem spreminjajo življenja udeležencev.

Slika 19: Slovenska ekipa v Nemčiji, 2016

6   ZAKLJUČEK

Vsekakor so tabori ICC po četrt stoletja že dobro utečen projekt izrazito povezovalne narave. Tehnološki, pedagoški in socializacijski aspekti se prijetno združujejo in dopolnjujejo, pomembni pa so tudi drugi vidiki tabora.

Upamo, da bomo lahko mladim iz vse Evrope ponudili lepo izkušnjo tudi naslednje leto v Sloveniji.

VIRI

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Osebna eRedovalnica

Personal electronic grade book

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POVZETEK

Vzgojitelj v dijaškem domu mora biti pri svojem delu seznanjen tudi s šolskimi ocenami svojih dijakov. Večina šol ima v ta namen vzpostavljen sistem eRedovalnice. Uporaba tega sistema pa je žal v večini primerov tudi plačljiva. Zamisel o uvedbi osebne eRedovalnice je tako nastala iz potrebe po spremljanju ocen in v izogib plačljivi uporabi šolskih eRedovalnic. Za izvedbo osebne eRedovalnice sem uporabil aplikacijo Mahara na portalu Listovnik.sio.si. Z uvedbo osebne eRedovalnice sem poleg dijakov seznanil tudi njihove starše, ki sem jih povabil, da pri spremljanju ocen s pomočjo osebne eRedovalnice tudi sami sodelujejo. Uvedba osebne eRedovalnice se je izkazala zelo pozitivno, saj mi je zelo olajšala in poenostavila delo pri spremljanju ocen.

KLJUČNE BESEDE

Izobraževanje, vzgoja, učni uspeh, ocene, elektronska redovalnica

ABSTRACT

The educator in the boarding school must be at his work notified with the school grades of his students. For this purpose most schools have an electronic grades book. Unfortunately, in most cases the use of this system is chargeable. The idea of introducing a personal electronic grades book is arose from the need to monitor grades and to avoid the paid use of school electronic grades book. For implement a personal electronic grades book I used the Mahara application on the Listovnik.sio.si. With the introduce of personal electronic grades book I acquainted a students and their parents. I invited the parents to participate in monitoring the grades with the help of a personal electronic grades book. The introduction of the personal electronic grades book proved to be very positive, it is greatly facilitated and simplified my work in monitoring grades.

KEYWORDS

Education, learning success, grades, electronic grade book

1 UVOD

Prvi začetki uvajanja eRedovalnice v šole segajo v leto 2001, storitev eRedovalnice sta šolam in staršem ponudili kar dve podjetji [1]. Vendar takrat za eRedovalnico (razen v treh pri razvoju storitve sodelujočih šolah) še ni bilo veliko zanimanja. Politika in stroka sta bili pripravljeni v skrbi, da starši ne bi preveč nadzirali svojega otroka, onemogočiti tudi nekaj kar je pozitivno [2].

Šolsko leto 2007/2008 je tako prvo leto uspešne uporabe eRedovalnice. V tem letu je eRedovalnico uporabljala skoraj četrtina slovenskih šol in več kot 5.000 staršev [3].

Danes si težko predstavljamo šolo brez ustreznega informacijskega sistema, ki podpira interne pedagoške in administrativne procese in olajša vodenje šolske dokumentacije. Ko pa so razni podatki (ocene, izostanki od pouka, itd.) zapisani v digitalno zbirko podatkov, je eRedovalnica zgolj logično izkoriščanje možnosti, ki jih ponuja informacijska tehnologija.

Čeprav danes že zelo veliko staršev izkorišča možnost spremljanja ocen s pomočjo eRedovalnice, pa nekateri to še vedno zavračajo saj menijo, da zmanjšuje zaupanje med staršem in otrokom. Menijo tudi, da bo zaradi nenehnega nadzora, otrok postal nesamostojen in nezmožen reševati nastale probleme [4].

Vzgojitelj v dijaškem domu vodi skupino 28 dijakov in je seznanjenost z njihovimi ocenami pri njegovem delu zelo pomembna. Ker pa možnost spremljanja ocen s pomočjo šolskih eRedovalnic ni brezplačna, naš dijaški dom tega ne uporablja. Za potrebe spremljanja ocen si vzgojitelj tako pripravi svojo evidenco (v obliki zvezka ali ocenjevalnih listov) v katero nato dijaki vpisujejo svoje ocene.

Prva težava pri tem načinu spremljanje ocen je, da dijaki zelo neredno prihajajo k vzgojitelju vpisovat svoje ocene, druga pa, da Pravilnik o bivanju v dijaškem domu [5] v dokumentaciji dijaškega doma ne predvideva tudi vodenja evidence ocen.

2 PRIPRAVA USTREZNE REŠITVE

Zadal sem si cilj, da poiščem drug način seznanjanja z ocenami in vodenja evidence, ki bo enostavnejši tako za dijake kot tudi za vzgojitelja. Predvsem pa sem želel doseči bolj sprotno sporočanje ocen s strani dijakov.

Odločil sem se, da v ta namen uporabim aplikacijo Mahara na portalu Listovnik.sio.si (e-Listovnik). Vsak dijak si bo v e-Listovniku v obliki dnevnika ustvaril svojo osebno eRedovalnico. Nato bo ustvaril še pogled v katerega bo vključil osebno eRedovalnico in za ta pogled dodelil dovoljenje vzgojitelju,

lahko pa tudi svojim staršem. Dijaki bodo nato v osebno eRedovalnico, ki je v obliki spletnega dnevnika le še sproti vpisovali svoje ocene.

Ker so nekateri dijaki že prej vodili svoje lastne evidence ocen v obliki preglednice na papirju ali pa v svoji mobilni napravi, sem smatral, da jim vodenje evidence ocen v e-Listovniku ne bo predstavljalo dodatnega odvečnega dela.

S to rešitvijo pa je odpravljen tudi problem glede spornosti [5] vodenja evidence ocen s strani vzgojitelja oziroma dijaškega doma. S to rešitvijo je evidenca ocen v lasti dijaka, ki vzgojitelju le omogoči vpogled v evidenco.

3 PREDSTAVITEV REŠITVE STARŠEM

Pred začetkom šolskega leta sem staršem posredoval spletni vprašalnik v katerem sem jih vprašal ali so v preteklem šolskem letu uporabljali šolsko eRedovalnico, o razlogih zakaj jo oziroma je ne uporabljajo, ter ali jo nameravajo še naprej uporabljati. Starše sem ločil na tiste katerih otroci so v preteklem letu že obiskovali srednjo šolo in na tiste katerih otroci so obiskovali še osnovno šolo.

Tabela 1. Uporaba eRedovalnice

	Da	Ne	Skupaj
Srednja šola	2	9	11
Osnovna šola	4	2	6
Skupaj	6	11	17

Od 17 prejetih odgovorov je bilo le 6 takih, ki so uporabljali eRedovalnico (tabela 1). Na vprašanje zakaj eRedovalnice ne uporabljajo, pa je bila večina odgovorov, da svojemu otroku zaupajo, da jim ocene sporoča sam.

Na prvem roditeljskem sestanku sem vsem staršem predstavil rezultate ankete in svojo zamisel uvedbe osebne eRedovalnice. Starše sem tudi pozval, da v kolikor želijo spremljati ocene svojega otroka preko eRedovalnice, da v tem šolskem letu v ta namen uporabijo osebno eRedovalnico. Za starše sem pripravil tudi nazorna navodila kako se prijavijo na portal Listovnik.sio.si in si uredijo pogled v osebno eRedovalnico svojega otroka.

4 UVEDBA REŠITVE

Dijakom sem osebno eRedovalnico predstavil na prvem sestanku skupine. Pojasnil sem jim namen novega načina sporočanja njihovih ocen vzgojitelju ter moja pričakovanja glede doslednosti. Ker večina dijakov ni imela AAI uporabniške identitete, sem jim pripravil navodila za prijavo na portal Listovnik.sio.si in ureditev uporabniškega profila. Sledile so vodene delavnice v računalniški učilnici. Na delavnicah sem jim najprej predstavil spletno aplikacijo Mahara (Listovnik.sio.si), nato pa je sledilo:

- ustvarjanje osebne eRedovalnice
- ustvarjanje pogleda in dodeljevanje pravic vpogleda (vzgojitelj, starši)
- ureditev nadzorne plošče – prikaz osebne eRedovalnice na osnovni strani

Pri ustvarjanju osebne eRedovalnice sem dijakom delo poenostavil tudi tako, da sem za posamezne letnike vnaprej pripravil predloge osebnih eRedovalnic z že oblikovano preglednico in vnesenimi učnimi predmeti. Na ta način sem dosegel tudi enoten izgled vseh osebnih eRedovalnic (slika 1).

Slika 1. Osebna eRedovalnica

Tisti dijaki, pri katerih nekateri učni predmeti v predlogi niso bili ustrezni, pa so morali po iz predloge ustvarjeni eRedovalnici, le še spremeniti, dodati ali odstraniti neustrezne učne predmete. Na voljo pa jim je bila tudi predloga z oblikovano preglednico brez vnesenih učnih predmetov.

Med uporabo osebne eRedovalnice sem dijake spodbujal k sprotnemu vpisovanju ocen. Vpisovanje ocen sem vsakodnevno redno spremljal. Pri tem mi je bil v veliko pomoč sistem, ki me je seznanjal o novih vpisih ocen, tako sem vpogledal le v osebne eRedovalnice v katerih so bile narejene spremembe (slika 2). O vsaki na novo vpisani oceni sem se z dijaki pogovoril in jih tudi pohvalil za dosledno vpisovanje ocen.

Slika 2. Seznam pogledov, kot ga vidi vzgojitelj

V prvi polovici meseca decembra sem obiskal vse razrednike in preveril v osebnih eRedovalnicah vpisane ocene z dejanskim stanjem na šoli:

- skoraj polovica (11 od 23) dijakov je imela vpisane vse ocene
- petini (5 od 23) so manjkale ena ali dve oceni
- slabi tretjini (7 od 23) pa je manjkalo več ocen

Ob zaključku prvega ocenjevalnega obdobja sem dijake seznanil z rezultati preverbe, pohvalil vse tiste, ki so dosledno vpisovali ocene v svoje osebne eRedovalnice, tisto slabo tretjino, pri katerih je manjkalo več ocen, pa spodbudil k bolj odgovornemu vpisovanju ocen.

5 IZOBRAŽEVANJE NA DALJAVO

Ko sem se odločil za uvedbo osebne eRedovalnice nisem vedel, da bo to šolsko leto potekalo nekoliko drugače kot smo bili do sedaj navajeni. Ko se je 16. marca začelo izobraževanje na daljavo, so se zaprli tudi dijaški domovi in dijaki so odšli domov. Z začetkom ocenjevanja na daljavo, pa je prvi dijak svojo tako pridobljeno oceno samoiniciativno vpisal že 31. marca. K vpisovanju na daljavo pridobljenih ocen sem nato pozval tudi vse ostale dijake skupine. Tudi v tem času sem redno spremljal njihove vpise ocen in jih s povratnim odzivom po elektronski pošti pohvalil ali kako drugače spodbujal k delu in izobraževanju na daljavo.

Z njihovim odzivom in vpisovanjem ocen v osebno eRedovalnico sem bil zelo zadovoljen vse do zaključka pouka. Osebna eRedovalnica je tako predstavljala pomemben del mojega dela na daljavo s skupino v času zaprtja šol in dijaškega doma.

6 EVALVACIJA

Ob koncu pouka sem izvedel evalvacijo dela v minulem šolskem letu. K evalvaciji sem povabil dijake in njihove starše. Med drugim sem jih vprašal tudi o njihovem stališču do osebne eRedovalnice.

Dijaki: Kako si sprejel vpisovanje ocen v eRedovalnico?
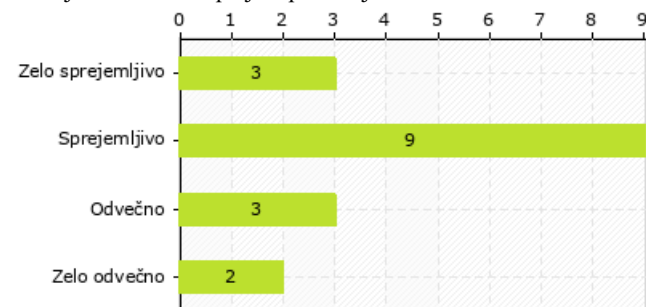
n = 17

Slika 3. Stališče dijakov do eRedovalnice

Starši: Kakšno je vaše stališče glede uporabe osebne eRedovalnice za sporočanje ocen vzgojitelju (in staršem)?
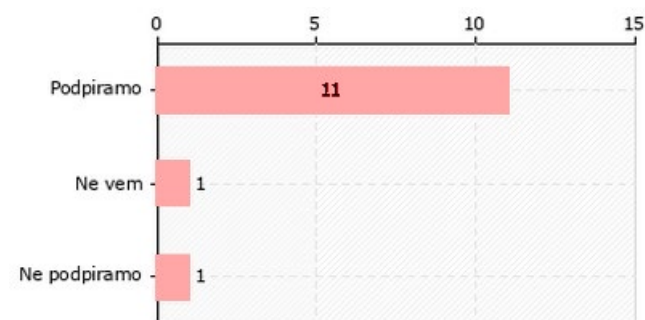
n = 13

Slika 4. Stališče staršev do eRedovalnice

Vpisovanje ocen v osebno eRedovalnico je bilo s strani večine dijakov sprejeto pozitivno (slika 3) in so ocene tudi sproti vpisovali. Seveda pa je bilo tudi pri tem nekaj dijakov, ki jim je bilo to odveč, kot bi jim bil oziroma jim je odveč tudi kakršen koli drug način sporočanja ocen vzgojitelju.

Zelo pa me veseli tudi pozitivno stališče staršev glede uporabe osebne eRedovalnice (slika 4).

Aplikacija Mahara za poglede vodi tudi seštevek vseh vpogledov, tako mi je bil na voljo tudi podatek koliko vpogledov v osebno eRedovalnico posameznega dijaka sem opravil. Število vpogledov je bilo seveda odvisno od učnega uspeha posameznega dijaka, predvsem pa od njihovega doslednega in sprotnega vpisovanja ocen. Osebne eRedovalnice dijakov, ki so bolj sprotno vpisovali svoje ocene imajo tako več vpogledov.

- Najmanjše število vpogledov 12
- Največje število vpogledov 163
- Povprečno število vpogledov 52

Če iz izračuna povprečja izvzamem tri najmanjša in tri največja števila, pa je povprečno število vpogledov 45.

7 DISKUSIJA

Spremljanje ocen s pomočjo osebne eRedovalnice se je izkazalo kot veliko bolj učinkovito in enostavnejše. Na novo vpisanim ocenam je vedno sledil pogovor o pridobljeni oceni. Če kot vzgojitelj od dijakov pričakujem odgovorno in sprotno sporočanje ocen, je prav, da tudi dijaki od mene dobijo sprotni povratni odziv.

Mnenje ene od dijakinj: "Drugače pa super, da nas takole spodbujate tako v domu (ko smo še bili tam) in sedaj ko smo doma in pohvalite ob dobri oceni. Sem prepričana, da vsaki dijakinji dvigne samozavest in pa je bolj ponosna nase ter se želi zaradi tega še dodatno potruditi."

Sporočanje ocen vzgojitelju s pomočjo osebne eRedovalnice pa je tudi s pedagoškega vidika bolj vzgojno. Za sporočanje ocen je odgovoren dijak in ne razrednik preko informacijskega sistema šole. Osebna eRedovalnica temelji na zaupanju in gradi odnos med dijakom in vzgojiteljem. Informacijsko-komunikacijska tehnologija pri tem služi zgolj kot sredstvo, ki sistem naredi pregleden in učinkovit.

Za izvedbo osebne eRedovalnice sem izbral spletno aplikacijo Mahara. Sistem ponuja vse kar sem za uspešno

izvedbo in uporabo potreboval, vendar pa bi si vseeno želel dve dopolnitvi:

- gradnik "Pogledi, ki jih spremljam" (prikaže poglede, ki so pripeti v nadzorni seznam) bi moral imeti možnost razvrstitve prikazanih pogledov glede na naslov pogleda ali glede na priimek in ime avtorja pogleda. Trenutno so pogledi razvrščeni izključno le po datumu, ko so bili ustvarjeni.
- gradnik "Zadnje spremembe" pa naj prikazuje le poglede, ki so pripeti v nadzorni seznam. Trenutno prikazuje vse poglede do katerih imam dostop, torej tudi tiste, ki so definirani kot javni in me ne zanimajo. Pri postavitvi gradnika na nadzorno ploščo bi bilo potrebno dodati filter v katerem določimo katero skupino pogledov želimo spremljati na seznamu.

8 ZAKLJUČEK

S spremljanjem ocen dijakov s pomočjo njihovih osebnih eRedovalnic se je spremenil tudi način mojega dela. Dijakov nisem več vedno znova spraševal ali imajo kakšno novo oceno, ampak sem se z nimi, ko so oceno vpisali o tem pogovoril. Zaradi uporabe osebne eRedovalnice sem se z dijaki pogosteje in bolj usmerjeno pogovarjal o njihovih ocenah. Večina dijakov je sporočanje ocen vzgojitelju s pomočjo oebne eRedovalnice sprejela pozitivno in tudi odgovorno.

Neglede na (ne)dostopnost (plačljiva storitev) šolskih eRedovalnic, bo moje spremljanje ocen še naprej potekalo s pomočjo osebnih eRedovalnic. Z uporabo osebne eRedovalnice

bom pri dijakih gradil odnos na zaupanju in odgovornosti. Pri nadaljnji uporabi osebne eRedovalnice pa si želim, da bi bila pozitivno sprejeta s strani velike večine vseh dijakov, ter da bi vsi starši, ki želijo spremljati ocene svojih otrok preko eRedovalnice, le te spremljali preko osebnih eRedovalnic.

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Raba IKT kot predmet filmske upodobitve

The use of ICT as a subject of film depiction

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POVZETEK

Kratki film učencev OŠ Idrija predstavlja primer, ko IKT nastopa kot predmet filmske obravnave in sredstvo za delo (namenski programi za montažo). Filmski medij ima pri učencih precejšen motivacijski in ustvarjalni potencial, zato ga je smiselno uporabiti v vlogi sredstva za pridobivanje digitalnih kompetenc. Medij tako ponuja obilo možnosti za delo na taksonomski stopnji vrednotenja. Pri izdelavi kratkega osnovnošolskega filma smo poenostavili nekatere faze ustvarjanja. Poseben poudarek smo namenili oblikovanju izvirne in jasno določene ideje ter čim bolj natančnemu zapisu dogajanja (zaporedje kadrov), kar smo snovali s pomočjo metode brainstorming. Pomembno je, da se posamezne dogodke (kadre) in njihove povezave oblikuje že z mislijo na montažo in končni izdelek. Snemali so večinoma učenci sami, montažo pa je prevzel mentor. Osnovna ideja filma je napetost med tehnološko nadvlado (IKT) našega življenja in temeljnim človeškim stremljenjem po svobodi. Poleg tega tudi opozarja na razliko med tehničnimi značilnostmi naprav in njenimi družbenimi rabami. Film je uporaben tudi kot učno (motivacijsko) gradivo za šolsko rabo za splošen premislek o vlogi IKT, predvsem pametnih telefonov, v našem življenju.

KLJUČNE BESEDE

Osnovnošolski film, družbena raba tehnologije, ideologija, digitalne veščine

ABSTRACT

The short film created by the students of Idrija Primary School is an example of ICT appearing as the subject of film treatment and a means of work (dedicated editing programs). The film medium has considerable motivational and creative potential for the students, therefore it makes sense to use it as a means of acquiring digital competences. The medium thus offers plenty of opportunities to work at the taxonomic level of evaluation. We have simplified some stages in the making of the short primary school film. Special emphasis has been placed on the formation of an original and clearly defined idea and the most accurate record of events (sequence of shots) possible. That was devised using the brainstorming method. It is important that individual events (shots) and their connections are formed with the film editing and the final product in mind. Most of the filming was performed by the students themselves and the editing was taken over by the mentor. The basic idea of the film is the tension between the technological domination (ICT) of our lives and the fundamental human pursuit of freedom. Moreover, it draws attention to the difference between the technical characteristics of devices and their social uses. The film can also be useful as a teaching (motivational) material when making a general reflection on the role of ICT (mostly smartphones) in our lives.

KEYWORDS

Primary school film, social use of technology, ideology, digital competences

1 UVOD

Predstavljena bosta proces ustvarjanja in sporočilo kratkega filma, v katerem je tema vloga IKT v šolskem prostoru in posledično tudi v širši družbi. Način, kako je prikazan vpliv družbene rabe tehnologije, pa omogoča izhodišče za prevrednotenje vloge IKT v današnji socialni stvarnosti, zlasti z vidika mlajših uporabnikov (osnovnošolcev). Filmski medij je za prikaz te tematike zelo primeren, saj omogoča prepričljivo vizualizacijo učinkov rabe komunikacijskih naprav. Podobe, fotografije, posnetki imajo pri mladih precejšnjo vlogo pri dojemanju, gradnji razumevanja in delovanju v družbi, zato jim je film privlačen kot ustvarjalno sredstvo in so za delo zelo motivirani.

Na OŠ Idrija že nekaj let deluje filmski krožek, katerega namen je bil sprva seznanjanje s kakovostnimi filmi in zatem tudi ustvarjanje lastnih kratkih filmov. Film Generacija Z: Ne al᾽ ja?, ki bo predstavljen v nadaljevanju, je bil gotovo zaradi svoje drugačne tematizacije komunikacijskih sredstev v letu 2019 uvrščen na več festivalov in osvojil nekaj nagrad: zmaga na filmskem natečaju KoRaketa (tema je bila Korak v prihodnost), sodelovanje v tekmovalnem programu 13. mednarodnega filmskega festivala ZOOM.13 v Ljubljani, na filmskem festivalu MEET – Movies for European Education and Training, ki je potekal v Rimu, je prejel nagrado Menzione speciale in nazadnje je film v Izoli na 55. srečanju najmlajših filmskih in video ustvarjalcev Slovenije, ki poteka pod okriljem JSKD, prejel zlato priznanje in najpomembnejšo nagrado – priznanje za najboljši film, ki ga podeljuje otroška žirija.

1.1 Povzetek filma

Skupina otrok, oblečenih v črna (temna) oblačila se počasi premika proti šoli. Njihovi gibi so mehanični, podobni, ves čas pa gledajo zgolj v ekrane pametnih telefonov oz. tablic. Tudi njihova hoja po šoli je podobna: kolona, uniformni gibi, slepa zazrtost v zaslone. Najbolj se to pokaže pri pouku, ko otroci hkrati dvigujejo roke in kosilu, ko imajo spet vsi enake gibe in hkrati zajemajo hrano. A že od začetka je ena učenka drugačna: njena oblačila so svetla, hoja in gibanje sta spontana, nima elektronske naprave. Drugi jo seveda izločajo, končno pa se najde učenka, ki jo sprejme, vendar še naprej so njene oči uprte le v zaslon naprave. Drugačna deklica ji nazadnje vzame pametni telefon in ji pokaže, da lahko sebe in okolico dojema na nov način. Tudi ostale odvrneta od elektronskih naprav in vsi skupaj se razposajeno gibajo, igrajo z žogo in drugimi rekviziti, ter nazadnje stečejo v naravo. (Trajanje 5:50.)

2 USTVARJANJE FILMA

Delo je potekalo po naslednjih korakih: oblikovanje ideje, zapis poteka dogajanja (namesto scenarija), snemanje in montaža. V prvih dveh korakih smo delali tudi že z mislijo na samo snemanje: predvsem za prvi del filma smo izbrali lokacije snemanja, scenografijo in oblačila – kolikor je bilo potrebno, da se je poenotil videz nastopajočih (glavnih igralcev in statistov), nismo pa se pri teh vidikih posebej ustavljali. Z didaktičnega vidika je bilo pri ustvarjanju morda preveč spontanosti, vendar bi po drugi strani pretirano načrtovanje, ki je sicer pri daljših filmskih izdelkih nujno, lahko zaviralo motivacijo in elan za ustvarjanje.

2.1 Oblikovanje ideje

Začetna faza je zelo pomembna, kajti govori o tem, kaj želimo prikazati, povedati. Vsebinsko je bilo oblikovanje ideje vezano na natečaj KoRaketa 2019 z nosilno temo Korak v prihodnost, kar je bilo vodilo ustvarjanju, naša osnovna ideja pa je bila predstaviti vizijo šolskega prostora v prihodnosti in določen aspekt funkcije IKT v njem.

Po začrtanju osnovne usmeritve so vsi naslednji koraki lažje konkretno določljivi. Treba pa je bilo neprestano misliti na uresničljivost ideje v danih pogojih šolske interesne dejavnosti, kajti nima smisla pretiravati s kompleksnostjo ideje in zgodbe s kompliciranim potekom dogajanja. Pomembno je, da učenci ves čas razumejo, kaj delamo (vsebina) in kako bomo kaj posneli in kasneje montirali (tehnično-izvedbeni vidik).

Idejo smo oblikovali predvsem z metodo brainstorming in tako, da je najprej ideje zapisal vsak posameznik, potem v dveh skupinah, nazadnje pa smo skupaj pretresli uporabnost zapisanih predlogov. Skupaj smo ocenili primernost idej, tj. njihovo uresničljivost v filmskem mediju. Vsebinsko pa smo izhajali iz same izkušnje otrok, ki jim je komunikacijska naprava zelo pomemben del življenja oz. delovanja v družbi. Namesto analitične pripovedi smo izbrali enostavnejši pristop, ki je predstavil določeno stanje stvarnosti, je pa zahteval preobrat v mišljenju, dojemanju stvarnosti in vedenju.

Vizualno izhodišče za estetiko prvega dela filma so bili uvodni kadri iz znanstvenofantastične klasike Metropolis režiserja Fritza Langa, ko delavci monotono, uniformno in apatično korakajo po hodniku. To vzdušje smo poskušali vnesti

v začetek filma oz. z njim določiti ritem, čutno in čustveno naravnanost v filmu (za prvi del), ki je moral biti temačen, utesnjujoč, da bi dosegli čim bolj učinkovito nasprotje z drugim delom filma.

Slika 20: Učenci korakajo proti šoli zroč v pametne telefone oz. tablice

2.2 Zapis poteka dogajanja

Običajno se idejo za film razvija naprej v obliki scenarija, vendar smo za šolsko rabo zaradi časovne omejenosti ter predvidene kratke forme izdelka pisanje pravega scenarija opustili, mdr. tudi zato, ker v filmu ni dialogov. Namesto tega smo oblikovali potek dogajanja, ki je bil na koncu zapisan kot zaporedje dogodkov oz. kadrov, hkrati s tem pa so potekale še druge priprave na snemanje (npr. izbira lokacij). Nekaj sprememb in dopolnitev je bilo kasneje še med samim snemanjem (prehod iz »mračnega« prvega dela filma v drugi, radostni del). Praviloma v tej fazi ugotovimo, kaj v filmu dejansko deluje oz. ima neko vlogo. Prav tako pravočasno izločimo preveč ambiciozne prizore, ki presegajo naše tehnične zmožnosti, predvsem pa zmožnosti učencev, saj lahko to kasneje ob spoznanju, da nečesa ni možno posneti tako, kot so si zamislili, hitro vodi v upad zanimanja in motivacije.

Za oblikovanje razvoja zgodbe in gradnjo filma po posameznih prizorih (kadrih) smo uporabili isto metodo kot pri oblikovanju ideje. Pri tem je lahko v veliko pomoč zgodboris [1], vendar te tehnike nismo uporabili, temveč smo se o posameznih prizorih in estetskih vidikih (npr. prazni prostori, temne barve, uniformno gibanje v prvem delu filma, v drugem delu pa ravno obratno) ustno dogovorili, kako bodo izgledali.

2.3 Snemanje in montaža

Snemanje je trajalo približno teden dni v februarju 2019 predvsem v času pouka, organizacijo snemanja pa so praktično ves čas vodile devetošolke (izbira sodelujočih igralcev in podajanje navodil za oblačila, rekviziti, izbiranje dodatnih lokacij snemanja itd.), prav tako so posnele večino materiala. V tej fazi se nam je pridružil učitelj David Stegu, ki je film sproti montiral in ga opremil z glasbo, tako da so učenci lahko delo prejšnjega dne pogledali pred poukom v šolski predavalnici, kar jih je še dodatno motiviralo. Želeli bi si sicer aktivnejšega sodelovanja učencev pri montaži, predvsem kar zadeva uporabo programa, vendar smo morali tak pristop zaradi časovne stiske in tehničnih omejitev opustiti – v šoli namreč nismo imeli na razpolago dovolj zmogljivega računalnika. Po drugi strani pa tudi drži, da so učenci posredno film sestavljali že med pripravo na snemanje ter med snemanjem, saj se obe fazi načrtuje in oblikuje z mislijo na montažo filma in končni izdelek. Lahko tako zatrdimo, da je zaradi predhodno dovolj določenega poteka dogajanja umanjkal dejansko le tehnični vidik uporabe programa

za montiranje filma. Montaža je sicer zanimiva in poučna faza, saj je moč učencem pokazati, da je mogoče iz istih posnetkov sestaviti različne zgodbe, kar vodi v spoznanje o konstruirani realnosti vsakdana [2], ki v dobršni meri poteka prek sodobnih komunikacijskih sredstev (v filmu so to pametni telefoni in tablice).

2.4 Vloga mentorja

Mentorjeva vloga v fazi oblikovanja ideje in gradnje poteka dogajanja je bila predvsem v tem, da se ni preveč oddaljilo od osnovne zamisli in teme (o čem film govori), da smo ohranili funkcijsko ustrezne prizore in opustili tiste, ki za osnoven tok zgodbe niso bili pomembni, ter da smo izbirali bolj enostavne in s snemalnega vidika uresničljive in prepričljive prizore. Seveda je bilo potrebno upoštevati tudi osnove filmskega jezika [3]. V primeru, da ima mentor na začetku izoblikovano zamisel o vsebini in poteku dogajanja, je treba delo voditi tako, da učenci čim bolj samostojno pridejo do želenega cilja – da se jim ne posreduje domala izdelan potek dogajanja – in pri tem dodajo čim več predlogov za izboljšave. Pri tem filmu je bila za mentorja še zanimiva naloga: pripraviti učence, da spremenijo pogled na vlogo pametnih telefonov, in sicer tako, da jih ne dojemajo kot nekaj dobrega, kar omogoča številne socialne možnosti, temveč nasprotno kot nekaj negativnega, nekaj, kar omejuje svobodo in individualnost.

3   IDEOLOŠKI IN DRUŽBENI VIDIKI

Šolsko polje in medijski prostor sodita v okvir t. i. ideoloških aparatov države (IAD), s pomočjo katerih se vzpostavlja, obnavlja oz. reproducira družbena razmerja oz. družbene formacije. Pomembni način oz. sredstva, s pomočjo katerih se to dosega, so vsakokratna komunikacijska sredstva, v sodobnem času torej tudi, kar sodi na področje IKT, pri čemer posebej izpostavljamo komunikacijski aparat, ki ga imamo vedno s sabo in funkcionira že kot jedro posameznikove komunikacijske strukture. Mehanizem IAD deluje tako, da ideologija posameznika interpelira v subjekt [4], tj. v pripadnika skupnosti in kulture. Dandanes se to zelo učinkovito izvršuje prek IKT – osamitev skorajda ni mogoča, naprava je vedno z nami.

Omenimo še koncept družbene rabe tehnologije, ki dodatno osvetli sporočilo filma. Kot je na primeru radia pokazal že B. Brecht [5], jo je potrebno ločevati od same zmožnosti aparata, zavzemal se je namreč, da bi bil radio naprava za komunikacijo, ne le za distribucijo načrtovanega programa. Film pa nakazuje, da smo nemara že pri obratu: pametni telefon morda ni več komunikacijski aparat, kot ga »naravno« dojemamo (razen govora in besedilnih sporočil), temveč je postal predvsem distribucijski. Posreduje nam namreč določen vnaprej pripravljen paket: modus vivendi, način razmišljanja, usmerja delovanje ipd. – skratka je izvrsten medij ideološke distribucije. Nekateri aspekti naštetega so v filmu pokazani dovolj neposredno in skrajno, da imajo učinek na gledalca.

Slika 21: Uniformna motorika otrok pri kosilu

V filmu je dejansko v ospredju funkcija komunikacijske tehnologije v skupnosti – informacije in komunikacija potekata praktično samo prek tehničnega pripomočka. Ta raba je tako obsežna in totalna, da vključuje skorajda celotno komunikacijo subjekta z okoljem. Čuti so tako (vsaj deloma) izključeni, nadomešča jih tehnologija kot posrednik med okoljem in telesom. Impulze posameznik ne sprejema več neposredno iz okolja, temveč prek tehnološkega vmesnika – tudi povsem enostavno opravilo, kot je hoja po stopnicah, kar je vidno v enem kadru filma. Ta vmesnik/posrednik (pametni telefon) pa dejansko ni več individualiziran, temveč uniformiran in enak za vse, kar je prikazano z enako motoriko otrok (npr. pri kosilu). S tem film nakazuje vpliv pametnih naprav v resničnem svetu, kajti skozi navidezno pestrost, raznolikost, prilagodljivost in možnostjo neizmerne personalizacije dajejo videz individualnosti – a vendar gre za razlike znotraj enake prakse, v resnici pa reproducirajo istost oz. enako delovanje, želje, mišljenje.

Film seveda ne zajame problematike celostno, a opozarja na tveganje, ki smo mu izpostavljeni v družbi totalnega dostopa informacijsko-komunikacijskih sredstev – da dejansko izgubimo nadzor. Gre za možnost distopične prihodnosti, v kateri je skupnost prikazana kot neke vrste totalitarna, kar je v opoziciji z današnjim pojmovanjem svobodne, demokratične in raznolike skupnosti, saj tak družbeni ustroj razumemo kot pravilen in kot »naravno danost«. Prvi (totalitarni) del filma pa ima močan učinek zaradi popolnega obrata, ko se učenci odrečejo komunikacijskim napravam in dejansko zaživijo, se veselijo – so otroci in niso skupina odtujenih in uniformnih posameznikov. Kaže opozoriti še na eno pomembno dejstvo. Znotraj fikcijskega sistema je za pripadnike totalitarne družbene formacije taka ureditev lahko dojeta kot normalna, naravna in nujna danost. V filmu je to prikazano s tem, da skupina zavrača drugačno učenko, a se potem po preobratu sistem spremeni, nastopi nova normalnost, s čimer je pokazano, da prejšnje stanje ni naravno in samoumevno, temveč je vzpostavljeno kot tako. In seveda, ne le v fikciji, to isto velja tudi za našo stvarnost – tudi ta realnost je (ideološko) konstruirana prek IAD oz. družbenih institucij.

4   UPORABNOST ZA ŠOLSKO POLJE

Pri ustvarjanju filma izpostavljamo štiri dosežene cilje. Najprej gre za vlogo IKT kot predmeta obravnave in kot sredstva izdelavo filma. Zatem so pomembni snovanje, snemanje in montaža filma kot umetniškega, izdelka (tvorbna, estetska funkcija). Nadalje je končni izdelek izraz vrednotenja družbene rabe IKT, tako s strani članov filmske ekipe kot vsakokratnih gledalcev (vrednotenje kot višja taksonomska stopnja). Nazadnje

pa je film lahko učno gradivo in motivacijsko sredstvo za premislek omenjene rabe komunikacijske tehnologije in naprav, in to ne le na področju humanistike v OŠ (družboslovni predmeti in interesne dejavnosti) in tudi ne le za omejeno starostno skupino.

5 ZAKLJUČEK

Produkcija filma Generacija Z: Ne al' ja? je pri učencih filmskega krožka OŠ Idrija spodbudila precej ustvarjalne energije in pokazala na potencial, ki ga ima raba IKT pri osmišljanju njihovega prostora v šolski in širši skupnosti. Opozorili so tudi na nevarnosti tehnologije pri njeni (napačni) družbeni rabi. Predvsem je film tisti medij, ki jih zelo pritegne, tako v vlogi konzumentov kot ustvarjalcev. Motivacijski potencial je zato smiselno uporabiti tudi za učenje namenskih programov za obdelavo filmov (in fotografij) ter usmerjati

učence v čim bolj produktivno rabo IKT, konkretno pametnih telefonov, s čimer jih usmerjamo v to, da jih razumejo kot sredstvo za ustvarjalno delo.

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S spletnimi zemljevidi raziskujem svoj domači kraj

Exploring the hometown with web maps

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POVZETEK

Učenci so s pomočjo raziskovalne metode raziskovali svoj domači kraj ter kolesarske in pešpoti znotraj občine Žalec ter izdelali svoj predlog družinskega izleta, ki so ga opremili z zemljevidom ter ga s pomočjo Windows orodij predstavili ostalim učencem. Pri tem so si pomagali z različnimi spletnimi zemljevidi (Google zemljevidi, Najdi.si - zemljevid…), ki so jim bili v veliko pomoč pri samem izračunu dolžine poti, določanju premagane višinske razlike izbrane kolesarke poti, spoznavanju krajevnih znamenitosti, ki ležijo ob poti ter izdelavi preprostega zemljevida. Pridobljeno znanje so učenci samostojno ob pomoči IKT nadgrajevali s pomočjo praktičnega in teoretičnega raziskovanja kolesarskih in pešpoti doma ter okolice. Končni rezultat pa so v obliki govornega nastopa predstavili v razredu. Njihovi izdelki so se zrcalili v obliki turističnih knjižic, PowerPoint predstavitev, fotografij izletov, načrtov kolesarskih in pešpoti. Skratka nastala je pestra paleta poučnih izletov skozi oči petošolcev.

KLJUČNE BESEDE

Zemljevidi, spletna orodja, orientacija, kolesarske poti, peš poti

ABSTRACT

Students explored their hometown using the research method. They explored the cycling and hiking trails in the municipality of Žalec, designed their own idea for a family trip and added a map to it. Using the Windows programs, they presented the idea to their schoolfriends. They used various web maps, for example Google Maps or Najdi.si map. Those maps helped them to determine the length of the trail, the elevation changes along the cycling trail and the local tourist sights that we can visit along the trails. Using those maps, they created their own basic map. Students upgraded their acquired knowledge by practical and theoretical research of cycling and hiking trails in their local area with its surroundings and they used information and communications technology (ICT) independently. The result of their research work was a presentation in their classroom. Students created tourist brochures, Power Point presentations, photos of their trips and some plans for cycling and hiking trails. The final product is a colourful palette of educational trips, as seen through the eyes of 5th graders.

KEYWORDS

Maps, web tools, orientation, cycling trails, hiking trails

1 UVOD

Danes živimo v digitalni dobi, kjer se na vsakem koraku srečujemo z različnimi oblikami tehnologije. Po podatkih Statističnega urada Slovenije ima dostop do interneta kar 89 % gospodinjstev v Sloveniji. Večina nas ima dostop do interneta, različnih spletnih orodij ter pametnih telefonov, pa vendar odmeva podatek komisarke za digitalno gospodarstvo in družbo EU **Gabrielove**, da 44 % Evropejcev še vedno nima osnovnih digitalnih spretnosti.

Učenci dandanes na spletu preživijo večji del prostega časa, obožujejo novo tehnologijo, njihovo navdušenje pa raste, če s pomočjo le-teh raziskujejo in pridobivajo nova znanja. Pomembno je, da že zgodaj spoznajo, da različne spletne strani niso namenjene samo zabavi in kratkočasenju, ampak lahko s pomočjo le-teh odkrivajo in spoznavajo pomembne podatke. Pri tem je zelo pomembno, da njihovo navdušenje, željo po novih znanjih ter uporabi računalnika pri šolskem delu čim prej vpeljemo v izobraževalni proces. Učenci naj bi že v zgodnjem učnem obdobju pridobili čim večji spekter tehnološkega znanja. Zelo veliko strokovnjakov je mnenja, da se digitalne pismenosti začnemo učiti čim bolj zgodaj, že na prehodu iz vrtca v šole, ko smo za to najbolj dovzetni [1].

Učenci se s spoznavanjem svoje domače pokrajine seznanijo že v predšolskem obdobju. Svoje znanje v višjih razredih poglobijo in se v 4. razredu srečajo z orientacijo ter izdelavo preprostega zemljevida domače pokrajine. Pri pouku družbe v 4. in 5. razredu je tudi v učnem načrtu zapisano, da učenec zna poiskati različne vire za pridobivanje informacij ter zbrati podatke tudi s pomočjo informacijske tehnologije [2].

2 METODE DELA

Delo petošolcev je potekalo v šolskem in domačem okolju. Zaradi varstva osebnih podatkov bomo v prispevku uporabljali samo moško obliko učenca.

Najprej je bilo potrebno ugotoviti, kako vešči so že desetletniki z računalnikom ter kakšno je njihovo poznavanje domače pokrajine. Ugotovili smo, da imajo v razredu skoraj vsi

učenci pametne telefone ter da vsakodnevno dostopajo do spleta, bodisi zaradi komunikacije s sošolci ali pa zaradi igranja igric. Brez pametnega telefona je bila le ena deklica, ki pa do spleta skoraj vsakodnevno dostopa preko domačega računalnika. Vsi učenci v razredu vedo, kaj je Google, kako se do njega dostopa in kako z njegovo pomočjo iščemo pomembne podatke. V razredu smo si ogledali tudi aplikacijo Google zemljevidi ter se učili, čemu služi in kako jo lahko uporabimo. Učenci so omenjeno aplikacijo zelo hitro usvojili, najbolj všeč jim je bilo iskanje doma in znanih znamenitosti kraja s pomočjo možnosti pogleda - Street View.

V okviru pouka, v običajnih razmerah, smo skupaj s pomočjo spletnih brskalnikov poiskali naravne in kulturne znamenitosti domačega šolskega okoliša posameznega učenca. Ključne znamenitosti smo zbrali in izdelali preprost miselni vzorec s programom X-mind. Sledil je skupen pregled in preučevanje zemljevida o že obstoječih kolesarskih poteh občine Žalec.

Sledilo je samostojno delo s pomočjo IKT v domačem okolju. Pri iskanju informacij o posameznih znamenitosti kraja so si pomagali z brskanjem po spletu. Dobljene podatke so uporabili kot fotografije in podatke pri končnih predstavitvah.

Primer slike 1 prikazuje znamenitost Jame Pekel, kjer je učenec na spletu poiskal fotografijo in jo opremil z ustreznimi podatki.

Slika 1. Opis naravne znamenitosti

V tej fazi raziskovanja so učenci lahko pokazali svojo ustvarjalnost, inovativnost in na podlagi zemljevida poiskali nove kolesarske poti na spletnih zemljevidih, ki še niso vrisane na zemljevidu kolesarskih poti občine Žalec, vendar so jim bile všeč, bodisi zaradi dolžine ali zaradi kulturnih in naravnih znamenitosti na poti. Svoje zamisli so vnesli v predstavitve Power Point, tako, da je sledilo sprotno poročanje o napredku učenca. V šoli so nam ob predstavitvah poročali, kako napreduje njihov projekt. Učiteljica jih je po potrebi usmerjala in spodbujala. V oddelku je četrtina tujcev, razumevanje jezika je slabo. Pri tem projektu so lahko podatke iskali na spletu tudi v svojem jeziku.

Na podlagi zbranih podatkov o kulturnih in naravnih znamenitosti kraja ter učencu izbrano kolesarsko potjo so se lotili praktičnega dela. Najprej so na spletnih zemljevidih vrisali posamezne postojanke in označili svojo kolesarsko traso. Te obstoječe zemljevide so natisnili in jih preizkusili v praksi.

Na podlagi teh podatkov, natisnjenega zemljevida in praktičnih izkušenj z izleta, so naredili še lasten zemljevid. Svoje raziskovalno delo so zaključili z govorno predstavitvijo svojega predloga izleta.

3 REZULTATI

Učenci so v zaključku predstavili svoje končne izdelke. Nekateri so jih pripravili v Power pointu, brušuri, drugi so izdelali samostojni zemljevid (slika 2 in 3).

Slika 2. Brošure   **Slika 3. Predstavitev brošur**

Pri tem je pomembno, da so bili aktivni vsi učenci. V oddelku imamo kar četrtino učencev, ki imajo težave z razumevanjem jezika. Ker ni bilo nujno, da izdelajo svojo predstavitev v Power Point obliki, so izdelali svoj zemljevid. Pri tem v ospredju niso bile njihove težave z jezikom, zato so bili zelo motivirani za delo in so se zelo izkazali pri sami izdelavi končnega izdelka in pri tem pokazali veliko ustvarjalnost.

Učenci so najprej predstavili osnovne podatke o dolžini poti, višinski razliki, ki jo pri tem opravijo, kar je prikazano na sliki 4.
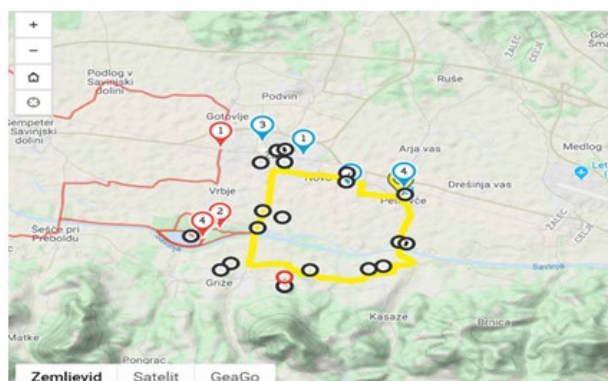
Slika 4. Žalec, kolesarka pot, dolžina 8, 2km, višinska razlika 55 m

V nadaljevanju so nam eni prikazali le del poti z vmesnim postankom, kar nam prikazuje slika 5.

Učenci so si pomagali na različne načine ter le-to vključili v končne predstavitve. Učenec je v navodila za pot vključil tudi možnost funkcije Street view (slika 6) ter podal podroben opis poti. Pri tem je izkazal dobro poznavanje možnosti uporabe IKT (street view, slika zaslona, vnašanje slike v predstavitev).

Slika 5. Postanek Savinova hiša in del opisa poti
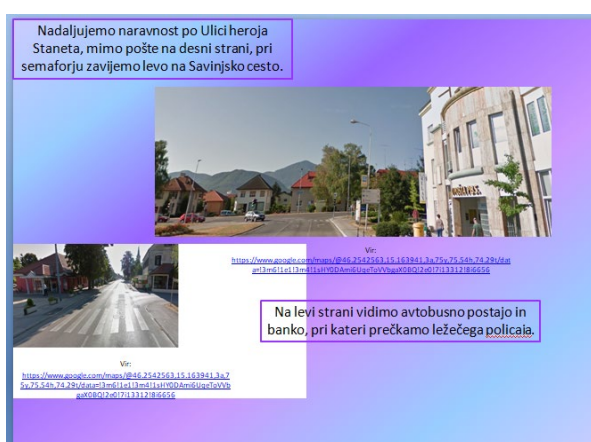
Slika 6. Opis poti in slike satelita

Poleg zgoraj omenjenega Google zemljevida so se učenci posluževali še z drugimi prikazovalniki razdalj, kar vidimo prikazano na sliki 7.
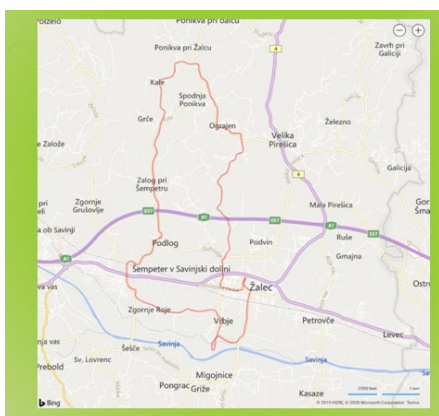
Slika 7. Celotna pot

Svojo predstavitev so zaključili z različnimi hudomušnimi slogani, kot so »Ko dolgčas ti je, sedi na kolo in razmigaj svoje telo. S kolesom v naravo po zdravje in razgled. Sedi na kolo, pa boš videl, kako je v naši dolini kolesariti lepo«.

Z učenci smo na koncu opravili analizo posameznih predlogov. Osredotočili smo se na orise poti, zemljevide, jih med sabo primerjali in ugotavljali, kje se lažje znajdemo. Ugotovila sem, da so učenci pri analizi dokaj kritični, podajali so zanimive ter konstruktivne predloge. Opazila sem, kako so napredovali v sami orientaciji, predvsem pa v poznavanju svojega lastnega kraja.

Vsem učencem smo s pomočjo odprtih možnosti ponudili različne načine predstavitve, kjer so lahko izkazali svoje znanje, pridobili nove spretnosti in izkušnje. Tako, so vsi učenci, ne glede na učne ali govorne težave izdelali svoj končni izdelek.

4 DISKUSIJA

Uporaba omenjenih programov, aplikacij omogoča, da učenci razvijajo digitalno pismenosti, ki jim omogoča lažje doseganje želenih ciljev. Učencem uporaba spletnih orodij kot npr. Google zemljevidov pri pouku omogoča hitri vpogled v celotno pot, ki jo bodo opravili sami ali njihovi sošolci, znamenitosti, ki ležijo ob poti. Učenci se pri tem preizkušajo in urijo v sami orientaciji preko spletnih zemljevidov in v praksi.

Učenci so v raziskovalno delo vložili veliko truda in časa. Pri tem je nastala res cela paleta izdelkov, opremljena s pomočjo IKT-ja z zelo dobrimi primeri kratkih družinskih izletov. Za samo izvedbo takšnega projekta je pomembno, da učitelj sam skrbi za razvijanje digitalnih kompetenc. Učitelj mora sam raziskovati in iskati različne aplikacije, ki so enostavne za uporabo, mora jih zelo dobro poznati, da jih lahko prenese v sam pouk in pri tem izkoristi visoko motivacijo učencev za delo. Tovrstni projekti so učencem zanimivi zaradi večje uporabe IKT pri pouku in v domačem okolju in raziskovanju domačega okolja in drugačnega načina dela pri pouku.

5 ZAKLJUČKI

Znanje je velika vrednota in moč. Učenci bodo lahko uporabljene aplikacije in programe uporabljali in nadgrajevali tudi v prihodnje, bodisi pri pouku kot v vsakdanjem življenju. Nastali so zelo dobri izdelki, ki bi celo lahko dopolnili že obstoječe kolesarske trase v občini Žalec. Predvsem pa so dober pokazatelj ustvarjalnosti petošolcev.

Prav v času karantene smo zelo dobro občutili, kako je digitalna pismenost pomembna tako za učitelja kot za učence. Prav to nam je dalo misliti, da klasični pouk ni dovolj, ampak je treba čim hitreje učence digitalno opismeniti ter jih seznaniti z različnimi računalniškimi orodji, ki jim bodo v pomoč pri premagovanju ovir.

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Geografija in izobraževanje na daljavo

Geography and distance education

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POVZETEK

Šolsko leto 2019/2020 je bilo nekoliko drugačno od preteklih šolskih let. Pandemija koronavirusa covid-19 je namreč na vseh ravneh, od vrtca do univerze, narekovala vzgojno-izobraževalno delo na daljavo, ki je zaradi nekaterih omejitev zahtevalo določene prilagoditve. V prispevku se osredotočamo na izveden praktičen primer poučevanja geografije na daljavo v šestem razredu osnovne šole. Izpostavljamo dobre in slabe strani takšne oblike vzgojno-izobraževalnega dela ter podajamo nekatere ideje za njegovo nadgradnjo v primeru, da bi bilo poučevanje na takšen način potrebno izvesti tudi v prihodnje.

KLJUČNE BESEDE

Geografija, vzgojno-izobraževalno delo na daljavo

ABSTRACT

The school year 2019/2020 was slightly different from previous school years. The pandemic of the Corona virus Covid-19 hit us at all levels, from kindergarten to university, leading to distance education, which required several adjustments due to certain limitations. In this paper, we focus on a practical example of distance geography teaching in the sixth grade of primary school. We highlight the pros and cons of distance educational process and provide some ideas for its upgrade in case distance teaching would again be necessary in the future.

KEYWORDS

Geography, distance education

1 UVOD

Šolsko leto 2019/2020 je bilo prav posebno in drugačno od preteklih šolskih let. Soočili smo se s pandemijo koronavirusa covid-19, ki je onemogočila običajno poučevanje z neposrednim kontaktom učiteljev in učencev. Potrebna je bila sorazmerno hitra prilagoditev na drugačen način vzgojno-izobraževalnega dela na vseh ravneh, od vrtca do univerze. Le-to je potekalo na daljavo preko informacijsko komunikacijske tehnologije. Takšen

način poučevanja ima poleg prednosti tudi slabosti, zahteva pa tudi nekatere prilagoditve in določeno mero iznajdljivosti.

Napovedi nakazujejo možnost, da se lahko podobna situacija ponovi tudi v prihodnje, zato moramo biti pripravljeni tudi na takšno obliko izobraževanja. Pri tem pa se lahko opremo na izkušnje iz preteklega šolskega leta: ognemo se narejenim napakam ter se zgledujemo po primerih dobre prakse, ki jih lahko tudi nadgradimo.

V prispevku je predstavljen primer izobraževanja na daljavo pri geografiji v šestem razredu na Osnovni šoli Antona Martina Slomška Vrhnika. Prikazane so prednosti in slabosti takšnega načina vzgojno-izobraževalnega dela ter izzivi, s katerimi smo se spopadali. Podanih pa je tudi nekaj idej za izboljšanje.

2 GEOGRAFIJA V OSNOVNI ŠOLI IN POUČEVANJE NA DALJAVO

Cilj geografije je, da učenci postanejo geografsko pismeni. To pomeni, da deklarativno znanje (poznavanje temeljnih geografskih pojmov in procesov) nadgradijo s proceduralnim znanjem (razvijanje sposobnosti in spretnosti, ki so povezane z učnimi metodami in delovnimi postopki (npr. terensko delo, ekskurzije, eksperimentalno delo, iskanje in analiza virov, načrtovanje ipd.)). [1]

Za pouk geografije v osnovni šoli so najprimernejši tematski učni projekti s prvinami raziskovalnih vprašanj, geografsko in kritično mišljenje na podlagi problemskega pristopa (študija primerov, problemska razprava, učne simulacije, igra vlog ipd.), izvedba terenskega dela in ekskurzije. [1]

Geografija je šolski predmet, ki je že v osnovi naravnan tako, da učenci informacije o geografskem okolju oziroma zaznave pridobivajo z vsemi čutili. Zato mora učitelj različnim zaznavnim tipom učencev (motorični, vizualni, slušni) omogočiti raznovrstno učno gradivo za prehajanje od konkretnih zaznav k zahtevnejši abstrakciji. Pri tem pa mora upoštevati tudi nazornost, da lahko učenci svoje (čutne in čustvene) zaznave povežejo z racionalnimi. Poučevanje geografije torej od učitelja zahteva ustrezno izbiro in uporabo učnih pripomočkov ter nenehno interakcijo učenca in učitelja. Skozi pouk geografije učenci razvijajo celostno geografsko mišljenje, ki temelji na nenehnem medpredmetnem povezovanju.

Težnja po čim boljšem znanju učencev zajema tudi preverjanje in ocenjevanje znanja, ki je odvisen tako od učenja kot tudi od poučevanja. Sprotno preverjanje spodbuja k samonadzoru, sprotnemu utrjevanju ter informiranju o napredku. Poleg tradicionalnega pisnega in ustnega ocenjevanja se

ocenjujejo tudi geografski izdelki (npr. plakati, prospekti ipd.), dejavnost (npr. učni eksperiment, terensko delo ipd.) in pristne naloge (npr. učne simulacije, življenjske, praktične in uporabne naloge).

Vse našteto pa postane prav poseben izziv, ko gre za poučevanje na daljavo. Vse aktivnosti morajo biti prilagojene dani situaciji. Takrat še bolj kot običajno pride v ospredje uporaba informacijsko kumunikacijske tehnologije (IKT). IKT sestavljajo informacijske tehnologije, telefonija, elektronski mediji, vse vrste obdelave in prenosa avdio in video signalov ter vse funkcije nadzora in spremljanja, ki temeljijo na tehnologiji omrežja. [2] Delo s pomočjo IKT pri pouku geografije je delno že prisotno tudi v času običajnega pouka, kadar je to smiselno in potrebno.

Delo na daljavo na nekatere geografske aktivnosti nima večjega vpliva, nekatere aktivnosti so na takšen način lahko izvedene delno, drugih pa sploh ni mogoče izvesti.

3 IZOBRAŽEVANJE NA DALJAVO NA OSNOVNI ŠOLI ANTONA MARTINA SLOMŠKA VRHNIKA

Na Osnovni šoli Antona Martina Slomška Vrhnika je pouk na daljavo potekal med marcem in junijem leta 2020, ko je bil na državni ravni zaradi pandemije koronavirusa covid-19 izdan Odlok o začasni prepovedi zbiranja ljudi v zavodih s področja vzgoje in izobraževanja. V razmeroma kratkem času se je bilo potrebno prilagoditi na nov način vzgojno-izobraževalnega dela, ki je od vseh akterjev (učiteljev, učencev in njihovih staršev) zahteval tudi nekatere prilagoditve in tudi dobro mero iznajdljivosti. Pri tem pa je bilo potrebno upoštevati štiri pomembne vidike takšnega poučevanja: tehnični, didaktični, organizacijski in psihološki vidik.

Zaradi nenadne izdaje odloka ni bilo možno izvesti posebnih priprav oziroma izobraževanj za izvedbo pouka na daljavo. Tega smo se na Osnovni šoli Antona Martina Slomška Vrhnika lotili nekoliko manj sistematično kot to počnemo sicer. V začetni fazi je pouk na daljavo potekal s pomočjo objave navodil za delo na šolski spletni strani. Ta način dela smo dopolnili z uporabo elektronske pošte, spletnih učilnic, različnih spletnih orodij in okolij, z video konferencami ipd. Uporabili smo tudi elektronska gradiva številnih institucij (založb, zavodov ipd.), ki so se dokaj hitro odzvale na takšen način dela (s ponudbo spletnih izobraževanj, prostih dostopov do učnih gradiv, izobraževalnih vsebin ipd). Vsak izmed učiteljev naše šole pa se je nato na podlagi lastne presoje odločil, kakšne oblike in metoda dela ter (spletna) orodja in okolja za poučevanje na daljavo bo uporabil pri predmetu, ki ga poučuje.

4 GEOGRAFIJA NA DALJAVO V ŠESTEM RAZREDU

Tudi vzgojno-izobraževalno delo na daljavo pri geografiji v šestem razredu na Osnovni šoli Antona Martina Slomška Vrhnika je sledilo potrjenemu učnemu načrtu. Vsebina je bila torej znana, prilagoditi pa je bilo potrebno oblike dela, saj je delo na daljavo v času pandemije virusa koronavirusa covid-19 za učence in učitelje postalo obvezni del izobraževanja.

Na naši šoli je pouk geografije naravnan tako, da oblikujemo raziskovalna vprašanja, ki učence motivirajo k raziskovanju in samostojnemu odkrivanju geografskih vsebin. Velik del pouka namenimo tudi problemskemu pristopu, kjer učeneci preko igre vlog, problemske razprave ipd. odgovorijo na zastavljena geografska vprašanja, sodelujejo pri terenskem delu ipd. ter tako v veliki meri sami raziščejo neko geografsko temo. Učitelj pa jim je pri tem ves čas v podporo. Seveda pa je učence na takšen način dela pri geografiji potrebno navajati že od samega začetka, torej že v šestem razredu.

Tukaj je potrebno omeniti, da smo imeli pri tem v letošnjem šolskem letu precej omejitev. Pred pričetkom izobraževanja na daljavo so bila izvedena le tri srečanja v živo (blok ure), torej šest šolskih ur, saj je v šolskem letu 2019/2020 pouk geografije v šestem razredu potekal po fleksibilnem predmetniku v drugi polovici šolskega leta. Šest šolskih ur, ki so bile izvedene v živo, predstavljajo le 17 % od vseh 35 ur (100 %), ki so po učnem načrtu namenjene geografiji v šestem razredu. Učenci morajo v šestem razredu usvojiti temeljna geografska znanja, ki jih nato nadgrajujejo v višjih razredih. Učenci so bili pred začetkom šolanja na daljavo seznanjeni z uvodnimi informacijami, spoznali so tudi vesolje oziroma naše Osončje, preostali del učne snovi pa je bilo potrebno obravnavati na daljavo.

Zaradi vsega omenjenega smo način dela tokrat morali precej prilagoditi. V skladu z navodili vodstva šole smo na šolski spletni strani tedensko objavljali navodila za šolsko delo, ki so ga morali učenci sami opraviti doma in po obsegu ni smelo presegati časa, ki je namenjen običajnemu pouku geografije. Potrebno je bilo tudi prilagajanje glede obsega in izbora učnih vsebin.
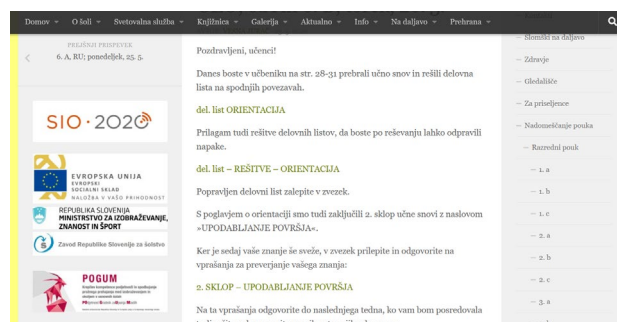
Slika 1: Primer tedenskih navodil za učence na šolski spletni strani.

Za poučevanje geografije na daljavo smo uporabljali izključno komunikacijo preko šolske spletne strani in elektronske pošte, saj se je izkazalo, da vsi učenci (vsaj na začetku izobraževanja na daljavo) niso opremljeni z ustrezno računalniško opremo oziroma niso vešči dela z drugimi spletnimi orodji.

V začetni fazi dela na daljavo smo se osredotočili na ponavljanje in utrjevanje snovi s pomočjo učbenika in delovnega zvezka. Nadaljevali pa smo z obravnavo nove učne snovi.

Informacije so učenci samostojno pridobivali s pomočjo različnih virov in literature (učbenik, atlas, video posnetki na spletu ipd.). Raziskovalna vprašanja na delovnih listih so spodbudila njihovo geografsko in kritično razmišljanje. Ob oblikovanju povzetkov snovi v zvezke so urili sposobnost ločevanje bistvenega od nebistvenega. S sprotnim preverjanjem ob koncu vsakega obravnavanega učnega sklopa pa so bili učenci

usmerjeni k samonadzoru, sprotnemu utrjevanju ter informiranju o napredku. Zaradi posebnih okoliščin je ocenjevanje potekalo drugače od običajnega, in sicer so učenci na podlagi pridobljenega znanja za oceno izdelali geografski izdelek, povezan z učno snovjo.

Delo je potekalo tako, da so učenci v skladu z učiteljevimi tedenskimi navodili na šolski spletni strani morali prebrati določeno poglavje v učbeniku in razmisliti o njegovi vsebini. Učitelj jim je za lažje razumevanje obravnavane učne snovi posredoval tudi nekaj povzetkov snovi, slikovnih prikazov pa tudi spletnih povezav do video gradiv. Nato so učenci morali oblikovati ustrezen zapis snovi v zvezek in v geografski slovarček dodati razlago tipičnih geografskih pojmov, s katerimi so se srečali pri obravnavi snovi. Pomagali pa so si lahko tudi z atlasom. Pri delu jim je bil ves čas v oporo in pomoč učitelj, s katerim je potekala komunikacija preko elektronske pošte.

Ob zaključku vsakega učnega sklopa je učitelj učencem posredoval tudi vprašanja za preverjanje znanja. Svoje odgovore so učenci lahko preverili s pomočjo dodanih rešitev.

V mesecu maju je potekalo tudi ocenjevanje znanja, ki smo ga zaradi posebnih okoliščin morali precej prilagoditi. Namesto običajnega pisnega in ustnega ocenjevanja so učenci po navodilih na šolski spletni strani izdelali ustrezen geografski izdelek (križanko, pesem, plakat, didaktično igro ali model), povezan z eno od tem, ki smo jih obravnavali v času šolanja na daljavo. Podana so bila natančna navodila oziroma kriteriji, po katerih je izdelek bil tudi ocenjen.

Omejeno pa je bilo tudi izvajanje terenskega dela. Učenci naše šole se v šestem razredu običajno udeležijo dveh šolskih ekskurzij, kjer je poudarek prav na tej obliki šolskega dela. Zaradi odpovedi obeh ekskurzij pa tokrat učenci te izkušnje niso dobili.

5 PREDNOSTI IN SLABOSTI IZOBRAŽEVANJA NA DALJAVO TER IDEJE ZA IZBOLJŠAVE

Z delom na daljavo smo se na osnovni šoli Antona Martina Slomška Vrhnika tokrat srečali prvič. To je bil obvezen način dela, ki je bil vzpostavljen na državni ravni, in na katerega se je bilo potrebno prilagoditi v razmeroma kratkem času. Vzgojno-izobraževalno delo je potekalo s pomočjo informacijsko komunikacijske tehnologije. Ker ni bilo časa za pripravo na takšno obliko pouka, smo delo prilagajali sproti glede na zmožnosti in potrebe.

Učitelji so vsebine, ki jih obravnavajo pri pouku, učencem morali posredovati preko različnih spletnih orodij in okolij na takšen način, da so bile le-te jasne, nazorne in so učenca postavile v aktivno vlogo.

Aktivno učenje predstavlja kognitivno, emocionalno in socialno akcijo učenca, je osebno pomembno in vpeto v resnične življenjske okoliščine. Takšen pristop procesu učenja omogoča ustvarjanje kakovostnega ponotranjanja in globljega razumevanje tistega, kar se uči. [3] Učenci so v procesu izobraževanja na daljavo dobili aktivnejšo vlogo predvsem z evalvacijo svojega znanja, zbiranjem dokazov in pridobivanjem povratnih informacij.

Učitelji so bili tudi spodbujevalci inovativnosti, predvsem z oblikovanjem in posredovanjem vidnega (učnega) gradiva, kar

pa jim je običajno vzelo ogromno časa (samo iskanje primernega spletnega gradiva in aplikacij, ki ustrezajo pouku).

Vsa navodila za delo so bila učencem posredovana preko šolske spletne strani. Zaradi velike obremenjenosti le-te (običajno v določenem delu dneva), je večkrat prihajalo do motenj (npr. onemogočeno ali dlje časa trajajoče dostopanje do spletne strani oziroma vsebin kot običajno ipd.). Na tem mestu vidimo rešitev v delu preko spletnih učilnic, ki predstavljajo posebej pripravljene spletne strani oziroma portale, ki podpirajo elektronsko izobraževanje.

Vsak učitelj se je po lastni presoji odločil za spletna orodja oziroma okolja, ki jih je uporabljal za izvajanje pouka. Izkazalo se je, da vsi učenci šestega razreda (vsaj na začetku izobraževanja na daljavo) niso bili opremljeni z (ustrezno) informacijsko komunikacijsko opremo ali pa niso imeli možnosti dostopa do spleta od doma. Opaziti je bilo tudi težave z inštaliranjem oziroma operiranjem z različnimi spletnimi orodji oziroma okolji. Zato smo se odločili, da pri geografiji v šestem razredu za poučevanje na daljavo uporabljamo zgolj šolsko spletno stran in elektronsko pošto. Na podlagi tega se je za nujno izkazalo, da učenci že v šoli pridobijo temeljne digitalne kompetence.

Za uspešno delo na daljavo je velikega pomena tudi dobra organizacija samega dela. Potrebno je vzpostaviti delovni red oziroma osebni načrt učenja z rednim spremljanjem podanih informacij, saj se v nasprotnem primeru le-te hitro spregledajo in izgubijo, posledično pa prihaja do neizpolnjenih nalog ali zamujenih rokov za oddajo. Učenci in učitelji so si morali pogosto deliti delovno opremo (računalnik, tablica) z ostalimi družinskimi člani, zato je delo potekalo v različnih delih dneva, tudi izven predvidenega časa. Posledično je prišlo do brisanja meja med zasebnim in službenim časom oziroma časom, namenjenim delu za šolo.

Kot pomanjkljivost šolanja na daljavo je potrebno izpostaviti tudi fizično in časovno ločenost učiteljev, ki lahko vodi tudi v manjšo odzivnost. Pomanjkanje osebnega stika povzroči težji vpogled v samo šolsko delo posameznega učenca, težave pri razumevanju snovi ipd. Učiteljevo razlago, ki je vsekakor boljša in nazornejša, pri delu na daljavo zamenja pisanje navodil, komunikacija po elektronski pošti, pošiljanje video gradiv ipd. Zelo pomembna pri takšnem načinu dela je tudi ustrezna povratna informacija, ki je pogoj za spremljanje učnega napredka posameznika.

6 ZAKLJUČEK

Delo na daljavo, ki je zaznamovalo letošnje šolsko leto, je izziv za vse, tako učence kot učitelje. Zahteva nekoliko drugačen način dela in uporabo IKT. Zavedamo se, da izobraževanja na daljavo nikakor ne moremo enačiti z običajnim izobraževanjem v živo. Ima določene prednosti in tudi slabosti. Zahteva veliko mero prilagajanja, vse to pa s ciljem, da bi učenci obravnavano učno snov čim bolje razumeli. Za takšno obliko dela so potrebna določena znanja in veščine ter ustrezna oprema. Dobra organiziranost in sprotno delo pripomoreta k dobrim učnim rezultatom. Ker je geografija veda, ki poleg dela z IKT zahteva veliko osebnega stika in tudi ostale učne metode (npr. teresko delo), so z delom na daljavo določene dejavnosti omejene ali jih celo ni možno izvesti.

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Učinkoviti načini učenja rabe spletnih orodij

Efficient ways of learning how to use on-line applications

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POVZETEK

V tem prispevku obravnavamo težave klasičnega pouka, ki so s pomočjo spletnih orodij lahko premagljive in nekatere metode dela na daljavo s pomočjo IKT, ki bi lahko nadomestile klasične. Hkrati opisujem nekaj ovir, ki smo jih imeli pri šolanju na daljavo in primere dobrih praks, s katerimi smo jih premostili. Največja težava je bilo neznanje uporabe IKT. Ker učim v OŠ je bilo potrebno poleg kolegov in učencev hkrati izobraziti tudi starše. Predstavljam nekaj primerov dobrih praks premagovanja odpora, neznanja in nejevolje pri uporabi spletnih orodij.

KLJUČNE BESEDE

Šolanje na daljavo, dobre prakse , premagovanje težav, starši, spletna orodja za poučevanje, izobraževanje staršev in učencev

ABSTRACT

The paper touches upon methods of classical in-class teaching which could be improved by or even replaced by elements of distance learning. During distance learning due to covid-19 we have successfully overcome some difficulties in teaching. The major one has been illiteracy in using communication technology and ignorance of useful teaching applications. In this text it is described how parents, students and even colleagues have successfully overcome their fear and ignorance of modern technology

KEYWORDS

Distance learning, good practice examples, overcoming difficulties, parents, on-line teaching applications, educating parents and students

1 UVOD

Učinkovitost šolanja na daljavo v šolskem letu 2019 / 20 bo slabo primerljiva s klasičnim šolanjem, saj smo se ga lotili "ad hoc". Kljub temu je učenje na daljavo več kot uspešno rešilo mnoge izzive, ki so se zdeli pri klasičnem pouku težko premostljivi. Klasičen pouk v razredu je nenadomestljiv – prav tako so novi

načini dela na daljavo.[1] Za konkurenčnost bodočih generacij, bo potrebno učinkovito prilagajati klasične metode dela, jih kombinirati z digitalnimi orodji, nadgraditi, nekatere celo opustiti. Največja ovira je bila slabo znanje uporabe računalniških orodij, ki pa smo jo zelo uspešno premostili. Zato je nujno, da na predznanju gradimo ne glede na način šolanja, ki bo sledil v naslednjem šolskem letu in tako učinke šolanja bistveno povečamo. V nadaljevanju opisujem nekaj primerov dobrih praks izobraževanja prereza široke palete prebivalstva predvsem staršev in učencev, in opišem nekaj prednosti izobraževanja na daljavo pred klasičnim poukom, ki bi ga bilo smiselno uvesti v reden pouk.

2 KOMUNIKACIJA IN OPISMENJEVANJE STARŠEV V OŠ

V začetku šolanja na daljavo zaradi covid-19 učitelji in učenci nismo imeli neposrednega stika. Za podajanje snovi smo uporabljali Arnesove spletne učilnice (Moodle), šolsko spletno stran in elektronske naslove staršev. Ker učenci niso imeli uporabniških gesel za spletne učilnice, so bili starši obremenjeni z nadzorom svojih otrok, posredovanjem med učenci in učitelji, poročanju in posredovanjem dodatne oz. prilagojene razlage. Tako sem v 14 dneh kot razredničarka 6. razreda in učiteljica tujega jezika na predmetni stopnji izmenjala približno 1200 elektronskih sporočil. Zato sem iskala učinkovitejše načine komunikacije.

2.1 Slabosti elektronske pošte

Elektronska pošta je bila dobro izhodišče za komunikacijo, vendar je za potrebe šolanja na daljavo zastarela.

V tretjem tednu pouka na daljavo smo prebili led in uspešno izvedli prvo razredno srečanje v živo preko Microsoft Teams konference. Ker noben učenec in skoraj noben starš s tem orodjem ni imel izkušenj, je bilo potrebno ogromno priprav. Preko elektronske pošte sem staršem najprej poslala obvestilo, da pripravljam razredno uro, vsebino razredne ure, predvideno uro in datum. Nato sem jim poslala povezavo do spletnih video navodil, v katerem je ponazorjeno, kako se Microsoft Teams video sestanek vključijo brez gesla prek spleta. [2] Ker sem izbrala različico v angleščini, sem priložila tudi prevod navodil. Nato smo določili dva termina pred prvo razredno uro, v katerih smo skupaj z otroki in starši vadili samo "vklop". Med tema "vajama" sem bila hkrati pozorna še na svojo elektronsko pošto saj sem večini staršev kljub video navodilu s prevodom pomagala pri določenih korakih (npr. "Klik na moder gumb v ekranu

zgoraj desno na katerem z belim piše »join in« . Počakajte da se ekran spremeni.”). V povprečju sem samo med "vajo vklop" z vsakim od 25 staršev izmenjala po 5 elektronskih sporočil. Čeprav se je elektronska pošta izkazala za uporabno, je bilo potrebno najti hitrejši in prijaznejši način.

2.2   Spletne ankete

Po omenjeni razredni uri, smo začeli načrtovati naslednje. Ker sem razredno uro načrtovala tudi kot poskus pouka v živo, sem želela povratne informacije. Zanimalo me je predvsem, koliko je razredna ura v živo sploh prijazna do družin – kateri termini jim časovno ustrezajo, kdaj si lahko brez težav elektronske pripomočke delijo, ipd. V želji ustrezati večini sem sestavila anketo prek aplikacije 1KA, eno za starše in eno za učence. Za orodje 1ka sem se odločila zato, ker sem sklepala, da je večini uporabnikov najbolj domač. Orodje je omogočilo pisanje zgolj enega e-sporočila vsem staršem, zato sem v nadaljevanju šolanja na daljavo za zbiranje povratnih informacij uporabljala le še spletne ankete; za starše še naprej 1KA, za učence pa sem jih sestavila v Microsoft Forms. Slika 1 je prikaz pregledno zbranih povratnih informacij.

Slika 1. Primer pridobivanja povratnih informacij prek 1ka spletne ankete

2.3 Aplikacija Microsoft Planer

Konec aprila smo začeli načrtovati ocenjevanje. Eden izmed ciljev je bil sestaviti mrežni plan ocenjevanja tako, da se učencem ocenjevanje čimbolj prijazno razporedi. Učitelji smo uporabili orodje Lopolis, učencem in staršem pa sem datume in vsebino ocenjevanja prepisala v aplikacijo Microsoft Planer. Do takrat so namreč učenci že dobili uporabniška gesla in imena za Microsoft Teams in je bilo tako najlažje. Vendar je bilo treba učence in starše naučiti uporabe tega orodja. Zato sem sestavila navodila za uporabo. Tehtala sem med video in slikovnimi navodili in sem se na koncu odločila, da bodo slikovna navodila najbolj uporabna na vseh napravah, tudi kadar ne bo internetne povezave. Slika 2 prikazuje eno stran slikovnih navodil za uporabo aplikacije. Za vsak korak do vpogleda v mrežni plan posameznega učenca sem naredila posnetek zaslona, ga vstavila v Microsoft PowerPoint, z orodji dopisala komentarje in potem zaklenila v dokument v PDF formatu.
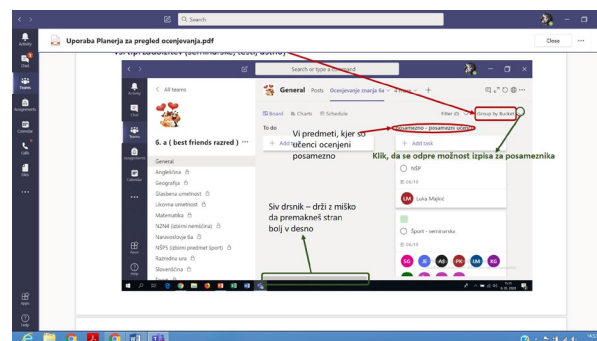
Slika 2. Prikazuje primer slikovnih navodil za uporabo spletnega orodja

2.4 Video konference

Nobeno spletno orodje ne nadomesti osebnega stika, pa vendar je videokonferenca trenutno najboljši približek, predvsem kadar gre za komunikacijo med dvema osebama. Ko so učenci dobili uporabniška gesla in imena za Microsoft Teams sem z učenci komunicirala prek video klicev. Kako vzpostaviš video klic so potem učenci naučili tudi svoje starše. Tako sem opravila večino govorilnih ur na daljavo. Za roditeljski sestanek prek video konference pa se po razmisleku nisem odločila. Pretehtali sta dejstvi, da povratne informacije najbolj prijazno in učinkovito lahko zberem prek spletnih anket, podajanje informacij pa po elektronski pošti. Za vse ostalo pa sem bila na voljo individualno prek omenjenih video klicev.

3   OPISMENJEVANJE UČENCEV V OŠ IN PREDNOSTI POUKA NA DALJAVO

3.1   Arnesove spletne učilnice (Moodle)

Učenci so tudi v obdobju pred šolanjem na daljavo znali uporabiti spletno učilnico. V času pred šolanjem na daljavo so tam našli vaje, preverjanja, rešitve vaj in preverjanj, zanimive povezave do video posnetkov IPD. Ker pa niso imeli uporabniških gesel, prek spletne učilnici z njimi nismo mogli komunicirati oz. učitelji nismo imeli povratne informacije o njihovem napredku.

3.1.1   Prednosti Moodla pred Microsoft Teams

Moodle je odlično orodje izobraževanje, vendar od uporabnika zahteva precej časovnega vložka, da se ga nauči uporabljati tako, da izkoristi vse, kar program zna. Uporabniku začetniku je neprijazen, kajti deluje na principih, ki ji uporabniki niso vajeni iz drugih spletnih okolij. Hkrati pa je to velika prednost, kajti učenci težje najdejo »luknje v sistemu« in so preverljivi podatki in povratne informacije (npr. ocenjevanje, statistični podatki o uporabi učilnice ipd.) varni in zanesljivi.

3.2   Microsoft Teams

Učencem smo gesla in uporabniška imena dodelili, vendar ne za Moodle pač pa za Microsoft Teams. To se je izkazalo za pametno potezo, kajti uporaba Microsoft Teams je zelo podobna aplikacijam, ki jih mladina že uporablja in so se novemu načinu dela hitro prilagodili. Hkrati pa smo na tak način elegantno in hitro obšli ovire, s katerimi se ukvarjamo v razredu.

3.2.1 Disciplina in časovni izkoristek

Video konferenca s skupino učencev in z učiteljem je trenutno najboljši približek pouku v realnem času. Kljub temu, da je slab nadomestek za pouk v živo, ima vseeno številne prednosti. Ena izmed teh je ta, da obstaja gumb »mute all« (utišaj vse). V razredu je to včasih časovno zamudno dosežen cilj, sploh pri pouku tujega jezika, kjer je spodbujanje komunikacije bistvo predmeta. Frontalni del pouka zato lahko poteka nemoteno. Vsebinska vprašanja in komentarje učencev lahko obravnava učitelj ločeno, tako da posamezniku da besedo ali pa jih napiše v komentarje. V obeh primerih je tudi to bolj učinkovito, kajti v razredu se učenci včasih ne poslušajo in pogosto podobna vprašanja postavijo večkrat. Še ena velik prednost tovrstnega pouka pa je seveda ta, da si posnetek pouka učenci kadarkoli in kolikokrat se jim zdi potrebno ogledajo ponovno.

3.2.2 Motivacija in enostavno usvajanje orodij

Učenci so bili za pouk preko Microsoft Teams orodij zelo motivirani, saj smo se raziskovanja lotili sodelovalno in so bili ponosni na to, da so pomočniki meni in svojim staršem. Ko so imeli gesla so tudi sami ustanovili svoje skupinice (npr. 6.a Punce) in se prek njih družili, si pomagali pri snovi in učenju uporabe spletnih orodij. Veliko jim je pomenilo, kadar sem jih potrebovala, da so testirali kakšno funkcijo, ki sem se je naučila. Bili so zelo spretni in pomagali tudi meni, saj sami uporabljajo socialna omrežja, ki delujejo na podoben princip. Na tak način smo se naučili uporabljati obrazce in ankete v Microsoft v Forms, klepet, video klice, Microsoft Planer, OneNote zvezek in podobno.

V sklopu razrednih ur smo reševali kvize, ki se popravijo sami. V mislih sem imela seveda pripravljanje na morebitno ocenjevanje, a učenci so kljub temu radi sodelovali. Sami so namreč prispevali zabavna vprašanja in se veselili, če sem uporabila prav njihov predlog. Slika 3 prikazuje primer vprašanja razrednega kviza.
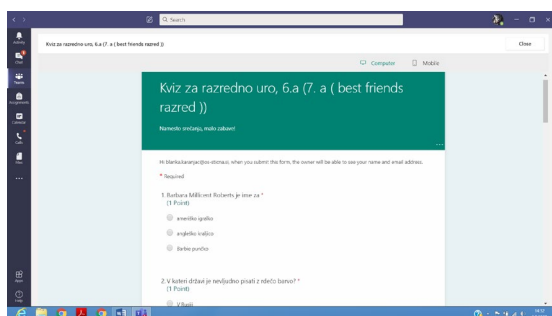
Slika 3. Prikazuje primer zabavnega kviza narejenega v Microsoft Forms, ki se popravi sam

Podobno sodelovalno smo prek Microsoft Forms izvedli tudi glasovanje za razredne naslove na koncu leta in sestavljali vsebino razrednih ur v OneNote Class Note zvezku. Slika 4 prikazuje zbrane rezultate glasovanja za naziv »glavica razreda«.
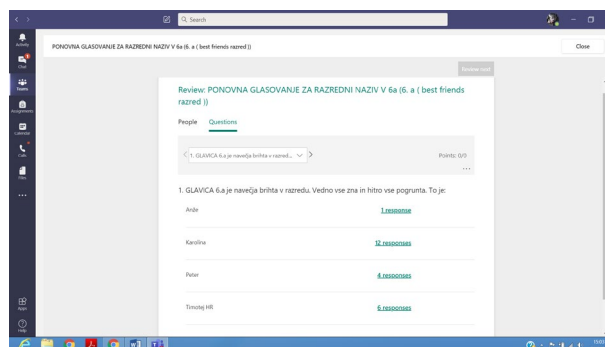
Slika 4. Prikazuje primer avtomatske analize zabavne ankete sestavljene v Microsoft Forms

3.2.3 Usmerjanje pozornosti učencev

Veliko več veselja do mehaničnega utrjevanja snovi so imeli tudi z učenjem novih besed prek programa Quizlet [3] https://quizlet.com/496898602/flashcards, kjer sem jih pritegnila tako, da sem včasih namenoma sestavila jezikovni set z napako. Torej tako, da je program slovenske besede bral kot angleške in so jezikovni set zato ponovili večkrat kot bi ga sicer, saj so se ob njem nasmejali.

Tako je motivacijo za utrjevanje, preverjanje znanja, sodelovanje pri pouku in podobno mnogo lažje spodbuditi kot pri rednem pouku. Pri rednem pouku je namreč bistvo socializacija med učenci in ta pogosto težko tekmuje s snovjo, ki jo obravnavamo pri pouku. Pri rabi spletnih orodij pa učenci vseeno lahko delijo mnenja in sodelujejo, vendar jih pri tem ne motijo dejavniki skupinskega pouka.

4 PREDNOSTI UPORABE DIGITALNIH ORODIJ PRI POUKU

Poleg že zgoraj opisanih prednosti uporabe digitalnih orodij (motivacija, pozornost, disciplina, aktivno sodelovanje) je vredno razmisliti o prednostih nekaterih oblik pouka pred klasičnimi. Nekatere bi lahko dopolnile, druge pa povsem nadomestile klasičen način pouka.

4.1 Dopolnilni pouk

Dopolnilni pouk [4] v šoli je običajno organiziran po koncu pouka, enkrat tedensko. Namenjen je učencem, ki težje sledijo snovi pri pouku. Običajno je organiziran za heterogeno skupino učencev, katerih potrebe po pomoči se lahko zelo razlikujejo. Poleg tega so učenci po zaključenih sedmih urah pouka pogosto preutrujeni, da bi ga lahko dobro izkoristili. Zato bi bilo veliko bolj smiselno, da bi dopolnilni pouk potekal prek videokonference v popoldanskih ali večernih urah (učenci in učitelji bi se uskladili), vsebino in trajanje posameznega srečanja pa bi učenci določili skupaj z učiteljem.

4.2 Dodatni pouk in interesne dejavnosti

Dodatni pouk [5] je v šoli organiziran podobno kot dopolnili pouk, le da je namenjen učencem, ki poleg rednega pouka želijo dodaten izzive ali pa se pripravljajo na tekmovanja. Le ta bi bil veliko bolj učinkovit, če bi gradivo učenci in učitelji lahko soustvarjali v OneNote Class Notebook-u in se občasno dobili v šoli ali prek videokonference in se o ustvarjenjem pogovorili v

živo. Tako bi pokrili bolj široko paleto interesov, bili pri delu bolj motivirani, poglobljeni, ustvarjalni in učinkoviti.

4.3 Premagovanje specifičnih učnih težav

Učitelji DSP (dodatna strokovna pomoč) so nenadomestljiva podpora učencem, ki imajo specifične učne težave. **[6]** Veliko njihove strokovne pomoči žal odpade na ročno prilagajanje gradiv posameznim učencem. Ta del njihove pomoči bi lahko v celoti prevzel. One Note Class Notebook. ki ima vgrajeno funkcijo potopnega bralnika. Ta omogoča prilagajanje pisnih gradiv glede na specifične učne težave učenca. Poleg oblikovanja besedil omogoča tudi glasno branje zapisanega. Namesto da učitelj DSP učencu pomaga prilagajati gradivo bi se učenci lahko naučili bralnik uporabiti sam. Učenci z bralno-napisovalnimi težavami se sicer učijo z njimi spoprijemati, vendar te težave ne izginejo in bi jim poznavanje tega orodja vse življenje koristila. Učitelji DSP pa bi imeli več časa, da bi z učenci vadili specifične tehnike usvajanja znanja.

4.4 Individualne govorilne ure

Učitelji v OŠ imamo tedenske dopoldanske in mesečne popoldanske govorilne ure. Čeprav se šola trudi, so oboje so za starše pogosto ob neugodnem času. Dopoldanskih se namreč starši udeležijo takrat, kadar pride do težav in bi bilo do mesečnih popoldanskih nesmiselno počakati. Za starše to pogosto pomeni, da se morajo za odsotnost dogovarjati z delodajalcem, za učitelje pa je organizacijsko to lahko težko izvedljivo (ni proste učilnice ob tisti uri, nepredvidene zadolžitve ipd.). Dopoldanske tedenske individualne govorilne ure bi bilo pametno povsem nadomestiti z videokonferencam, ki bi po predhodnem dogovoru prek elektronske pošte ali chat (klepet) sporočil potekale prek video klicev.

5 ZAKLJUČEK

Največja ovira pri znanju uporabe digitalnih kompetenc je nepoznavanje široke palete orodij in neznanje njihove uporabe. Čeprav imajo mnogi zadržke pri usvajanju znanja uporabe orodij, obstajajo preizkušeno dobre prakse, prek katerih se lahko hitro izobrazi širok prerez uporabnikov. Z znanjem uporabe teh orodij pa se znanje usvaja hitreje in na bolj učinkovite načine. Ker nas je obdobje korone prisililo v raziskovanje boljših načinov podajanja in usvajanja snovi, bi bilo potrebno z dodano vrednostjo nadaljevati in ponekod v celoti nadomestiti manj učinkovite načine komunikacije med šolskimi strokovnimi delavci, učenci in starši.

VIRI

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Spletna učilnica pri športni vzgoji

Online classroom for physical education

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POVZETEK

Ko sem se odločal za spletno učilnico pri športni vzgoji, se je porajal dvom v smiselnost le-te. Pomisleki kot so »a sedaj bodo pa še pri športni vzgoji potrebovali računalnik in sedeli za mizo namesto da bi bili otroci aktivni«. Vendar pa je bolj poglobljeno razmišljanje pripeljalo do tega, da sem se vseeno odločil zanjo. Učilnica ni namenjena temu, da jo dijaki uporabljajo vsakodnevno. Namenjena je temu, da ko so dijaki v dilemi glede same tehnike določenih elementov pri športih, si lahko pogledajo te elemente. Prav tako je namenjena oddaji seminarskih nalog, raziskovalnih nalog in poročil v okviru športne vzgoje. Izkoristim pa jo tudi sam saj je izbor športov na Gimnaziji Bežigrad velik. Ker nismo sposobni v vseh športih izvajati kvalitetnih demonstracij lahko te vsebine uporabimo za prikaz pravilne tehnike določenih elementov pri različnih športih. To so E-gradiva v obliki slik, video posnetkov, grafik, kinematik in podobnega, kar bi nam omogočilo še kvalitetnejšo športno vzgojo. Obenem pa tudi poučevanje športov, s katerimi nismo bili seznanjeni med študijem ali pa so nam predstavljali težavo in jih kasneje v karieri nismo obnavljali in utrjevali. Zaradi tega jih nismo vključili v svoje učne načrte, ker jih nismo bili sposobni demonstrirati. S tega vidika bi tudi dijaki dobili na področjih, kjer je učitelj slabše tehnično podkovan, kakovostno demonstracijo. Dobili bi vpogled v res pravo izvedbo vseh tehničnih elementov pri različnih športih. Prav tako mislim, da bi se na ta način paleta športov, ki jih šole ponujajo svojim učencev oziroma dijakom, precej povečala. Dvignila bi kakovost demonstracij pri urah športne vzgoje. Prav tako bi lahko učitelji sprotno preverjali svoje znanje v različnih športih in sledili razvoju tehnike v posameznih športih. Seznanjali bi se tudi v smislu taktične priprave ekip, ki jih vodijo na tekmovanja. Zato je po mojem mnenju spletna učilnica pri športni vzgoji smotrna in bi vsekakor pripomogla h kvalitetnejšemu pouku športne vzgoje.

KLJUČNE BESEDE

Šport, športna vzgoja, e-gradiva, spletna učilnica

ABSTRACT

When I decided on an online classroom for sports education, there was a doubt about the reasonableness of it. Concerns such as "but now they will still need a computer in sports education and sit at a desk instead of children being active." However, more in-depth thinking led me to decide on it anyway. The classroom is not intended for use by students on a daily basis. The purpose is that when students are in a dilemma about the technique of certain elements in sports that we have in sports education at the Bežigrad high school, they can look at these elements. It is also intended for the submission of seminar papers, research papers and reports of sports education. But I also use it myself, because the selection of sports at the Bežigrad High School is such that we are not able to perform quality demonstrations in all sports, and so we can use these contents to demonstrate the proper technique of certain elements in different sports. These are E-materials in the form of pictures, videos, graphics, cinematics and the like, which would allow us even better quality sports education and also teaching sports that we were not familiar with during our studies or which were a problem for us and later in our careers renewed and consolidated, because we did not include them in our curricula precisely because we were not able to demonstrate them. From this point of view, students would also get in areas where the teacher is less technical, demonstration quality and insight into the true implementation of all technical elements in various sports. I also think that in this way the range of sports offered by schools to their pupils and students would be greatly increased and at the same time the quality of the demonstrations during the physical education classes would be raised. Teachers could also keep checking their skills in different sports and keep up with the development of techniques in individual sports, thus learning about the tactical preparation of teams leading them to competitions. So in my opinion online classroom at physical education, will be necessary for better education.

KEYWORDS

Sports, physical education, e-materials, online classroom

1 UVOD

Spletna učilnica pri športni vzgoji. Kaj? Kaj pa naj bi tam bilo? Ima to sploh smisel?

To so vprašanja, ki se seveda porajajo odločitvi ali je pri športni vzgoji res smiselno imeti spletno učilnico. Po premisleku in tehtanju razlogov za ali proti, pa sem se na podlagi argumentov odločil, da si naredim spletno učilnico. Pri postavitvi učilnice

seveda ne gre brez izobraževanja. Če sem želel pripraviti spletno učilnico sem se seveda moral naučiti kako se spletna učilnica kvalitetno naredi in uporablja. In tako sem šel na izobraževanje. Na šoli imamo kar nekaj učiteljev, ki odlično obvladajo to področje, bili pa so pripravljeni to deliti z nami in organizirali izobraževanje na to temo. Tako sem se udeležil nekaj delavnic. Po začetnem zagonu in informacijah, pa je seveda najpomembneje, da zadevo uporabljaš, če ne znanje izgine nekje v oblakih in ves trud je bil zaman. In tako sem ugotovil kaj vse ponuja spletna učilnica. Veliko stvari je bilo potrebno prilagoditi, da sem lahko materiale, ki sem jih imel na voljo uspešno uporabil v spletni učilnici.

Že kar nekajkrat sem se znašel pred izzivom, kako pokazati oziroma demonstrirati elemente v kakšni športni panogi, o kateri imam slabše znanje ali pa ga celo sploh ne znam, a bi dijaki radi ta šport igrali. Na fakulteti za šport tudi ni možno osvojiti znanja iz vseh športov, ki bi jih dijaki radi spoznali ali jih celo igrali pri urah redne športne vzgoje. Normalno je tudi, da smo učitelji v nekaterih športih, pa čeprav smo jih imeli na predmetniku na fakulteti za šport, slabše strokovno podkovani, ker nam ti športi niso blizu. Za izpit smo opravili obvezne vaje, opravili teoretični in praktični del izpita in tu se z nekaterimi športi zgodba lahko konča. Potem pa se po dvajsetih letih soočiš na šoli z oddelkom dijakov, ki bi rad spoznal ali igral ta šport. Nastane problem, ki ga moraš rešiti, če želiš dijakom ponuditi kvaliteten pouk športne vzgoje. Ko nekega športa deset ali dvajset let ne demonstriraš, ga niti ne spremljaš, se ne seznanjaš z novimi pravili, torej si lahko v veliki zagati. Še posebej morda to velja za srednjo šolo, kjer težko pred dijaki nekaj opraviš na »blef«. Na fakulteti za šport tudi ne morejo ponuditi vseh možnih športov, zato ponujajo osnovne športe, pa tudi ti zadnje čase, če izhajam iz informacij, ki jih dobim od študentov, ki prihajajo k meni na obvezno prakso, niso več v takem obsegu, kot so bili v času mojega študija v devetdesetih letih prejšnjega tisočletja. Verjamem, da se je s povečevanjem vpisa v prvi letnik fakultete število študentov toliko povečalo, da profesor določenega praktičnega predmeta potrebuje kar nekaj asistentov, da lahko opravijo obvezne vaje pri tem predmetu, hkrati pa se tudi število ur praktičnega dela zmanjša, da bi lahko profesor z asistenti uspel izvesti praktični del predmeta za vse študente. Jasno je, da ker smo si ljudje različni, se tudi pri obveznih vajah dogaja, da asistenti bolj poudarjajo določene elemente tehnike in taktike, na izpitu pa profesor zahteva poudarek na drugih tehničnih in taktičnih elementih. V drugih državah imajo tudi na študiju športne vzgoje vzporedno še en predmet, ki zagotovi širše znanje in večjo možnost zaposlovanja v starejših letih, saj je jasno, da učitelj pri šestdesetih letih najbrž ni več zmožen v celoti opraviti praktičnega dela demonstracij pri določenih osnovnih športih, pa tudi različne poškodbe so lahko ovira za takšne demonstracije.

2 SPLETNA UČILNICA

Zato sem si že pred nekaj leti sam pripravil nekatera e-gradiva, ki so mi bila že takrat v pomoč in so mi, moram priznati, iz leta v leto bolj. Nekatere tehnične elemente sem že takrat našel na spletnih straneh, nekatere pa sem posnel sam. Takrat še s spletnimi kamerami in slabe kakovosti. Prosil sem dijake, ki so trenirali določen šport, če mi pomagajo pri demonstraciji, prosil nekatere kolege, ki so bili vešči v določenem športu, da mi pomagajo pri demonstraciji, ali pa sem se posnel sam. Nekajkrat

pa sem za pomoč prosil študente fakultete za šport, ki so bili pri nas na praktičnem usposabljanju. Skozi leta se je nabralo kar nekaj gradiva, ki pa je interne narave za poučevanje športne vzgoje na Gimnaziji Bežigrad. Takrat se je na spletnih straneh dobilo še vse gradivo. Danes je veliko gradiva plačljivega, tudi glede uporabe spletnega gradiva se stvari lahko zapletejo, saj so lahko avtorsko zaščitena. Sam sem si pripravil gradiva iz odbojke [1], [5], košarke, nogometa, badmintona [3], gimnastike [7], namiznega tenisa [4], atletike, fitnesa [8], v novejšem času, ko pa sem začel s predstavitvami osnovnih motoričnih sposobnosti, dijakom pripravljam še ta gradiva. To so gradiva iz ravnotežja, preciznosti, koordinacije, hitrosti, moči, gibljivosti. Hkrati pa tudi različne vaje za osnovno telesno pripravo športnikov ali dijakov, ki bi želeli začeti ali nadaljevati z vadbo.

2.1 Športna gradiva

E-gradiva, ki so povezana s športom, so sestavljena iz osnovnih podatkov o športu, opremi, ki jo potrebujemo za ta šport, pravili, ki veljajo v tem športu, tehničnih in taktičnih elementih tega športa in ne nazadnje tudi z vprašanji ali kvizom na temo določenega športa. V gradivu so razne slike ali animacije, ki so vezane na tehnične elemente tega športa, slike določenih pomembnih elementov, na katere je potrebno posebej paziti. Lahko pa so tudi razni filmčki, ki govorijo o metodiki učenja določenih elementov. To posebej velja za osnovne motorične sposobnosti, kjer za določene elemente učitelj potrebuje ali veliko časa in želje, da se jih nauči, zato bi bili dobrodošli filmčki, ki so dosegljivi na raznih omrežjih in spletnih straneh, da dijakom pokaže tehniko in izvedbo določenih vaj, hkrati pa tudi metodiko vaj, da se te elemente naučijo. Uporaba računalnika pri športni vzgoji dejansko lahko pomaga učitelju. Tako je recimo aerobika [2], oziroma sestavljanje raznih koreografij in sklopov vaj pri aerobiki, lahko precej lažja oziroma omogoča tudi učitelju s poškodbo ali kako drugače handikapiranemu učitelju, da poučuje takšne športe oziroma elemente določenega športa, pa čeprav jih sam ne zna ali jih ne zmore več narediti, je pa usposobljen za asistenco ali opozarjanje na napake oziroma metodične postopke pri posameznih elementih določenega športa.

Vsekakor bi lahko to pripomoglo k večji kakovosti ur športne vzgoje, prav tako pa tudi k večji pestrosti športne vzgoje v šolah, saj se pogostokrat zgodi, da so učitelji športne vzgoje pri svojem delu postali tako rekoč rutinerji. Kar pomeni, da so po začetni vnemi zapadli v krog ustaljenih navad in metod poučevanja, ki se jim zdi najboljši. Prav zaradi tega ne iščejo možnosti za raznovrstnost, posebej še ne na področjih, kjer so malo manj usposobljeni in kjer imajo manjši interes, ker pač teh športov ne obvladajo ali pa z njimi v času svojega študija sploh niso bili seznanjeni. Tudi tehnika in taktika pri posameznem športu se razvijata in napredujeta in učiteljem je težko spremljati razvoj vsega. Zato menim, da bi ponudba gradiv, ki bi bila na voljo učiteljem, najverjetneje popestrila športno vzgojo dijakom v mnogih šolah, hkrati naredila ure bolj zanimive in pestre. Po drugi strani bi olajšala delo učiteljem športne vzgoje in jim pokazala, da lahko s pomočjo teh gradiv poučujejo tudi športe, v katerih so slabše tehnično in taktično podkovani ali pa jih celo ne poznajo, saj bi se jih učili skupaj z učenci ali dijaki.

2.2 Moja spletna učilnica

Že nekaj let pri svojem delu uporabljam tudi svojo spletno učilnico, kjer imajo dijaki na voljo raznolika gradiva v zvezi s športi, ki jih izvajamo v sklopu pouka športne vzgoje na Gimnaziji Bežigrad.

Spletno učilnico uporabljam tudi pri teoretičnih vsebinah pri športni vzgoji. Tako morajo dijaki oddajati razne seminarske naloge v zvezi s športno vzgojo, predvsem ko imam pouk v fitnesu, obdelamo nekaj teoretičnih vsebin kot so: športna prehrana [9], anatomija in fiziologija mišic, zgodovinski pregled razvoja fitnesa [11], športne poškodbe [14], doping [15] in njegov vpliv na telo in šport, pa tudi nekaj o osnovah gibanja in osnovnih motoričnih sposobnostih [13]. Dijaki imajo v spletni učilnici na voljo osnovne informacije o vseh osnovnih športih, ki jih izvajamo pri pouku, na kriterije, ki veljajo za oceno iz posameznega športa, o tehniki in taktiki posameznega športa.

Na voljo imajo tudi nekatere zanimivosti iz sveta športa: najboljši košarkarji, nogometaši, nosilci olimpijskih medalj z zimskih in letnih olimpijskih iger, svetovnimi rekordi v atletiki, pa tudi nekaj smešnic iz sveta športa, ki so se zgodile na raznih tekmovanjih. Na koncu jim je na voljo tudi kviz v zvezi s športom, ki ga spoznavajo ali dopolnjujejo svoje znanje o njem.

3 ZAKLJUČEK

Vsekakor menim, da mi je spletna učilnica omogočila da lahko pri športni vzgoji obravnavamo tudi teoretične vsebine in se dijaki seznanjajo tudi z informacijami, ki jih sicer ne bi dobili, prav tako pa lahko s posnetki, ki so na voljo na spletnih straneh dobijo kvalitetno demonstracijo. Izkazala pa se je tudi v obdobju, ko je pouk zaradi korona virusa odpadel in smo dejansko lahko preko spletne učilnice opravljali pouk športne vzgoje. Dijaki so lahko uporabljali gradiva, ki so bila v spletni učilnici, lahko so oddajali poročila in naloge, ki so jih morali narediti doma. Lahko so reševali pripravljeni kviz. Tudi teoretično ocenjevanje bi se lahko izvedlo v kolikor bi bilo to potrebno. Skratka spletna učilnica je uporabna tudi pri športni vzgoji, vsekakor pa ne sme nadomestiti telesne aktivnosti ampak jo spodbujati.

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Vodenje aktiva med šolanjem na daljavo

Team leadership during distance learning

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POVZETEK

Članek opisuje vodenje sedemčlanskega šolskega strokovnega aktiva matematikov na OŠ v času šolanja na domu med 16. 3. 2020 in 25. 5. 2020. Ker gre za primer šole z matično šolo in dvema podružnicama, večino članov aktiva dela na vsaj dveh lokacijah, zato je bilo potrebno veliko spretnosti pri usklajevanju in prilagajanju na nove okoliščine. Članek torej opisuje, kako smo delovni načrt iz začetka šolskega leta hitro in uspešno prilagodili delu v času pandemije. Opisuje predvsem učinkovito vodenje zahtevnega aktiva pod novimi delovnimi pogoji.

KLJUČNE BESEDE

Strokovni aktiv, MS Teams, matematični aktiv, vodenje

ABSTRACT

The paper focuses on leading a professional mathematical team at a primary school during the period of distance learning from 16th March to 25th May, 2020. The majority of 7 team members work at two branch schools, so leading the team demanded skilful compromising and swift adapting to the unexpected working conditions. Therefore, the paper describes how the original working plan from the beginning of the school year was successfully adapted to working through the pandemic. It focuses on successful team leadership under new working conditions.

KEYWORDS

Professional team, Microsoft Office Teams, mathematical team, leadership

1 UVOD

Sodobni čas od nas zahteva, da se vsi učitelji prilagajamo, sledimo spremembam, da se dobro poznamo in dobro sodelujemo. Sodelovanje učiteljev je zagotovo prvi pogoj za odlično delo. Vedno moramo gledati, da delamo kakovostno in da to pomeni, da spodbujamo znanje, nenehno učenje in izobraževanje, izmenjavo izkušenj, odgovornost, upoštevanje predpisov itd. S strokovnimi aktivi ima šola možnost, da

posameznega učitelja usmeri v izboljšanje lastnega dela in k medsebojnemu sodelovanju.

2 STROKOVNI AKTIV

Strokovni aktiv šole obravnava problematiko predmeta oziroma predmetnega področja, usklajuje merila za preverjanje in ocenjevanje, daje učiteljskemu zboru predloge za izboljšanje vzgojno-izobraževalnega oziroma študijskega dela, obravnava pripombe staršev, učencev, vajencev, dijakov in študentov višjih šol ter opravlja druge strokovne naloge, določene z letnim delovnim načrtom. [1]

Strokovni aktiv je skupina učiteljev istega predmeta. Delovati morajo enotno ter sodelovati na različnih področjih svojega dela:

- oblikujejo in usklajujejo učiteljeve letne priprave,
- načrtujejo učne ure,
- spoznavajo standarde znanja,
- določajo merila in kriterije za ocenjevanje,
- predstavljajo in uporabljajo nove didaktične pristope,
- načrtujejo medpredmetne povezave,
- obravnavajo pritožbe staršev in učencev,
- sodelujejo z aktivi po vertikali in načrtujejo različne dejavnosti,
- razvijajo in nadgrajujejo študijsko delo,
- izvajajo projekte, načrtujejo dneve dejavnosti, organizirajo delavnice.

3 VODJA AKTIVA

Vodja aktiva je določen s strani ravnatelja ali pa je za vlogo določen znotraj posameznega aktiva. V poročilu o pilotni izvedbi o vodenju aktiva so mnenja, da imajo vodje aktivov zelo različno vlogo in opravljajo široko paleto nalog, ki se od zavoda do zavoda razlikujejo, odvisno od njegove ravni, vrste, velikosti, kulture, zgodovine in stila vodenja. Posamezni udeleženci so omenili, da opravljajo (le) tri naloge, nekateri so jih našteli več kot dvajset. Potrebo po razjasnitvi nalog pojasnjujejo refleksije udeležencev, saj so omenili, da od učenja v programu pričakujejo predvsem razjasnitev svoje vloge in nalog, na podlagi česar sklepamo, da vloga in naloge na ravni zavodov niso razjasnjene. [2]

4 VODENJE AKTIVA MATEMATIKE

V letošnjem letu sem bila prvič vodja aktiva matematike. Na naši šoli poučuje matematiko sedem učiteljev. Poučujemo na matični šoli in še na dveh podružničnih devetletnih šolah. Nekateri

sodelavci so stalno samo na eni lokaciji, tri pa se vozimo tudi na podružnico. To pomeni, da nam za medsebojno komunikacijo ni preostalo drugega, da smo se velikokrat srečali preko elektronske pošte. Za posamezne ure pouka smo se morali dogovarjati sproti, največkrat na začetku tedna. Snov pri manjših učnih skupinah, kjer je bil potem prisoten tretji učitelj, smo morali uskladiti, da so učenci iz dveh različnih razredov lahko delali isto snov. Približno petkrat na leto smo se srečali tudi "v živo". Takrat smo se po navadi dogovarjali o datumih pisnih preizkusov in njihovi vsebini, velikokrat tudi o organizaciji tekmovanj Kenguru in ostalih. Na začetku šolskega leta pa smo seveda določili cilje letnega delovnega načrta (LDN) in razpored snovi po urah, ki nam pomaga pri lažjem sledenju obravnavane snovi. V mesecu marcu 2020 pa se je vse obrnilo na glavo.

5 VODENJE AKTIVA NA DALJAVO

5.1 Elektronska pošta

Ko je bilo jasno, da se s ponedeljkom, 16. 3., začne šolanje na daljavo, smo se v aktivu dogovorili, da bomo snov podajali enotno, v vseh razredih, na vseh treh devetletnih osnovnih šolah, to je na matični šoli OŠ Stična, PŠ Višnja Gora in PŠ Zagradec. Vse priprave bodo na šolski spletni strani prosto dostopne za učence oziroma starše. Priprave bomo delali v parih. Naša komunikacija se je najprej preselila izključno na elektronsko pošto. Glede na ozadje pošte je to pomenilo, da je bilo najmanj šest odgovorov, se pravi, novih e-mailov na eno temo. Ampak v prvem tednu ni bilo druge možnosti. Je pa to vse skupaj pomenilo, da smo se vsak dan prebijali skozi goro besedila, mnenj, idej … Pri uporabi elektronske pošte se pisec počuti, kot da bi govoril. Zato je več možnosti, da pride do nesporazumov zaradi slovničnih napak ter napačne uporabe besed. [3] Elektronska pošta, vemo, zna biti velikokrat neosebna, saj smo si ljudje različni in potrebujemo tudi slušne informacije. Tega pa nam je že po prvem tednu primanjkovalo. Več je bilo tudi komunikacije ena na ena preko telefona. Vseeno nam je uspelo postaviti pravi načrt za obdelavo snovi.

5.2 Office 365 in MS Teams

V drugem tednu šolanja na daljavo smo se odločili, da naše dejavnosti prestavimo na orodje Microsoft Teams. Gesla za Oblak365 smo že imeli in uporabljali. Oblak365 povezuje Arnes AAI s storitvami Microsoft Office 365. Ena od možnosti Microsoft Officea je tudi MS Teams.

5.3 Delo v MS Teams

Ko smo odkrili oziroma odkrivali MS Teams, so se nam odpirala obzorja. Pri tem smo vsak dan odkrili nove funkcije, nove lastnosti oziroma uporabnosti tega orodja. Predvsem pa to, da smo se lahko naenkrat vsi slišali in videli ter se kulturno pogovorili o svojem delu. Pogovor v takem okolju seveda pomeni, da je bilo potrebno vzpostaviti nekaj novih/starih pravil. Pogovor je moral potekati po bontonu. Ko nekdo govori, ostali ne skačemo v besedo. Počakamo, da dokonča s poročanjem, in nato lahko naslednji pove svoje mnenje. Čim manj skakanja v besedo, čim manj prekinjanja drug drugega in seveda poslušanje. Pri tem smo bili deležni tudi morda slabših internetnih povezav

in je vmes prekinjalo, kar je pomenilo, da smo morali biti še toliko bolj dosledni pri poslušanju sodelavcev.

5.3.1 Tedenski plan

Za vsak prihodnji teden sem predstavila plan dela (slika 1). Ob tem je bilo potrebno slediti snovi vseh razredov, tudi če nisi delal priprave za dotični razred in hkrati smiselno določiti, ali kje dodamo kakšno uro utrjevanja, morda potrebujemo preverjanje znanja. Na tem mestu smo bili zelo v kontaktu z vodstvom, da smo vedeli, če je potrebno načrtovati samo 3 ure pouka (zaradi načrtovanih dni dejavnosti). Ker so imeli vsi učenci enoten urnik na vseh treh devetletnih šolah, pomeni, da so imeli vsi isti dan iste predmete. V realni učni situaciji to seveda ni izvedljivo, v virtualnem/elektronskem svetu pa. Pravzaprav nam je bilo to zelo v pomoč pri organizaciji dela.

Slika 1. Prikazan je plan dela za 9. teden šolanja na daljavo

Včasih smo zaradi lažje organizacije in preglednosti dela načrtovali kakšno uro tudi že za teden kasneje. Še vedno smo si dopuščali možnost popravkov. Dovolili smo si, da upoštevamo mnenja učencev ali staršev, od katerih smo dobivali povratne informacije o delu učencev doma.

5.3.2 Srečanja v živo

Enkrat tedensko ob večernih urah smo izvedli sestanek aktiva. Jaz sem v začetku tedna v aplikaciji organizirala dogodek in zapisala cilje sestanka (slika 2). Sodelavci so potem imeli čas, da potrdijo udeležbo. Tako sem vedela, da so objavo videli in da si bodo takrat vzeli čas za naš aktiv.
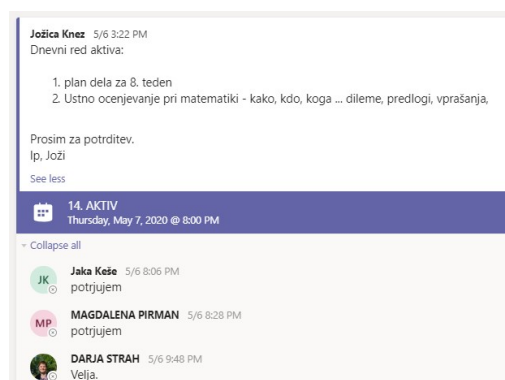
Slika 2. Objava sestanka z dnevnim redom in potrditev nekaterih članov aktiva.

Pri sestankih je bilo pomembno, da se za vsako tematiko dogovorimo. Vsak je imel možnost povedati svoje dileme in pričakovanja. Obvezno smo si poročali odzive svojih učencev.

Zavedali smo se, da so si učenci različni. V primerih, ko so bile priprave pretežke ali predolge, smo sklenili, da zmanjšamo število nalog. V času šolanja od doma so se pokazale tudi raznorazne stiske; tudi za to smo poskušali poskrbeti. Pomembno je, da si zaupamo, da si lahko povemo, da lahko izrazimo svoje dvome, skrbi in da to nekako konstruktivno prebrodimo skupaj. Kot pravi psiholog Musek Lešnik: »Sodelujte s kolegi, pomagajte si, delite dobre prakse, delite informacije; nobena sramota ni, če česa ne veste, ne znate, ne razumete – ogromno učiteljev se ta trenutek šele uči plavati v vodi, ki se ji reče izobraževanje na daljavo.« [4]

5.3.3 Pisanje in objavljanje zapisnikov

Kot vodja aktiva je moja naloga, da obveščam ravnatelja o naših dogovorih, problemih, sklepih … zato sem po vsakem sestanku še zapisala naše sklepe, jih naprej objavila v MS Teams, kjer smo si izoblikovali mapo v kanalu splošno (general) z imenom ZAPISNIK (slika 3). Tam so ostali učitelji aktiva prebrali zapisano in mi pomagali oblikovati sklepe ter dopisati, če sem kaj pozabila.
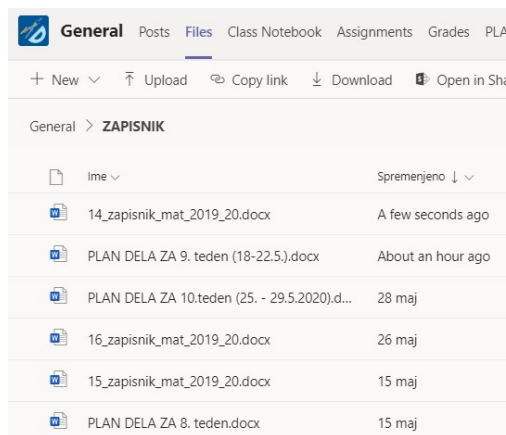
Slika 3. Objavljeni zapisniki v aplikaciji.

Pri vsakem zapisniku se vidi ime zapisnika, kje se nahaja, kdaj je bil nazadnje spremenjen in tudi kdo ga je spreminjal. Zato smo lahko vsi spremljali potek zapisov v dokumentu. Dokumenta ni bilo potrebno shranjevati na svoj računalnik, kar je dobro z več vidikov: ni nepotrebnih datotek na računalniku, tudi lažje in bolj aktivno urejanje dokumentov "online" in večja preglednost samih dokumentov, zbranih na enem mestu.

5.3.4 Razdelitev kanalov

Tekom tednov se je nabralo veliko vseh dokumentov v eni mapi. Zato smo se odločili, da bo najboljša organizacija dela, če si za vsak razred posebej ustvarimo kanal (mapo) (slika 4). V vsako mapo bomo oddajali dnevne priprave na vpogled sodelavcem. Vsak si jo lahko odpre, komentira, zapiše svoje mnenje kot komentar. Prednost tega spletnega orodja je, da lahko online spreminjamo dokument, ki se sproti shranjuje. Vsak udeleženec vidi, kaj je bilo spremenjeno, kar potrdi ali pa ne. Naše usklajevanje je potekalo hitreje in bolj dinamično.

Slika 4. Razporeditev kanalov v aplikaciji MS Teams.

V vsakem kanalu so bile priprave, ki so bile shranjene na dogovorjeno ime (slika 5). Najprej razred, potem zaporedna ura in še naslov ure.
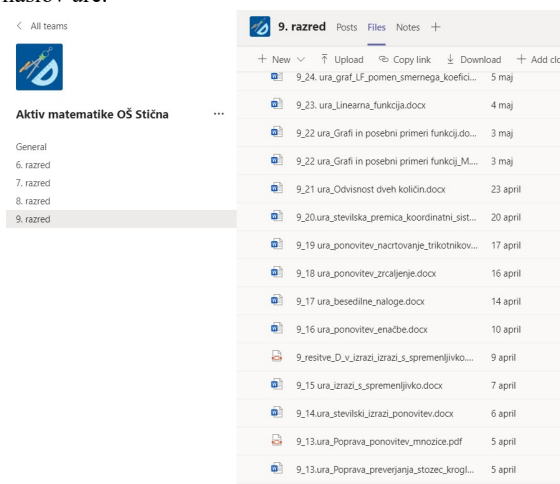
Slika 5. Priprave v kanalu za 9. razred.

6 ZAKLJUČEK

V času šolanja na daljavo sem pridobila neverjetno veliko novih znanj. Med drugim sem se naučila in potrdila spoznanje, kako zelo je pomembna komunikacija, pozitivna spodbuda, dobri zgledi. Po vrnitvi v šolo smo ohranili delo na MS Teams, kjer smo objavljali uporabne dokumente, zapisnike, poročila, ki smo jih morali še dopolniti ali urediti. Menim, da je delo v tem spletnem orodju kakovostno, učinkovito in predvsem za nas učitelje najenostavneje.

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Pl@ntNet in XMind pri pouku slovenščine in naravoslovja

Pl@ntNet and XMind at Slovene and science classes

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POVZETEK

Danes si življenja brez informacijske tehnologije ne znamo predstavljati. Pametni telefoni, računalniki, tablice in vsa druga informacijska tehnologija krojijo današnji vsakdan učencev in tudi nas odraslih. Učenci se v šoli veliko naučijo. Pomembno je, da znanje, ki ga osvojijo pri enem predmetu, uporabijo tudi pri drugem predmetu. Medpredmetno povezovanje je eden od elementov sodobnega pouka. Na naši šoli smo se odločili, da povežemo pouk slovenščine in naravoslovja. Učenci v 6. razredu pri pouku naravoslovja obravnavajo rastline, zato smo raziskovali floro v okolici šole. S pomočjo aplikacije Pl@ntNet smo identificirali rastline s fotografiranjem s pametnim telefonom in rastline opisali. Nastale so zanimive fotografije rastlin in miselni vzorci opisov v programu XMind, ki so jih učenci v obliki govornega nastopa tudi predstavili.

KLJUČNE BESEDE

Informacijska tehnologija, medpredmetno povezovanje, slovenščina, naravoslovje, Pl@ntNet, Xmind

ABSTRACT

Today, we cannot imagine life without information technology. Smartphones, computers, tablets and all other information technology shape today's everyday life of us adults and students as well. Pupils nowadays learn a lot of things at school. It is important that the knowledge they acquire in one subject is used in another subject as well. Cross-curricular integration is one of the elements of modern teaching. At our school, we have decided to combine the lessons of Slovene and Science. Pupils in 6th grade learn about plants in Science classes, so we decided to research the flora around the school. Using the Pl @ ntNet app, we identified plants by taking photos with a smartphone and described the plants. Interesting photographs of plants and mind maps of plants descriptions in the XMind program were created, which the students also presented in the form of an oral presentation.

KEYWORDS

Information technology, cross-curricular integration, Slovene, science, Pl@ntNet, XMind

1 MEDPREDMETNO POVEZOVANJE

Učni načrti se prenavljajo in posodabljajo in zahtevajo fleksibilnega in inovativnega učitelja, ki postavi v ospredje učenca, ki pri pouku aktivno sodeluje [1]. Zelo pomembno je tudi povezovanje različnih predmetnih področij. Medpredmetno povezovanje je celosten didaktični pristop – pomeni horizontalno in vertikalno povezovanje znanj, vsebin in učnih spretnosti [2]. Medpredmetno zasnovan pouk spodbuja učenca k samostojnosti, sodelovanju in k aktivni vključenosti v pouk. Raziskave so pokazale, da učenci pri medpredmetnem reševanju učnih situacij razvijajo interes in motivacijo za učenje ter poglabljajo razumevanje in uporabo znanja, pri čemer dosegajo boljše učne uspehe, kažejo bolj kakovostne medosebne odnose in zavzetost za učenje [2].

Tudi na naši šoli se spodbuja medpredmetno povezovanje, zato sva se s sodelavko odločili, da medpredmetno poveževa slovenščino in naravoslovje, pri čemer uporabiva tudi informacijsko tehnologijo. Učencem sva želeli dokazati, da se sodobnih elektronskih naprav ne uporablja samo za pogovor s prijateljem ali za igranje igric, ampak nam lahko olajšajo delo, se z njihovo pomočjo nečesa novega naučimo. V ta namen jih pri pouku učimo uporabe različnih informacijskih orodij, aplikacij in programov, ki jih bodo lahko uporabili tudi kasneje, v času študija, službi …

2 NAČRTOVANJE POUKA

Učiteljici naravoslovja in slovenščine sva se odločili, da pouk načrtujeva sodobno, medpredmetno in z uporabo informacijske tehnologije. Zavedava se, da je razvoj komunikacijsko-informacijske tehnologije prinesel nove možnosti za učenje in poučevanje. Najprej se moramo uporabe sodobne tehnologije in naprednih aplikacij naučiti učitelji, da lahko znanje prenašamo naprej na učence.

Učenci pri pouku naravoslovja v 6. razredu obravnavajo rastline, njihovo zgradbo, razmnoževanje, razvrščanje, njihove prilagoditve … [3].

Načrtovali sva drugačen pouk, pouk zunaj učilnice, z uporabo sodobne informacijske tehnologije in z medpredmetnim povezovanjem slovenščine in naravoslovja, saj se nama zdi pomembno, da učenci osvojeno znanje povezujejo.

Na tablice sva naložili aplikacijo Pl@ntNet, na računalnike v računalniški učilnici pa program XMind, ki je namenjen izdelovanju miselnih vzorcev.

2.1 Aplikacija Pl@ntNet

Pl@ntNet je aplikacija (glej Slika 1), ki nam omogoča identifikacijo rastlin s fotografiranjem s pametnim telefonom [4]. Pl@ntNet je velik projekt, saj vse rastline, ki jih fotografiramo, zbirajo znanstveniki po vsem svetu in jih analizirajo. Aplikacija nam omogoča identifikacijo rastlin, dreves, trav, iglavcev, vinskih trt, divjih solat in kaktusov. Aplikacija zna prepoznati rastlino po rodu ali družini. Z iskanjem najdemo latinsko ime rastline, ki ga vnesemo v iskalnik in poiščemo slovensko ime rastline.

Slika 1. Aplikacija Pl@ntNet [5]

2.2 Program XMind

XMind je program, ki nam omogoča izdelovanje miselnih vzorcev in je zelo enostaven za uporabo. Izdelamo lahko enostavne miselne vzorce, v katere lahko dodajamo besedilo, slike in različne datoteke. Program nam omogoča uporabo različnih predlog in ozadij [6].

2.3 Navodila za delo

Učence sva razdelili v pare. V razredu je enako število dečkov in deklic, zato so se naključno postavili v dve koloni, tako da sta bila v paru deklica in deček. Vsak par je dobil svojo tablico. Odpravili smo se v naravo v okolici šole. Pozorni so morali biti na floro, predvsem na cvetoče rastline, mahove, lišaje in drevesa. Učenci so imeli 90 minut časa, da so poiskali različne cvetoče rastline in jih fotografirali. Slika 2 prikazuje učenca, ki fotografirata rastlino.

Slika 2. Fotografiranje rastlin s pomočjo tablice

Po končanem fotografiranju smo se odpravili v učilnico, kjer sva učencem predstavili delovanje aplikacije Pl@ntNet. Vsak par je med svojimi fotografijami izbral najboljšo, najlepšo in jo prenesel v aplikacijo. Program jim je včasih ponudil več različnih rešitev. Vemo, da so si nekatere rastline med seboj zelo podobne in se razlikujejo v malenkostih, zato smo fotografije natančno primerjali, da smo poiskali pravo rastlino. Učenci so dobili rešitev v latinskem jeziku. Latinsko ime so vpisali v iskalnik in poiskali slovensko ime za rastlino.

Drugi del naloge je bil opis rastline. Najprej so v zvezek napisali osnutek miselnega vzorca (glej Slika 3). Ponoviti smo morali, katere podatke mora opis rastline vsebovati. Skupaj smo ugotovili, da bomo zapisali slovensko in latinsko ime rastline, družino, v katero spada, dele rastline, čas cvetenja, rastišče, uporabnost in raziskali, ali ima rastlina več različnih poimenovanj. Pri opisu rastline so si lahko pomagali s spletom ali odšli v knjižnico, kjer so poiskali slikovne ključe za določanje rastlin.

Slika 3. Oblikovanje miselnih vzorcev

Ko so učenci v zvezek oblikovali miselni vzorec, smo se preselili v računalniško učilnico. Na računalnikih je že bil naložen program XMind. Najprej sva jim pokazali, kako program deluje, nato so sami oblikovali (iz zvezka prepisali) miselni vzorec. Vanj so vstavili svojo fotografijo rastline.

Ko so vsi opravili vse naloge, so v parih predstavili svojo rastlino v obliki govornega nastopa.

3 ZAKLJUČEK

Medpredmetni pouk zahteva veliko načrtovanja in usklajevanja. Učitelji morajo biti pripravljeni na sodelovanje, poznati cilje, ki jih želijo doseči, in se didaktično usposobiti.

Za delo smo porabili sedem šolskih ur. Dve šolski uri smo se zadrževali v naravi, na travniku, kjer so učenci samostojno iskali rastline in jih fotografirali. Dve uri smo porabili v razredu, da so poiskali ime rastline s pomočjo aplikacije Pl@ntNet in oblikovali miselni vzorec opisa rastline v zvezek. Dve šolski uri so s pomočjo programa XMind oblikovali miselne vzorce. Zadnjo šolsko uro pa smo namenili predstavitvi rastlin v obliki govornega nastopa.

Na koncu sva opravili spletno anketo, kjer so učenci zapisali svoja mnenja o pouku. Vsi učenci so bili navdušeni, saj so spoznavali svojo okolico, rastline in uporabljali sodobno tehnologijo. Pouk je potekal sproščeno in naučili so se veliko novega. Vsi so bili enotnega mnenja, da si želijo več pouka v

obliki medpredmetnega sodelovanja in več pouka, kjer so aktivno udeleženi v učni proces.

Na koncu je pomembno tudi to, da učence naučimo vseživljenjskih znanj, da bodo znali misliti, da se bodo znali učiti, da bodo znali poiskati informacije in ločiti bistvene informacije od nebistvenih … Čaka nas še veliko dela.

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Včeraj za danes in jutri

Yesterday for today and tomorrow

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POVZETEK

V prispevku je predstavljena izvedba projektnega dne, ki ga na Srednji šoli Veno Pilon Ajdovščina izvedemo en dan v šolskem letu. Lansko leto v mesecu novembru smo izpeljali projektni dan na temo izumov, z naslovom IzUMi za trajnost. Sodelavci iz področij kemije, zgodovine, fizike in matematike smo z dijaki spoznavali, kako so nam izumi skozi različna obdobja življenje izboljšali, nekateri pa tudi otežili in za vedno zaznamovali človeštvo.

KLJUČNE BESEDE

Matematika, zgodovina, kemija, fizika, izumi

ABSTRACT

The article presents the implementation of the project day, which takes place for one day each year at Secondary School Veno Pilon Ajdovščina. Last year in November, the project day, entitled Inventions for Sustainability, was about inventions. Students and teachers from chemistry, history, physics and mathematics observed how inventions have improved our lives in different periods of time, and sometimes even made life difficult and forever marked humanity.

KEYWORDS

Mathematics, history, chemistry, physics, inventions

1   UVOD

Posodobljeni učni načrti profesorjem ponujajo možnosti za pripravo drugačnih učnih ur. Ker dijakom poskušamo prikazati kompleksnost predmetov, ki jih poučujemo, iz različnih zornih kotov in področij, se poslužujemo tudi medpredmetnih povezav. Dijaki na ta način pridobijo nova znanja, tudi v kontekstu vseživljenjskega učenja. Tak način dela ima tudi močan motivacijski učinek, saj dijakom predstavimo neko snov multiperspektivno. Dijaki se aktivno vključijo v proces pri pridobivanju novih informacij. Za profesorja pomenijo

medpredmetne povezave način poučevanja, ki zahteva podrobnejšo organizacijsko in snovno pripravo.

Projektni dnevi, ki se na naši šoli izvajajo že nekaj let zapored, predstavljajo profesorjem izziv pri iskanju podajanja snovi na drugačen, zanimivejši način. V preteklem šolskem letu smo se tako povezali profesorji kemije, zgodovine, fizike in matematike. Na temo izumov smo dijakom predstavili razvoj in uporabnost odkritega z različnih predmetnih področij.

V tem članku bova profesorici zgodovine in matematike predstavili, kako smo ta dan izpeljali.

2   IZZIVI SODOBNEGA POUČEVANJA

Na srednji šoli Veno Pilon Ajdovščina, kjer obe poučujeva že vrsto let, izvajamo pouk tudi s pomočjo medpredmetnih povezav, ki jih načrtujemo v letnem učnem načrtu posameznega predmeta. Matematiko lahko povežemo tako rekoč z vsakih predmetom, saj lahko prikažemo lepoto in uporabnost le-te na vseh področjih. Prav tako tudi zgodovino.

Medpredmetno povezovanje je eden od možnih didaktičnih pristopov poučevanja, ki si prizadeva povezovati vsebine različnih predmetov in medpredmetnih področij. Profesor poskuša določeno vsebino ali problem obravnavati čim bolj celostno ter isto vsebino osvetliti z različnih vidikov, pri čemer morajo biti jasno prepoznavni cilji drugih predmetov [1].

Zakaj medpredmetno povezovanje? Pri dijaku spodbuja samostojno, aktivno pridobivanje učnih izkušenj ter poteka v celostni dejavnosti dijaka [2]. Pouk je bolj zanimiv, pozitivno vpliva na razvoj samostojnega in kritičnega mišljenja ter se z razvijanjem različnih strategij mišljenja in povezovanja znanja povečata kakovost in trajnost pridobljenega znanja [3].

Sodelovanje s profesorji z drugega predmetnega področja omogoča doseganje ciljev, ki jih posamezen profesor v okviru svojega predmeta ne more doseči tako dobro, kot v sodelovanju s profesorjem drugega predmeta. Sodelovanje in usklajevanje s kolegi poveča motivacijo za delo in omogoča profesionalni razvoj. Zagotovo pa je medpredmetno sodelovanje tudi izziv, ker omogoča drugačen način dela, izboljša komunikacijo med profesorji, hkrati pa posameznik razširi in poglobi lastno znanje.

Pomembnost timskega poučevanja je v tem, da navzočnost dveh učiteljev dijakom omogoča sočasno podporo iz dveh predmetov, bolj individualiziran pouk in vzor timskega dela.

V našem primeru medpredmetne povezave smo uporabili metodo sodelovalnega učenja, ker so dijaki to metodo poznali in jo uporabljajo tudi pri drugih urah pouka.

Pomembnost sodelovalnega učenja je, da z metodo izvirne sestavljenke dosežemo, da dijaki drug drugemu pomagajo. Posameznik ima določeno nalogo in je hkrati za svoje delo odgovoren v svoji skupini. Bolje kot člani skupine sodelujejo, bolje, lažje in prej je delo opravljeno.

Poleg zgoraj naštetega smo se pri izpeljavi projektnega dne posluževali tudi skupinskega dela v razredu. Elizabeth G. Cohen skupinsko delo definira kot delo dijakov v skupini, ki ga jasno določi učitelj. Skupina naj bo dovolj majhna, da lahko vsak od njih k nalogi nekaj doprinese. Od dijakov se pričakuje, da izpeljejo nalogo brez neposredne in takojšnje pomoči učitelja. [4]

Ko učitelj da dijakom delo v skupini in jim pri tem dovoli, da delajo napake in se sami borijo za uspeh, s tem izvede prenos svoje avtoritete na dijake. Prenos avtoritete na dijake pa je temeljna posebnost (ang. key feature) skupinskega dela. To pomeni, da so zdaj dijaki odgovorni za svoj prispevek k skupinskemu delu. Pri svojem delu so svobodni, saj nalogo dokončajo na način, za katerega menijo, da je po njihovem mnenju najboljši, učitelju pa so odgovorni predstaviti svoj končni izdelek. Prenos avtoritete nikakor ne pomeni, da je učni proces nekontroliran. Učitelj z distance nadzoruje in ocenjuje delo dijakov ter na koncu oceni njihov končni izdelek.

Naslednja posebnost skupinskega dela je, da člani skupine sami ne morejo dokončati naloge, zato potrebujejo en drugega. Tako dijaki prevzamejo vlogo poučevanja in začne se medvrstniško učenje s tem, ko dajejo ostalim članom v skupini predloge, kaj naj delajo, da poslušajo druge in jih upoštevajo, spoštujejo vsa mnenja in da soodločajo pri tem, kako bodo delo zaključili v predvidenem časovnem okviru in z rekviziti, ki jih imajo na voljo.

Delo v skupini je aktivno in živahno, ker vključuje postavljanje vprašanj, razlaganje, podajanje predlogov, kritiziranje, poslušanje, strinjanje, nestrinjanje, iskanje rešitev, usklajevanje in skupne odločitve. Interakcija ni samo verbalna, ampak tudi neverbalna (npr. ponazarjanje, kimanje, neodobravanje, smejanje). [5]

Za načrtovanje takih povezav porabimo veliko več časa, zato jih moramo tudi večkrat ponoviti. Če povezavo izvedemo le enkrat, je izkoristek našega dela zelo majhen. Dijaki osvojijo nov način razmišljanja šele po nekaj ponovitvah. Pri preverjanju in ocenjevanju pa se je izkazalo, da je znanje dijakov pri takem načinu poučevanja kakovostnejše in trajnejše.

Poleg tega so učenci izpostavljeni nenehnim impulzom sodobne tehnologije in tudi s tega vidika potrebujejo drugačen pristop. Učitelji jim moramo omogočiti, da so pri pouku čim bolj aktivni, da samostojno pridobivajo potrebne informacije ter da razvijajo veščine, ki jim bodo pomagale pri vseživljenjskem učenju. Razvijati morajo kritično mišljenje, biti sposobni samovrednotenja in samokritičnosti. V poplavi informacij morajo biti sposobni presoditi, ali so informacije, ki jih pridobijo na spletu pridobljene iz verodostojnih virov. Pomembno je, da za svoje delo prejmejo povratne informacije, ker jih spodbudijo k nadaljnjem raziskovanju, sami pa morajo biti pripravljeni v delo vložiti svoj čas in trud.

Učitelji smo vsakodnevno postavljeni pred izzive sodobnega časa in digitalizacije pouka. Pri svojem delu moramo ponujati inovativne pristope in ustvarjalne dejavnosti, čeprav je to včasih težko zaradi preobremenjenosti učiteljev in slabše pripravljenosti učencev za opravljanje obsežnega samostojnega dela. Zavedati

se moramo izrednega pomena izobraževanja s področja uporabe inovativnih pristopov, medpredmetnih povezav in izmenjav izkušenj med sodelavci.

3 DEJAVNOST

3.1 Ideja in oblikovanje dejavnosti

Razredničarki 2 letnika gimnazijskega programa ter 4 letnika predšolske vzgoje sva se odločili, da bi sodelovali pri izvedbi projektnega dne na temo izumov. Poleg naju, ki poučujeva matematiko oziroma zgodovino, sva povabili h sodelovanju še profesorja fizike in kemije.

V Katalogu znanja za gimnazije kot tudi za srednje strokovno izobraževanje je priporočena uporaba različnih oblik in metod dela ter je poudarjeno samostojno delo učencev [6, 7, 8]. Dijaki naj bi pri samostojnem delu uporabljali različne vire in sodobno tehnologijo. Zato smo izvedbo zasnovali tako, da so dijaki pri naših urah bili samostojni in podajali svoje ideje ter kot posamezniki bili vključeni v skupinsko delo.

3.2 Cilji

Dijaki:
- razvijajo veščine dela v skupini in iskanja kompromisov za doseganje ciljev ter razvijajo ustvarjalnost in samoiniciativnost (elementi podjetnosti);
- oblikujejo definicijo pojmov izum in odkritje;
- ovrednotijo pomen izumov za človeka in zgodovinski razvoj;
- argumentirajo, kakšno bi bilo njihovo življenje brez izumov;
- predlagajo nove izume za zmanjšanje okoljske krize, izboljšanje udobja, reševanje življenj;
- razvijajo občutljivost za zaznavanje aktualnih problemov in iščejo rešitve;
- razvijejo temeljne spretnosti, veščine, znanja in navade za učinkovito in uspešno uporabo digitalne tehnologije;
- spoznavajo nove oblike učnih ur za popestritev frontalnega pouka.

3.3 Načrtovanje dejavnosti

Načrtovanje dejavnosti se je začelo z uskladitvijo učnih ciljev in pripravo poteka učnih ur.

Profesorica matematike se je že v samem začetku povezala z gospo Nino Klun Čakš iz Urada RS za intelektualno lastnino, ki je posredovala veliko literature, ki nam je bila v pomoč in vodilo pri izvedbi. Poiskali smo še video posnetke ter gradivo o izumih skozi čas. Dogovorili smo se glede delitev v skupine. Odločili smo se, da oblikujemo skupine, ki bodo sestavljena iz enakega števila dijakov programa gimnazija in predšolska vzgoja. To bi omogočilo lažje vodenje skupin, saj so dijaki 4. letnika programa predšolska vzgoja vešči vodenja manjših skupin. Člani skupine so bili nato izžrebani na dan izvedbe. Naredili smo seznam potrebnih pripomočkov za delo profesorjev in dijakov. Klopi v razredu so bile postavljene v obliki kvadrata za lažjo komunikacijo med člani skupine. Naloge so si razdelili člani skupine. Določili pa smo dijake – novinarje, ki so celotno izvedbo snemali, fotografirali in nato predstavili na plenarnem delu v obliki videoposnetka.

3.4 Izvedba dejavnosti

Delo je potekalo v obliki medpredmetnega sodelovanja med zgodovino, matematiko, kemijo in fiziko. Dijaki so delali v skupinah, del dejavnosti je potekal s tehniko svetovne kavarne.

Najprej smo dijakom predstavili cilje in potek dela.

Kot prvo iztočnico za delo so si dijaki ogledali eksperiment (slonova zobna pasta), ki sta ga pripravila profesorica kemije in profesor fizike. Pri tem sta dijakom razložila kemijske in fizikalne elemente.

Druga iztočnica za delo pa je bil ogled animiranega filma Baltazar – Izumitelj čevljev. To je dijake spodbudilo, da so po ogledu razmišljali o izumih, napakah, ki se dogajajo med delom, začetnih neuspehih in vztrajnosti, ki je pomembna za dokončanje dela.

Skupine dijakov so bile sestavljene tako, da je imela vsaka skupina po dva člana iz 2. letnika gimnazijskega programa ter dva dijaka iz 4. letnika predšolskega programa.

Izvedba projektnega dne je potekala po dejavnostih. V prvi dejavnosti je vsaka skupina na list napisala definicijo izuma in odkritja ter napisano predstavila ostalim skupinam.

Nato je profesorica matematike dijakom predstavila vpliv izumov na človeka in razvoj, nastanek izumov kot potreba po nečem, kar ne obstaja, pomoč drugim, izkoriščanje znanja o naravi ter najpomembnejše izume po izboru.

V naslednji dejavnosti je profesorica zgodovine vsaki skupini dala nemi zemljevid sveta in komplet sličic z antičnimi izumi. Naloga dijakov je bila, da posamezni izum postavijo na celino, na kateri je nastal. Dijaki so najprej razvrščali sličice na papirni zemljevid, ki smo ga predhodno pripravili (glej Sliko 1).
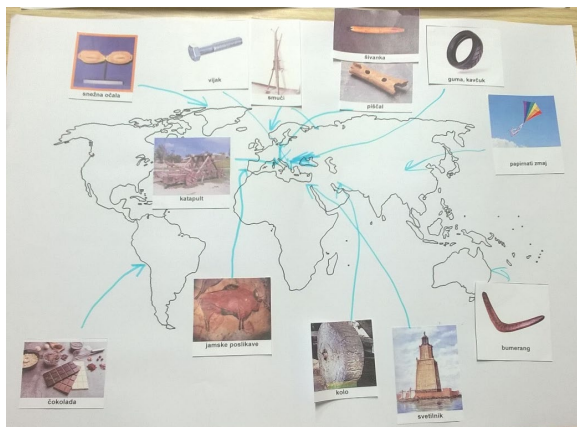
Slika 1. Izdelek druge dejavnosti

Pogovorili smo se o pravilnosti izbire postavitve posameznega izuma v zemljevidu. Potem pa so dijaki enako dejavnost ponovili še v Arnesovi spletni učilnici. Dejavnost, kje so dijaki razvrščali različne predmete na zemljevid, je pripravil kolega Urban Ščcek, s katerim smo skupaj sodelovali pri tem projektnem dnevu. Primer izbranih odgovorov je prikazan na Sliki 2.
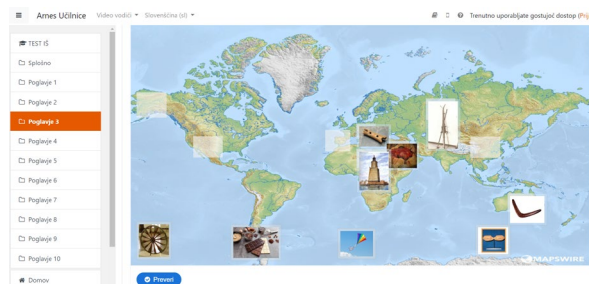
Slika 2. Izdelek druge dejavnosti

Tretja dejavnost je bila zastavljena tako, da so dijaki po skupinah izbrali najpomembnejši izum iz antike. Svojo izbiro so morali utemeljiti in ovrednotiti pomen izuma za razvoj človeka ali gospodarstva. Sledilo je poročanje po skupinah.

Nato je profesorica matematike dijakom pokazala in razložila še nekaj zabavnih izumov, ki pa nimajo vrednosti za človekov razvoj.

Nadaljevali smo s predstavitvijo štirih slovenskih izumiteljev in njihovih najpomembnejših izumov (brata Rusjan, Janez Puhar, Janez Puh in Peter Florjančič). Pri tem smo izpostavili pomen nekaterih slovenskih izumov in izumiteljev, npr. v letu 2020 smo obeležili stoto obletnico prvega slovenskega poleta Edvarda Rusjana.

V četrti dejavnosti so dijaki uporabili mobilne telefone za reševanje kviza Slovenski kvizum, katerega začetno stran prikazuje Slika 3, na temo slovenskih izumiteljev. Delo je potekalo individualno.

Slika 3. Začetna stran Slovenskega kvizuma

Sledil je eksperiment (dimni balon), ki sta ga pripravila profesorica kemije in profesor fizike in dijakom razložila kemijske in fizikalne lastnosti.

Pri peti dejavnosti je delo dijakov potekalo s tehniko svetovne kavarne. Najprej je vsaka skupina izbrala eno temo iz sledečega nabora: Izumi, ki nam poenostavljajo življenje, Izumi, ki rešujejo življenje, Izumi, ki nam škodijo, Izumi, ki bi pomagali rešiti ekološko krizo [9]. Naloga vsake skupine je bila, da so izbrali tri izume in utemeljili izbiro. Nato je en dijak ostal pri mizi v vlogi poročevalca, ostali trije pa so odšli k drugim skupinam. Pri matični skupini so novi člani dodali po tri izume in jih utemeljili. Nato so izbrali novega člana za poročanje o delu v skupini, ostali pa so se selili. Dejavnost se je zaključila, ko je vsak dijak sodeloval v vseh skupinah. Skupine so bile na koncu v drugačni sestavi kot na začetku in so poročali ostalim. Pri tej dejavnosti so dijaki uporabljali aplikacijo Padlet na način kot je prikazano na

Sliki 4, kjer so podajali ideje, o katerih so se pogovarjali v posamezni skupini.
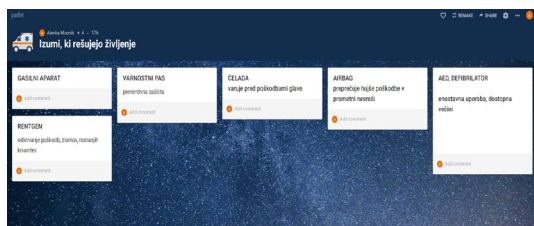
Slika 4. Izdelek pete dejavnosti

V nadaljevanju smo na tablo zapisali besede motor, knjiga, fotoaparat, telefon, ura, računalnik, radio, čevlji ter bicikel. Dijaki so morali po skupinah sestaviti nov izum tako, da so povezali dva ali tri samostalnike med seboj (glej Sliko 5). Izum so razložili ostalim in izpostavili uporabnost in prednosti novega izuma.
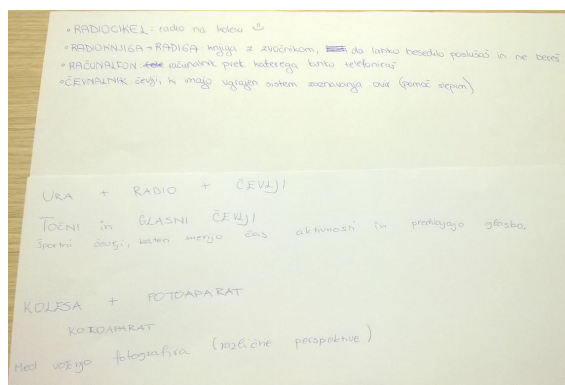
Slika 5. Skupinsko delo šeste dejavnosti

Nato so dijaki individualno reševali kviz Kahoot o izumih in izumiteljih. Del kviza je prikazan na Sliki 6. Najboljšega smo nagradili s praktičnim darilom.

Slika 6: Kviz izdelan s pomočjo Kahoota.

V osmi dejavnosti so dijaki v skupini izbrali tri predmete, ki jih uporabljajo vsak dan. Nato so opisali, kako drugačno bi bilo njihovo življenje, če teh izumov ne bi izumitelji delili s svetom. Potem so poročali ostalim skupinam, preostali dijaki so ustno ovrednotili izbor posamezne skupine.

Nazadnje je nekaj dijakov, ki so prikazani na Sliki 7, pripravilo videoposnetek o delavnicah, v katerih so sodelovali. Izdelan posnetek smo predstavili na skupni prireditvi, kjer so vsi sodelujoči na projektnem dnem imeli priložnost videti, kaj smo počeli.
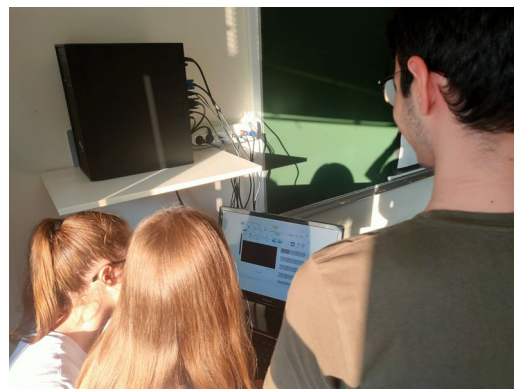
Slika 7: Montaža videoposnetka.

V dnevu po delavnicah so dijaki naredili evalvacijo projektnega dne v obliki vprašalnika.

4 EVALVACIJA UDELEŽENCEV

Dijaki so po končani dejavnosti izpolnili evalvacijski vprašalnik, v katerem smo jim zastavili štiri vprašanja, in sicer:
1. Kaj ti je bilo pri takem načinu dela všeč? Zakaj?
2. Zapiši predloge izboljšav.
3. Ovrednoti delo ostalih skupin v delavnici.
4. Naštej dve novi informaciji o izumih ali izumiteljih, ki ti bosta ostali v spominu.

Večini dijakov je bila celotna dejavnost všeč, vendar je bila predolga. Nekaterim delo z dijaki, ki jih ne poznajo, ni všeč in tega ne bi ponovili. Zelo ustvarjalni so bili pri sestavljanju novih izumov (združevanje samostalnikov). Presenetil jih je še živeči izumitelj Peter Florjančič in njegovi izumi. Delo ostalih skupin so ovrednotili kot uspešno, ustvarjalno zabavno in uporabno. Dijake sta navdušila eksperimenta in nekateri so poskusili oblikovati dimni balon. Težave so imeli z montažo videoprispevka, ker je bila ena ura časa premalo za dovršen izdelek.

5 EVALVACIJA IZVAJALCEV

Sama tema izumov in izumiteljev ni posebej zajeta v učni načrt, ampak nas izumi spremljajo dnevno, zato je smiselno, da dijaki razmišljajo o tem in ovrednotijo vlogo izumov in izumiteljev za življenje ljudi. Delo je zasnovano medpredmetno, zato je potrebno veliko koordinacije med sodelujočimi učitelji in veliko truda pri oblikovanju dejavnosti in usmerjanju dijakov pri delu. Pri oblikovanju skupin je smiselno, da se pred začetkom dela izvede igro spoznavanja članov, ker se vsi ne poznajo med seboj in nato delo lažje steče. Ker je bila celotna dejavnost dolga 6 ur je bila na določenih delih težko motivirati dijake za delo, saj so bili aktivni skozi celoten proces (razen pri eksperimentih in predstavitvi izumiteljev) in jim je koncentracija padala. Nekoliko jih je bilo treba usmerjati pri svetovni kavarni, da so se člani vsakokrat primerno razporedili po skupinah. Dijake smo med poročanjem opozarjali na izražanje in rabo besedišča.

6 ZAKLJUČEK

Projektni dan na temo izumov se nam je že sprva zdela zanimiva tema, ki jo je moč raziskati z različnih zornih kotov. Zbrali smo

se profesorji iz različnih področij, ki se tudi sicer zelo dobro dopolnjujemo, tako pri izvajanju vsakodnevnega pouka kot tudi v zasebnem življenju. Pri pripravi in izvedbi dela v delavnicah smo se zato zabavali in s sproščenostjo in dobro voljo tudi izpeljali potek celotnega dne. Meniva, da nam je uspelo predstaviti izbrano temo na zanimiv in drugačen način, saj se sicer dijaki v samem učnem načrtu s tovrstno tematiko ne srečujejo.

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Določevanje težnega pospeška s pomočjo pametnega telefona

Determining gravitational acceleration using smartphone

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POVZETEK

Učenje na daljavo je učiteljem naravoslovnih predmetov predstavljalo poseben izziv pri izvedbi eksperimentalnega dela. Medtem ko je predavanje učne snovi in ocenjevanje znanja dokaj enostavno izvajati preko spleta, pri eksperimentiranju ni tako. Učitelji smo morali laboratorijske vaje prilagoditi tako, da so bile primerne za samostojno delo v domačem okolju. Pri tem smo si lahko pomagali tudi s sodobnimi IKT orodji. V prispevku bo prikazan primer izvedbe fizikalnega eksperimenta na daljavo, pri katerem so dijaki 1. letnika gimnazije določevali velikost težnega pospeška s pomočjo pametnega telefona. Uporabljali so mobilno aplikacijo Phyphox za zajem podatkov in programsko orodje Logger Pro za grafično predstavitev rezultatov. Dijaki so eksperiment lahko izvedli s pripomočki, ki jih najdemo v vsakem domu in pri tem dobili zelo natančne rezultate. Predstavljene bodo prednosti in pomanjkljivosti omenjenega pristopa ter ideje za nadgradnjo eksperimenta.

KLJUČNE BESEDE

Eksperimentalno delo, težni pospešek, pametni telefon, Phyphox, Logger Pro, IKT

ABSTRACT

Distance learning presented a special challenge for science teachers in the implementation of experimental work. While lecturing and assessing knowledge is fairly easy to do online, experimentation is not. Teachers had to adapt the laboratory exercises so that they were suitable for independent work in the home environment. We were also able to help ourselves with modern ICT tools. The paper will present an example of performing a physical experiment at a distance, in which first-year high school students determined the magnitude of gravitational acceleration using a smartphone. They used the Phyphox mobile application to capture data and the Logger Pro software tool to graphically present the results. Students were able to perform the experiment with accessories found in every home, and the results were very accurate. The advantages and disadvantages of this approach will be presented, as well as ideas for upgrading the experiment.

KEYWORDS

Experimental work, gravitational acceleration, smartphone, Phyphox, Logger Pro, ICT

1 UVOD

Raziskava, s katero je Zavod Republike Slovenije za šolstvo preverjal učinkovitost letošnjega poučevanja na daljavo, kaže, da je okoli ⅘ učiteljev na daljavo uspelo predelati vsaj ⅔ predvidene učne snovi [1]. Poučevanje in ocenjevanje na daljavo torej ni bilo posebej problematično, kakovostno izvajanje eksperimentalnih vaj pa je učiteljem predstavljalo težavo. Večina vaj namreč zahteva pripomočke in opremo, ki je povprečen učenec nima na voljo doma. Učitelji smo zato morali, kjer je bilo to mogoče, prilagodili vaje za izvajanje v domačem okolju. Za prikaz naravnih zakonitosti smo se fiziki lahko zanesli tudi na sodobno IKT opremo, kot so različne spletne simulacije (appleti) in pametni telefoni.

2 PAMETNI TELEFON V FIZIKALNEM LABORATORIJU

K uporabi različnih spletnih orodij pri pouku fizike nas spodbuja tudi učni načrt [2]. Sam problem pri uporabi računalniških simulacij vidim v tem, da njihov algoritem temelji na tistem naravnem zakonu, ki ga nameravamo preizkušati. Na ta način bomo seveda vedno dobili vrednosti, ki izhajajo iz določenega algoritma in ne moremo sklepati, če bi enake rezultate dali tudi dejanski poskusi v naravi ali laboratoriju. Zato menim, da je fizikalne poskuse treba opravljati v živo in se posluževati računalniških simulacij le v redkih primerih, ko prvo ni mogoče. Drugačno možnost za izvajanje eksperimentov v domačem okolju pa nam nudijo pametni telefoni. Z njimi lahko dejansko fizično izvedemo nek eksperiment, pametni mobilnik pa uporabimo za zajem različnih parametrov. Moderni pametni telefoni namreč vsebujejo pester nabor različnih senzorjev: mikrofon, zvočnik, kamero, GPS, merilnik pospeška, žiroskop, magnetometer, termometer, barometer, higrometer, senzor zaznavanja bližine in osvetljenosti, kotomer … Torej jih lahko uporabimo za zajemanje in obdelavo mnogih fizikalnih količin

iz okolja. Čeprav se zanesljivost in kvaliteta tako pridobljenih podatkov verjetno ne moreta primerjati s specializirano laboratorijsko opremo, menim, da pametni telefoni predstavljajo precejšno popestritev pouka in poceni priložnost za izvedbo številnih enostavnejših eksperimentov, predvsem v primarnem in sekundarnem šolstvu.

Da lahko pametni telefon uporabimo kot del fizikalnega laboratorija, potrebujemo primerno aplikacijo. V prispevku bo predstavljena večkrat nagrajena aplikacija Phyphox, ki je bila razvita na nemški Univerzi RWTH v Aachnu.

3 DOLOČEVANJE TEŽNEGA POSPEŠKA S POMOČJO PAMETNEGA TELEFONA

3.1 Teoretična izhodišča

Težni pospešek ob površju Zemlje (g) lahko določimo s pomočjo prostega pada. Telo, ki ga spustimo padati z višine h, pade na tla v času t, pri čemer velja zveza: $g = \frac{2h}{t^2}$ [3]. Pri tem smo zanemarili vpliv zračnega upora. Za določitev težnega pospeška moramo torej natančno izmeriti čas padanja z znane višine.

Aplikacija Phyphox za to merjenje uporablja akustično štoparico, ki lahko do tisočinke sekunde natančno meri čas med dvema zvočnima signaloma [4]. Prvega ustvarimo ob tem, ko spustimo telo, drugi pa nastane, ko telo pade na tla. Izbrati moramo telo in podlago, ki ob trku ustvarita čim bolj glasen zvok, poskus pa je seveda treba izvajati v tihem okolju.

3.2 Izvedba eksperimenta

Dijaki so si na pametni telefon morali naložiti aplikacijo Phyphox, ki je brezplačno dostopna v Google Play in App Store (slika 1). Poleg telefona so potrebovali še merilni trak za merjenje višine, utež, ravnilo in palico. Za utež smo jim svetovali kakšen manjši kovinski predmet (npr. kovanec), ki ob padcu na trdo podlago ustvari glasen zvok. Namesto palice so lahko uporabili kuhalnico ali kar jedilno žlico. V primeru mehke podlage, so si lahko pomagali tudi s kovinsko ali leseno ploščo (npr. pladnjem), ki so jo položili na tla za okrepitev zvoka ob pristanku uteži.
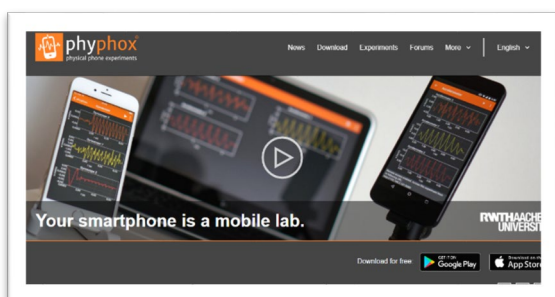
Slika 1. Aplikacija Phyphox

V Phyphoxu so odprli eksperiment Akustična štoparica (Acoustic Stopwatch). Najprej so si nastavili prag zajemanja zvoka (Treshold). Višji, kot je prag, glasnejši mora biti zvok, ki sproži štoparico. S primerno nastavitvijo praga, se lahko izognemo zvočnim motnjam iz okolja. Nastavili so si tudi minimalni zamik (Minimum Delay), to je najmanjši čas, ki mora

poteči od začetka do konca poskusa. Tako lahko dosežemo, da aplikacija reagira le na naš začetni sunek ter trk uteži s tlemi, ne pa npr. na odmeve v zaprtih prostorih ali druge zvočne motnje med poskusom. Seveda pa mora biti ta zamik v vsakem primeru manjši od dejanskega časa padanja. Dijakom sem svetoval, naj si nastavijo prag zajemanja zvoka na 0,5 relativnih enot in minimalni zamik na 0,2 sekunde ter te vrednosti po potrebi prilagodijo (slika 2).

Nato so dijaki lahko začeli s poskusom. Ravnilo je bilo potrebno položiti na vodoravno podlago (mizo, stol, polico …), tako da je en konec visel čez rob in na ta konec so dijaki postavili svojo utež. V bližino so postavili telefon in zagnali eksperiment Akustična štoparica v Phyphoxu. Nato so s palico udarili ravnilo v vodoravni smeri, tako da se je odmaknilo in je utež začela prosto padati (slika 3). Ta udarec je sprožil akustično štoparico, zvok padca uteži s tlemi pa jo je ustavil. Na ta način so dobili natančno izmerjen čas padanja. Na koncu so s pomočjo izmerjene višine in časa padanja izračunali težni pospešek. Poskus so opravili štirikrat, vsakič z drugačne višine.
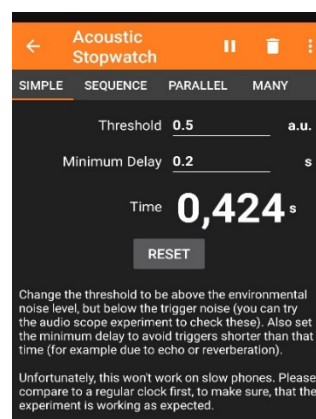
Slika 2. Akustična štoparica v Phyphoxu

Rezultate so dijaki vpisali na delovni list. Na koncu so dobljene vrednosti uporabili še za grafično upodobitev. V programski opremi Logger Pro, ki jo na šoli uporabljamo pri fizikalnih eksperimentih, so narisali graf, ki prikazuje odvisnost višine od časa padanja. V graf so vnesli tudi prilagoditveno kvadratno funkcijo. Nato so omenjeni graf še linearizirali in iz naklona dobljene premice odčitali povprečni težni pospešek. Oba grafa so priložili delovnem listu ter ga, skupaj s fizikalnimi ugotovitvami in komentarji, poslali profesorju.
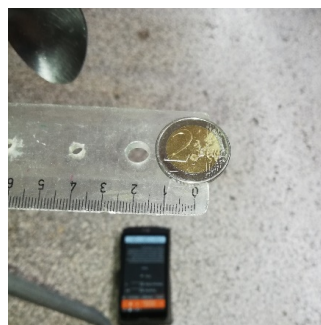
Slika 3. Postavitev eksperimenta

3.3 Rezultati eksperimenta

Aplikacija Phyphox se je pri tem eksperimentu izkazala za zelo zanesljivo, saj je večina dijakov za težni pospešek dobila rezultate, ki so za manj kot 5% odstopali od dejanske vrednosti 9,81 m/s² [3]. Glede na enostavnost eksperimenta, gre za presenetljivo dobre rezultate. Opazili smo, da so vrednosti, dobljene z višjih višin padanja, bolj natančne od tistih z nižjih višin (tabela 1). To gre verjetno pripisati dejstvu, da je relativna napaka izmerjenega časa manjša pri daljšem času. Veliko dijakov je odstopanja pripisalo dejstvu, da smo pri poskusu zanemarili vpliv zračnega upora. Prav tako pa smo zanemarili čas, ki ga zvok potrebuje za pot do mikrofona v telefonu. Zaradi slednjega je dejanski čas padanja uteži pravzaprav manjši od izmerjenega in sicer za približno 0,003 sekunde na meter prepotovane višine. Z upoštevanjem tega popravka bi se izračunane vrednosti težnega pospeška malo povečale in torej še bolj približale dejanski vrednosti (tabela 1).

Tabela 1. Rezultati meritev

h (cm)	t (s)	g (m/s²)
43,4	0,303	9,45
86,5	0,424	9,62
122,5	0,502	9,72
158,2	0,569	9,77

Natančnost rezultatov je bila vidna tudi iz priloženih grafov, saj sta se prilagoditvena kvadratna in linearna funkcija odlično prilegali vnesenim točkam. S kvadratno funkcijo so dijaki potrdili, da se je utež gibala enakomerno pospešeno (slika 4), saj velja $h = \frac{g \cdot t^2}{2}$.
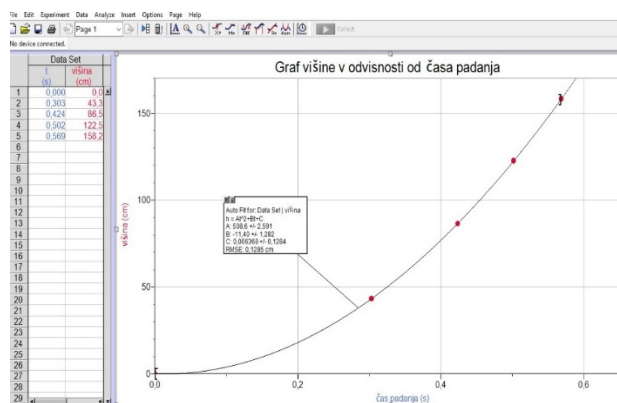
Slika 4. Višina v odvisnosti od časa pri prostem padu

Medtem pa je naklon premice lineariziranega grafa podal povprečno vrednost gravitacijskega pospeška. V predstavljenem grafu je ta znašal 9,79 m/s², kar je natančno na 0,2% (slika 5).
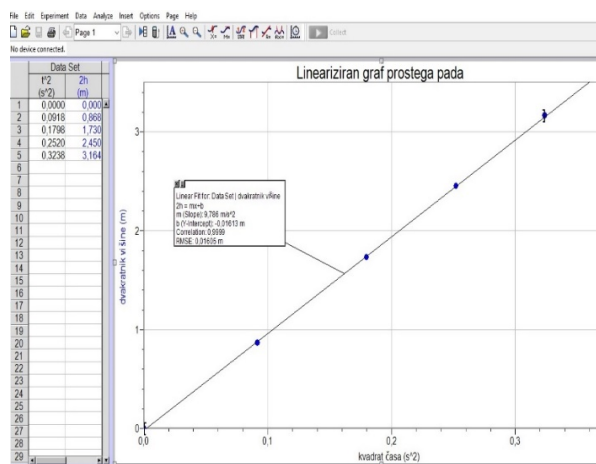
Slika 5. Lineariziran graf prostega pada

3.4 Evalvacija eksperimenta in dodatne možnosti

Phyphox se je pri tej eksperimentalni vaji odlično izkazal. Delo je bilo enostavno in hitro, rezultati pa zelo natančni. Aplikacija je brezplačna in ponuja izvedbo številnih poskusov iz različnih področij fizike. Navodila za izvedbo poskusov so jasna in v nekaterih primerih vsebujejo celo video posnetke in delovne liste za učence. Kot edino pomanjkljivost lahko omenim le dejstvo, da nekaterih eksperimentov ni mogoče izvajati na starejših pametnih telefonih.

Phyphox pri uporabi akustične štoparice omogoča tudi zajem niza petih zaporednih zvočnih signalov (Sequence) in meri čas med njimi. Če bi namesto kovinskega telesa spustili padati gumijasto žogico, bi lahko na ta način proučevali (ne)elastičnost trkov in energijske izgube žogice ob trkih. Naslednja možnost je zajem poljubnega števila zvočnih signalov v poljubnem času (Many), kjer dobimo celo izrisan graf dogodkov v času, povprečen tempo (bpm) in frekvenco dogodkov. Omenjeno možnost bi lahko npr. uporabili pri merjenju radioaktivnih razpadov s klasičnimi prskači. Prav tako se lahko akustična štoparica uporabi za merjenje hitrosti zvoka, vendar v tem primeru potrebujemo dva telefona in dve osebi za izvedbo eksperimenta.

4 ZAKLJUČEK

Pametni telefoni si nedvomno utirajo pot v fizikalni laboratorij. S svojimi številnimi senzorji ponujajo zajemanje številnih fizikalnih količin iz okolja ter celo njihovo analizo in grafično predstavitev. Pri prikazani vaji so se izkazali za presenetljivo natančen pripomoček, ki ponuja številne prednosti. Aplikacija Phyphox je brezplačna, enostavna za uporabo in je pri prikazani eksperimentalni vaji dala zelo natančne rezultate. Dijaki imajo radi takšen način dela in so se v velikem številu lotili samostojnega eksperimentiranja. Kot prednost omenjenega pristopa so omenili tudi samostojno prilagajanje časovne izvedbe poskusa in manjši stres. Vaja ne zahteva veliko učiteljeve priprave, večjih slabosti nisem zaznal. Pametni telefoni nam bodo olajšali terensko delo, saj ne bomo več potrebovali toliko nerodne laboratorijske opreme. Še posebej pa so lahko uporabni v primeru izvajanja pouka na daljavo, saj jih imamo praktično vsi. Aplikacijo Phyphox vsekakor priporočam učiteljem fizike.

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Uporaba aplikacije KamenCheck pri pouku geografije

Using the KamenCheck application in geography lessons

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POVZETEK

Živimo v obdobju, ko so družbene, gospodarske, izobraževalne in vzgojne potrebe čedalje večje, zato je uvedba informacijsko-komunikacijske tehnologije (IKT) v naše življenje pomembna in neizogibna. Pri vzgojno-izobraževalnem delu lahko z osmišljeno rabo IKT pri pouku geografije v osnovni šoli pouk obogatimo, učence motiviramo za raziskovanje in učenje, hkrati pa razvijamo geografske veščine in spretnosti. Z razvojem IKT in številnih aplikacij je raba le-te smiselna in uporabna ne le v učilnici, ampak tudi pri terenskem delu.

Prispevek opisuje načrtovanje in izvedbo naravnogeografskih učnih vsebin z uporabo aplikacije določevalnega kamninskega ključa KamenCheck, pri čemer so devetošolci v šolskem parku kamnin pri pouku geografije raziskovali in spoznavali kamnine, ki jih najdemo v Sloveniji.

KLJUČNE BESEDE

Informacijsko-komunikacijska tehnologija, osnovna šola, geografija, aplikacija KamenCheck

ABSTRACT

We live in a period when social, economic and educational needs are becoming more and more demanding, so the introduction of information communication technology into our lives is inevitable and necessary. Calculated use of ICT in teaching geography in primary school can result in enriched lessons, student motivation and developing of geographical skills. With the development of ICT and numerous applications, the use of it is reasonable and useful, not only in the classroom, but also in field work.

The article describes planning and performance of geography and natural resources educational content with the use of rock identification key KamenCheck. It was used in the school rock park by ninth graders during the geography lesson to see and explore rocks, found in Slovenia.

KEYWORDS

Communication technology, primary school, geography, application KamenCheck

1 UVOD

V času hitrih družbenih, gospodarskih in tehnoloških sprememb je uporaba IKT nujna. Vseživljenjsko učenje danes je dolžnost posameznika, da se izobražuje vse življenje – ne le formalno, ampak tudi neformalno.

Eden bistvenih dejavnikov vseživljenjskega učenja je uporaba IKT v izobraževanju, saj le-ta pomembno pripomore k vseživljenjskemu učenju tako s širitvijo dostopa do vsebin kot tudi z vpeljevanjem bolj raznovrstnih poti učenja. Uvajanje novih učnih sredstev in učil omogoča učitelju, da sta učni proces in vsebine učinkovita, zanimiva, razumljiva in aktualna. Tako je IKT prinesla nove možnosti za učenje, poučevanje in pridobivanje znanja v sodobni družbi.

Za uspeh v današnji družbi, bogati z informacijami in znanjem, morajo učenci in učitelji učinkovito uporabljati tehnologijo. Uvedba IKT v učilnice vpliva na naslednje načine:

- učencem pomaga razviti spretnosti, ki so potrebne za uspešno življenje in delo v 21. stoletju;

- spodbuja učitelje k izboljšanju načina učenja v razredu z interaktivnimi in dinamičnimi viri, ki jih nudi IKT, in

- zagotavlja več motivacije in bogatejšo izkušnjo učenja za učence, s tem pa možnosti za bolj učinkovito učenje in večje vključevanje učencev samih v izobraževalni proces. [1]

V učnem načrtu geografije za osnovne šole [4] je pri opredelitvi predmeta zapisano, da z vsebinami in dejavnimi metodami pri pouku geografije razvijamo sposobnosti učencev za uporabo preprostih geografskih raziskovalnih metod, s katerimi pridobivajo informacije o okolju in v okolju. Usposabljamo jih za rabo različnih sredstev in medijev, s katerimi urejajo, razlagajo, predstavljajo, uporabljajo, vrednotijo in posredujejo geografske informacije. Ob tem je še posebej pomembna informacijska tehnologija.

2 APLIKACIJA KamenCheck

Kamencheck je aplikacija določevalnega kamninskega ključa za poučevanje geoloških vsebin v okviru naravoslovnih predmetov. Nastala je v okviru projekta StoneKey znotraj razpisa Po

kreativni poti do znanja, ki spodbuja povezovanje visokošolskih zavodov s trgom dela in na tak način daje študentom možnost za pridobitev praktičnih izkušenj že med izobraževanjem. Projektno skupino so sestavljali študentje Geologije, Grafične in interaktivne komunikacije ter Elektrotehnike in Multimedije, pri razvoju pa so sodelovali s podjetjem DigiEd, d.o.o., ki je specializirano za razvoj produktov in storitev s področja e-izobraževanja. V proces izdelave in končno evaluacijo so vključili uporabnike.

Strokovna zasnova aplikacije, kar prikazuje slika 1, obsega navodila za uporabo ključa, »malo šolo«, kjer se nahaja razlaga 16 pojmov in 6 opisov poizkusov na kamninah, vsebinski del v obliki določevalnega kamninskega ključa, kjer prepoznavamo kamnine glede na mineralna zrna, plastnost in dodatne kriterije glede na tip kamnine, ter končne opise kamnin (enciklopedija), kjer je 28 opisov kamnin, so izdelali študenti geologije. Študentje grafičnih in interaktivnih komunikacij so poskrbeli za predstavitev in interpretacijo kamnin skozi grafični jezik. Pri načrtovanju in implementaciji multimedijske interaktivne mobilne aplikacije pa so sodelovali študentje elektrotehnike oz. multimedije. Avtorji so z inovativnimi in kreativnimi rešitvami izdelali orodje, ki obogati uporabnikovo izkušnjo učenja in doživljanja nežive narave.

Aplikacija je zasnovana kot interaktivni pripomoček za učenje v/o naravi in je uporabna za izobraževanje geoloških vsebin ter raziskovanja nežive narave. Učni pripomoček je zanimiv za uporabo, inovativen in združuje možnost interaktivnega učenja tako v učilnici kot v naravi. Aplikacija je prosto dostopna. Deluje na sistemu Android. [2]
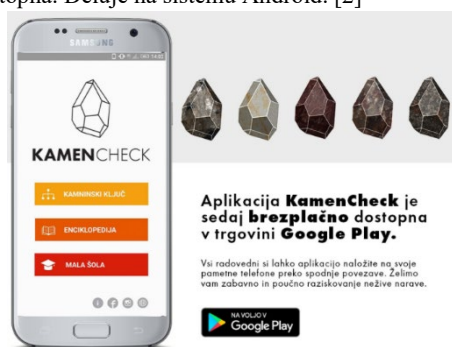
Slika 1: Aplikacija KamenCheck.

3 NAČRTOVANJE IN IZVEDBA

3.1 Načrtovanje

Geografija je v program osnovne šole umeščena zato, da učencu pomaga pridobiti znanje, sposobnosti in spretnosti, s katerimi se lahko orientira in razume ožje in širše življenjsko okolje, in da ga vzgaja v pravilnem vrednotenju in spoštovanju okolja, s čimer si pridobi tudi odnos do narave, sebe, sočloveka in družbe. Učni proces mora biti uravnotežen med poučevanjem in različnimi oblikami učenčevih dejavnosti. Učenje mora temeljiti na razvoju sposobnosti in spretnosti – vedeti, kako – in spoznavnosti – vedeti, kaj. Vedno bolj poudarjen pa je namenski vidik – vedeti, zakaj potrebujemo neko znanje, spretnost oz. sposobnost. Usvajanje geografskega znanja temelji na več stopnjah. Ena najpomembnejših je opazovanje, ki je osnova terenskega dela. Pri izboru učnega prostora je pomembno, da učitelj prouči

didaktično primernost lokacije za pouk, ki naj ustreza ključnim merilom, kot so prostorsko spoznavna oz. sporočilna moč pokrajine, povezanost s cilji učnega načrta, oddaljenost, metodična raznolikost in dostopnost učnega gradiva. [4]

Učenci v 9. razredu pri geografiji spoznavajo geografske, tako naravne kot družbene, značilnosti Slovenije. OŠ Lesično ima učilnico na prostem, ki jo v sodelovanju s Kozjanskim parkom dopolnjujemo in nadgrajujemo. Leta 2019 smo jo dopolnili s parkom kamnin, ki je prikazan na sliki 2.

Slika 2: Šolski park kamnin.

Učenci že v 6. razredu pri pouku naravoslovja spoznajo vrste kamnin in njihov nastanek. Pri urah geografije učno snov ponovimo in jo nadgradimo s terenskim delom, ki temelji pa prepoznavanju kamnin in ovrednotenju kamninske zgradbe za človeka. Šolski park kamnin predstavlja edinstveno priložnost za problemsko, izkustveno in raziskovalno načrtovan pouk, zato sem učne vsebine obravnavala v obliki terenskega dela, v katerega sem vključila IKT. Na takšen način uresničujem cilje sodobnega pouka, učencem približam učne vsebine, jih naredim privlačnejše in zanimivejše.

3.2 Izvedba učnega procesa v parku kamnin

Učence sem na terensko delo pripravila v razredu. Sami so se razdelili v skupine, ki so ji sestavljali trije oz. štirje učenci. Opozorila sem jih, da potrebujejo pametni mobilni telefon ali tablico in jih pozvala, da se dogovorijo, kdo bo telefon oz. tablico prinesel v šolo. Nato sem podala navodila, da si doma aplikacijo KamenCheck namestijo na svoje naprave.

Na dan izvedbe terenskega dela, ki smo mu namenili 2 šolski uri, smo odšli v park kamnin, kjer smo s problemskim vprašanjem »*Zakaj imamo kamnine v parku razporejene v tri različno velike skupine?*« preverili predznanje ter ponovili in utrdili že znano učno vsebino, da kamnine glede na nastanek delimo na magmatske, sedimentne in metamorfne ter kaj je posamezno skupino kamnin značilno.

Sledila so navodila za delo. Opozorila sem na natančno opazovanje in branje kamninskega ključa.

Raziskovanje in spoznavanje kamnin so pričeli tako, da si je skupina izbrala po dve kamnini v vsaki skupini in ju s pomočjo kamninskega ključa v aplikaciji KamenCheck poimenovala ter jo natančneje spoznala. Aktivno delo učencev prikazujejo slike 3, 4 in 5, na katerih vidimo, da so učenci pri delu uporabljali mobilni telefon in tablico. Svoje ugotovitve so zapisovali na delovne liste, ki so jih reševali sproti.

Sliki 3: Učenke spoznavajo kamnine s pomočjo aplikacije KamenCheck na pametnem telefonu.

Slika 4: Spoznavanje kamnin z uporabo tablice.

3.3 Pregled dela in evalvacija

Tretja šolska ura je bila izvedena v učilnici. Namenjena je bila pregledu dela in evalvaciji. Učenci so predstavili posamezne kamnine, ki so jih proučevali. Pri tem sem po potrebi opozorila na morebitne pomanjkljivosti, dodatno opisala ali pojasnila kamnino in njeno uporabnost ter učence usmerjala k dopolnjevanju odgovorov. Učencem sem posredovala povratne informacije o njihovi kvaliteti dela, za zaključek pa izpostavila vsebinske poudarke ter spodbudila k zastavljanju morebitnih vprašanj. Učenci so se nato preverili v kvizu o poznavanju kamnin.

Ustno so podali povratno informacijo o poteku učnih ur o spoznavanju kamnin v šolskem parku. Učencem je terensko delo všeč. Bilo jim je zanimivo, da je pouk potekal v naravi in z uporabo pametnih telefonov oz. tablic.

4 ZAKLJUČEK

Terensko delo je sestavni del pouka geografije. Zaradi številnih prednosti, ki jih prinaša tovrstno delo v domači pokrajini, je smiselno, da učitelji vedno znova iščemo nove možnosti za delo v pokrajini, hkrati pa raziskovanje prepuščamo tudi učencem. Če temu dodamo še uporabo IKT, motivacijo za delo le še

povečamo. Poleg tega pa razvijamo veščine dela z IKT, kar je izredno pomembno v času, v katerem živimo.

Osnovni namen, poleg spoznavanja nove učne vsebine o kamninah, je bil prikazati uporabnost mobilnika in aplikacije v konkretni situaciji na primeru šolskega parka kamnin. Cilj je bil v celoti uresničen. Devetošolci in devetošolke so spoznali še eno izmed možnosti, ki jih ponuja praktična uporaba pametnega mobilnika ali tablice v vsakdanjem življenju.

Slika 5: Aktivno opazovanje in proučevanje kamnin.

Terensko delo je temeljilo na natančnem opazovanju in branju, kar so tekom raziskovanja ugotovili tudi učenci. Učenci so razvijali sposobnosti in spretnosti ter spoznavali in prepoznavali kamnine ter njihovo uporabnost, hkrati pa pridobili uvid, zakaj potrebujemo znanje o kamninah in se urili v spretnosti oz. sposobnosti uporabe aplikacije KamenCheck na pametnem telefonu oz. tablici. S tem so bili uresničeni številni cilji predmeta.

Razvoj novih tehnologij in aplikacij od nas učiteljev zahteva vse več IKT znanja, zato je pomembno trajno izobraževanje, tako formalno kot neformalno, in učiteljeva prizadevnost za uporabo IKT pri pouku. S tem pa se spreminja tudi vloga učitelja, ki se iz podajalca znanja spreminja v organizatorja dejavnosti, mentorja in trenerja veščin.

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Delo z učenci s posebnimi potrebami v času šolanja na daljavo

Working with pupils with special needs during distance schooling

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POVZETEK

Šolanje na daljavo je od učiteljev zahtevalo spremembo načina dela. V zelo kratkem času smo se morali prilagoditi danim razmeram. To smo reševali na različne načine: s pregledovanjem dostopnih programov, portalov, spletnih strani. Vse z namenom, da bi učencem, kljub šolanju na daljavo, uspeli čimbolj približati učno snov, ostati v stiku z njimi. Marsikdo je ugotovil, da šola le ni tako slaba, saj se tam dogaja tudi veliko zanimivih in zabavnih reči.

V začetnem delu smo čas namenili učenju, spoznavanju in rokovanju z novimi spletnimi orodji. Učenci so ob pomoči učitelja opravili registracijo na portale z interaktivnimi učbeniki. Sledil je pouk, ki smo ga redno, vsakodnevno izvajali preko Skype. Učenci so razlago učne snovi pri vseh predmetih v 5. razredu dobili preko Skype ali preko videoposnetkov. Navodila za utrjevanju in ponavljanje učne snovi so dobili še preko elektronske pošte. V skladu z zahtevami smo obseg učne snovi zmanjšali za 2- do 3-krat in v počasnejšem tempu sledili učni snovi. Po vrnitvi v šolo smo ugotovili, da so učenci precej dobro osvojili učno snov. Preko Skype smo reševali tudi vse ostale težave, dileme, ki so jih imeli učenci ali starši. Na ta način smo izvedli tudi govorilne ure in roditeljski sestanek. Ocenjujemo, da smo dobili kar veliko dragocenih izkušenj, ki jih bomo uporabili v prihodnje, v kolikor bodo takšne potrebe.

KLJUČNE BESEDE

Učenci z več motnjami, prilagoditve, IKT, šolanje na daljavo

ABSTRACT

Distance education has required teachers to change the way they work. In a short period of time, we had to adapt to the situation. Teachers have dealt with this in different ways, but there is no doubt that this has required us to review possible programs, portals, websites, so that, despite remote schooling, pupils can be able to get as close to the learning material as possible, to stay in touch with them. A lot of people have found that the school isn't that bad, because there's a lot of interesting and fun stuff going on there.

In the initial work we devoted time to learning and handling new tools. With the help of a teacher, pupils registered on portals with interactive textbooks. It was followed by a course that smog a regular, daily exercise via Skype. Students were explained the learning material in all subjects in grade 5 via Skype or via video. Instructions for consolidating and repeating the learning substance were also given by e-mail. In accordance with the requirements, the volume of the learning substance was reduced by 2 to 3 times and followed the learning material at a slower pace. When we returned to school, we found that the students had a pretty good learning value. We also dealt with all the other problems, dilemmas that students or parents had, via Skype. In this way, we also held speaking hours and a parenting meeting. We estimate that we have gained quite a lot of valuable experience that we will use in the future, as long as there are such needs.

KEYWORDS

Pupils with multiple disabilities, adaptations, ICT, distance education

1 UVOD

Učenci so se v času šolanja na daljavo srečevali z različnimi težavami, stiskami v domačem okolju. Pomembno je, da jim v takšnih trenutkih omogočamo čustveno varnost, stabilnost in ustrezno samopodobo. Menimo, da so bilo to področje zelo pomembno v času karantene, saj so bili učenci prestrašeni, negotovi, zaskrbljeni zaradi trenutne situacije, prav tako tudi njihovi starši. Zavedajo se, da so vsi opredeljeni kot rizični otroci zaradi zdravstvenih težav, ki jih spremljajo. Od osmih učencev, ki so obiskovali 4. /5. razred jih je šest opredeljenih kot učenci z več motnjami.

Čustvena varnost je pomemben temelj samopodobe in samospoštovanja. V kolikor otroku sporočamo, da ni pomemben lahko to trajno vpliva na njegovo samospoštovanje in samopodobo [4]. Samopodoba je kompleksen proces, ki vpliva na številne procese pri otroku in je pomembna za nadaljnji razvoj in uspešnost otroka. Jurišičeva [1] opredeljuje tri vidike, ki vplivajo na samopodobo otroka: kognitivni, telesni in edukativni dejavniki. Kognitivni posegajo v oblikovanje otrokove samopodobe ter vplivajo na razvoj vseh ostalih sposobnosti.

Telesni dejavniki vplivajo na razvoj telesnih zmožnosti in videza. Edukativni trajajo vse od vstopa v šolo in tja do konca osnovne šole. Pogosto je v ospredju le šolsko delo, ostala področja so zanemarjena. Torej je izredno pomembno, kako bomo opogumili učence, da se soočajo s to, povsem novo situacijo [3].

2   METODE DELA

V času šolanja na daljavo smo pouk izvajali na drugačen način. Učitelji smo iskali različne načine, kako se povezati z učenci, priti v stik z njimi. V prvem tednu smo stik vzpostavili preko mesengerja, v naslednjem tednu smo nadaljevali preko Skype. V oddelku smo imeli 8 učencev z več motnjami. Vsi učenci so gibalno ovirani, stopnja le-te se razlikuje med njimi. Poleg videoklicev smo stik vzpostavili tudi preko e-maila, kjer smo jim ponudili možnost razlage učne snovi preko Skype. V roku enega tedna so se vsi učenci, ob pomoči staršev, sosedov, bratov ali sester uspeli prijaviti na Skype.

Tako je pouk lahko stekel. Prve ure so bile namenjene pogovoru, potem smo oblikovali urnik. K temu smo vključili vse učitelje, ki poučujejo v oddelku. Tako je nastal nov urnik za delo preko Skype.

Učenci so na začetku tedna dobili navodila za delo, kjer je bilo hkrati dopisano tudi, kaj vse bomo obravnavali preko Skype in kaj bodo opravili sami. V skladu s priporočili smo obseg učne snovi zmanjšali.

Razlaga učne snovi je v celoti potekala preko Skype. Vključili smo možnost obrnjenega ekrana in ob razlagi naredili tudi tabelsko sliko s programom Slikar ali v Wordu. Tako so učenci imeli tudi povzetek učne snovi, ki so jo prepisali v zvezek ali so jo dobili v dokumentu po e-pošti.

Pri samem delu smo si pomagali s spletnimi portal iRokus - https://www.irokus.si/ in učimte - https://www.ucimte.com/, kjer so bili brezplačno dostopni vsi delovni zvezki in učbeniki.

Za samostojno delo in utrjevanje znanja smo uporabljali portal za učence učimse - https://www.ucimse.com/. Registracijo smo opravili že v šoli.

V namen utrjevanja učne snovi pri matematiki smo posneli več videoposnetkov množenja in deljenja z eno in dvomestnimi števili. Tako so učenci lahko ponovili postopek izvedbe računske operacije. Videoposnetke smo posneli tudi za nekaj učnih snovi v okviru predmetov družbe ter naravoslovja in tehnike.

Preverjanje in del ocenjevanj smo izvedli s pomočjo kvizov na Google obrazcih.

Sprotno poročanje o opravljenem delu smo izvajali preko e-pošte (navadno staršev).

Pri vseh the oblikah smo upoštevali prilagoditve, ki so jih učenci potrebovali, da so lahko sledili razlagi in učni snovi.

3   REZULTATI

Učenci so se s prijavo v Skype račun bili deležni redne učne razlage učne snovi v celoti. Pouk v živo je potekal pri vseh predmetih. Pri tem smo upoštevali tudi prilagoditve, ki so jih učenci potrebovali pri pouku.

Na Skypu smo oblikovali skupino, kjer so učenci lahko spremljali pouk. Sprva so bili zadržani, že po parih dneh so bili zelo suvereni in so si oblikovali še eno skupino namenjeno klepetu brez prisotnosti učiteljev. Hitro so osvojili Skype, pisali so sporočila, glasovna sporočila, si pošiljali glasbo... Starši so hitro ugotovili, da so učenci veliko časa na internetu in so nekateri omejili te prijateljske klepete v popoldanskem času.

Pri družbi so učenci razlago učne snovi skoraj v celoti dobili preko Skype. Pri ponavljanju in utrjevanju smo si pomagali z nalogami na učimse.com. Tako smo kombinirali skupinsko in individualno delo. Učiteljica je občasno posnela videoposnetek, ga objavila na You tube kanalu. Učenci so ga sami predelali in smo skupaj pri uri preko Skype ponovili novo znanje (slika1) ter dobili se še dodatno razlago, v kolikor jim snov ni bila jasna.
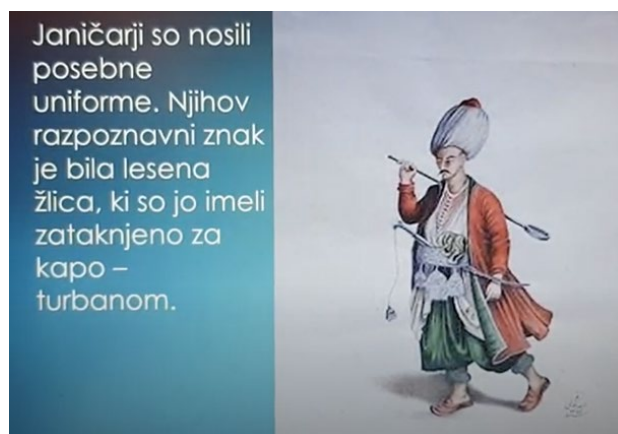
Slika 1: turški vojaki

Podobno smo obravnavali učno snov pri naravoslovju in tehniki. Kombinirali smo različne portale, saj so bili dostopni interaktivni delovni zvezki in interaktivne naloge. Za ponovitev smo posneli nekaj kratkih videoposnetkov (slika 2), da so si jih lahko ogledali še doma.

Slika 2: fotosinteza

Posebno pozornost smo namenili obravnavi deljenja, le-ta navadno učencem dela veliko preglavic. Želeli smo, da starši učence učijo na enak način, kot smo to delali preko Skype, da učenci ne bi bili dodatno zmedeni (slika 3).

Deljenje z enomestnim številom
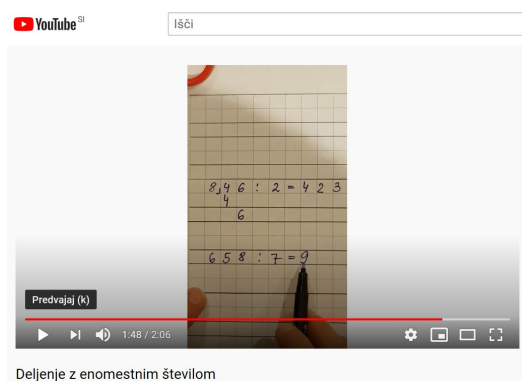
Slika 3: deljenje z enomestnim številom

Zato smo posneli 8 video gradiv namenjenih deljenju in še množenju z eno- ali dvomestnimi števili. Posnetke smo objavili na You tube kanalu (slika 4), da so učenci lahko do njih dostopali tudi popoldne.
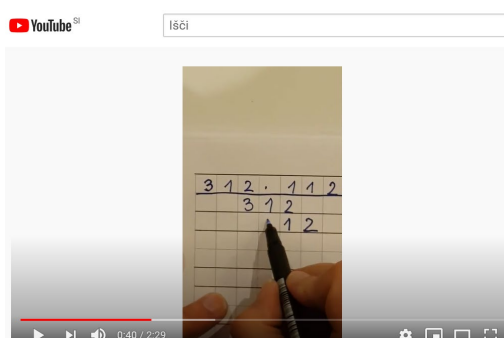
Slika 4: množenje

Pri slovenščini smo utrjevali učno snov s pomočjo Google obrazcev. Oblikovali smo kviz s pomočjo katerega smo najprej spoznavali to spletno aplikacijo. Prvo reševanje smo izvedli skupaj, nato so učenci dobili link v skupino Skype. Sledilo je samostojno delo (slika 5). Učenci niso imeli večjih težav. Je bila pa koristna povratna informacija, glede tega, kateri tip vprašanj učencem povzroča več tehničnih težav. To je bil odprti tip, kjer so sami morali zapisati odgovor. Kot pravilen odgovor se šteje le tisto, kar obkljuka učitelj oz. ponudi kot pravilno rešitev. V kolikor učenec besedo napačno zapiše, med dvema besedama ne zapiše presledka, uporabi malo začetnico namesto velike itd. je odgovor napačen. Na to smo učence še posebej opozorili po koncu reševanja kviza, saj smo skupaj pregledali, kako so reševali naloge.

Naslednji dan so še enkrat reševali isti kviz z namenom, da popravijo napake. Delno nam je to uspelo odpraviti.

Slika 5: Google obrazci – vaje za utrjevanja

Glede na Priporočila za delo na daljavo smo v mesecu aprilu izvajali preverjanje znanja z Google obrazci (slika 6) Učenci so dobili link in so samostojno reševali preverjanje znanja. Tudi te smo reševali na različne načine, enkrat tako, da so jih reševali sami doma, brez videopovezave. Drugič smo jih reševali preko Skype. Pri tem so učenci izklopili zvok, da niso motili drug drugega.
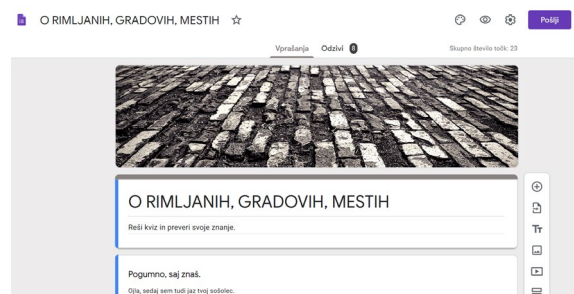
Slika 6: preverjanje znanja

V nadaljevanju smo na ta način izvedli tudi ocenjevanje znanja v mesecu maju. V skladu s priporočili [2] smo uporabili enake oblike in metode dela, uporabili smo učencem znano formo. Pred tem smo še analizo treh književnih del opravili s pomočjo Google obrazcev.

4 DISKUSIJA

Uporaba IKT je pripomogla k temu, da smo lahko kljub izrednim razmeram izvajali pouka. Učenci so preko različnih spletnih orodij prejeli razlago, navodila za delo. Tako so učenci lahko bili samostojni, starši niso bili okupirani s šolskim delom oz. bistveno razbremenjeni pri tem.

Starši so poročali o tem, da so učenci lahko na podlagi novih znanj samostojneje sledili pouku preko Skype in samostojnejšemu reševanju nalog v času izven pouka. Ugotovimo smo, da se lahko bistveno bolj prilagajamo individualnemu tempu učenca, njegovim posebnostim, pri tem pa upoštevamo prilagoditve, ki jih učenec potrebuje. Učenci so bili okupirani le z učno snovjo, ni bilo dodatnih terapij ali psiholoških obravnav. Po zaključku pouka so bili doma, niso porabili časa za terapije ali prevoz. Nekateri porabijo več kot dve uri dnevno samo za prevoz v šolo in nazaj. Posledično so bili učenci bolj spočiti. Slabo je bilo to, da so lahko socialne stike ohranjali le preko videoklicev, telefonskih pogovorov, ni bilo spontanih pogovorov in druženj po hodnikih šole.

Znanja, ki smo jih pridobili v času šolanja na daljavo bomo lahko uporabili tudi v prihodnjem šolskem letu, izkušnje nadgradili z novimi. Menimo, da je pomembno, da govorimo o pridobljenih izkušnjah, širimo znanje, iščemo nove rešitve, saj je to način za kvalitetnejši napredek v profesionalnem razvoju posameznega učitelja.

5 ZAKLJUČKI

Šolanje na daljavo je prineslo nove izzive iz katerih smo se mnogo naučili, bili postavljeni pred nove izzive, tako učenci kot učitelji. Dolgoročno gledano smo pridobili pomembne izkušnje, učitelji in učenci smo pokazali, da zmoremo veliko, pridobili smo ogromno znanj in izkušenj na področju uporabe IKT. Ključno je,

da se moramo ves čas izpopolnjevati, da bomo lahko nadgradili svoje znanje, izboljšali pristope in metode dela v primeru ponovnega šolanja na daljavo. Nedvomno bomo pogumneje stopali po tej poti.

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Uporaba IKT v času šolanja na daljavo pri učenki s težko motnjo v gibalnem razvoju

Use of ICT during distance learning in schoolgirls with difficult disturbance in motion development

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POVZETEK

Pri učencih s posebnimi potrebami je potrebno ob pomoči učitelja najti ustrezno prilagojeno izobraževalno tehnologijo, ki bo učencu v pomoč pri doseganju vsebin v vzgojno-izobraževalnem procesu. To od učitelja zahteva nenehen razvoj in raziskovanje tega področja, da lahko, glede na otrokove posebne potrebe najde ustrezne programe ali aplikacije. Pri delu z učenko z težko gibalno oviranostjo je to precej zahtevno delo, saj je potrebno poiskati takšne programa, ki ji bodo olajšali delo in hkrati omogočili njen napredek. V času šolanja na daljavo smo pouk in razlago učne snovi pri matematiki v celoti nudili preko Skype. V pomoč so nam služili različni spletni učbeniki, delovni zvezki, Power point, Google obrazci in Geogebra. Uporabljene metode učenki omogočajo, da je aktivna v skladu z zmožnostmi, razvija svoje sposobnosti, je izredno motivirana za delo, lažje nadomesti snov v času daljše šolske odsotnosti in pridobiva nova znanja.

KLJUČNE BESEDE

IKT, gibalno ovirani učenci, prilagoditve, šolanje na daljavo

ABSTRACT

When talking about students with special needs, it is crucial to work with the pupil`s teachers in order to find the optimal technology that will enable them to achieve the goals set forth in the educational plan. This requires the teacher to constantly explore this area in order to find the best possible tool adapted to the child`s specific needs. When working with a physically impaired pupil, this is particularly challenging as it is hard to find the best balance between a program that eases the process for the student in all fields while still challenging and allowing them to evolve in all aspects. During distance learning, we provided instruction and explanation of the subject matter in mathematics entirely via Skype. We were helped by various online textbooks, workbooks, Power point, Google forms and Geogebra. The methods allow the student to stay active within her capabilities while stimulating the development which motivated further growth, enabling her to make up for any deficit that were to arise due to a longer period of absence.

KEYWORDS

ICT, mobility-impaired pupils, adaptation, distance learning

1 UVOD

Delo z otroci z gibalno oviranostjo zahteva od učitelja številne prilagoditve za dosego ciljev. Deklica je težko gibalno ovirana učenka, ki je povsem odvisna od pomoči odrasle osebe. Gibalno ovirani otroci imajo prirojene ali tekom življenja pridobljene okvare gibalnega aparata, perifernega ali centralnega živčevja. Razlikujemo otroke z: lažjo, zmerno, težjo, težko gibalno oviranostjo [2]. Otroci s težko gibalno oviranostjo so funkcionalno popolno odvisna od druge osebe oseba, zaradi hude motnje, ne zmorejo samostojnega gibanja. Le-to je mogoče z električnim vozičkom, koliko je le-to samostojno, je odvisno še od funkcij rok, ki so pogosto slabe. Delno ali malo lahko pomaga pri osnovnih dnevnih opravilih, deklica ima tudi dihalno podporo. Pri dnevnih opravilih je povsem odvisen od pomoči druge osebe, tudi zaradi motnje kontrole sfinktrov [1]. Hude motnje so prisotne pri orientaciji, senzomotorični integraciji, zaznavanju in občutenju dražljajev. Pri šolskem delu potrebuje stalno pomoč druge osebe, prilagoditve pri sami izvedbi naloge, okolja in pripomočkov (individualno prilagojen in izdelan sedež, miza, IK tehnologija) [2].

Učenka, ki je težko gibalno ovirana je kljub vsem težavam zelo motivirana za delo z IKT. Želi si pridobivati vedno nova znanja, biti v stiku s sošolci,kjub daljši odsotnosti. Vse učne obveznosti opravi kot ostali, v kolikor je le mogoče se udeleži še dodatnih matematičnih in drugih tekmovanj. V tem šolskem letu smo se srečevali z drugačno obliko metoda, ki je od učiteljev in učencev zahtevala veliko mero prilagoditev. Šola na daljavo je lahko potekala bolj utečeno v kolikor je učitelj in učenci vešči uporabe IK tehnologije. Glede na to, da je učenka, ki jo omenjamo zgoraj vešča dela z različnimi programi, aplikacijami nam to ni bila posebna ovira. Ključno pri vsem je bilo, da smo se prilagajali zdravstvenemu stanju in psihofizični kondiciji deklice. V času šolanja na daljavo smo se lahko 100 % prilagodili temu,

urnik oblikovali glede na njene potrebe, na ta način je učenka izvrstno delovala.

2 METODE DELA

Delo v času šolanja na daljavo je zahtevalo od učitelejev uporabo drugih oblik dela, ravno IKT nam omogoča povezavo tudi v tem času.

Na podlagi njenega predznanja in izkušenj smo uvajali IKT na večjih področjih. Sama bom predstavila uporabo IKT pri matematiki. Pouk je v celoti potekal preko Skype, dnevno dve do tri uri. Oblikovali smo urnik, poseben za vsak razred za delo preko Skype. To smo učitelji uskladili znotraj aktiva od 6. do 9. razreda. Na ta način smo z delom začeli že v drugem tednu šolanja na daljavo, učenci so v tem času odprli Skype račune. V oddelku je manjše število učencev. Pri oblikovanju urnika smo upoštevali tudi želje učencev v kolikor je bilo to možno. Delo pri matematiki je potekalo preko Skype. V začetku tedna so učenci dobili navodila za delo, kjer je pri posamezni snovi pisalo kaj bomo predelali preko Skype in kaj po njihovo samostojno delo v domačem okolju.

Delo preko Skype je potekalo tako, da smo se pogovorili kdo je kaj naredil, preverili rezultate in razložili naloge v kolikor česa niso znali. Učenka, ki ima težko motnjo v gibalnem razvoju je sledila razlagi, poročala o opravljenem delu. Zaradi sorojencev starši niso mogli biti prisotni ves čas razlage, zato je učenka tabelske slike razlage preko Skype dobila v Wordovem dokumentu. Pri razlagi, ponavljanju, reševanju nalog (slika 1) smo uporabljali obrnjen pogled Skypa, da so pred sabo imeli tabelsko sliko razlage učne snovi. To je bilo še posebej pomembno, ko smo se srečevali z geometrijskimi vsebinami.
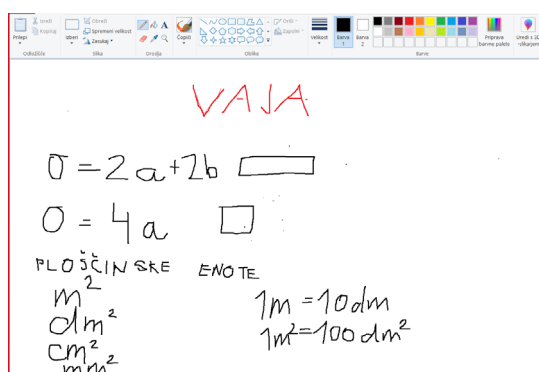
Slika 1: ponovitev učne snovi.

Učenka je sledila razlagi, kasneje so pa to tabelsko sliko dobili pri mailu in prilepili v zvezek. Pri sami razlagi smo uporabljali e-učbenike založbe Rokus, ki so bili v tem času prosto dostopni in so nam močno olajšali delo. Vsi učenci so lahko dostopali do njih s preprosto registracijo.

Hkrati smo kot uvod, zanimivost, dodatno motivacijo večkrat uporabljali naloge na spletni strani Mojamatematika (slika 2). Učenka je bila pri tem samostojna, ni potrebovala pomoči, ponovila je učno snov, ki je primerna za 5. razred, vendar so lahko koristne tudi šestošolcem. Vsem, ne samo učenki, ki ima številne omejitve. Na portalu Mojamatematika učitelj registira učence in jim pripravi naloge, tako lahko spremlja kaj so reševali in kako so bili pri tem uspešni.
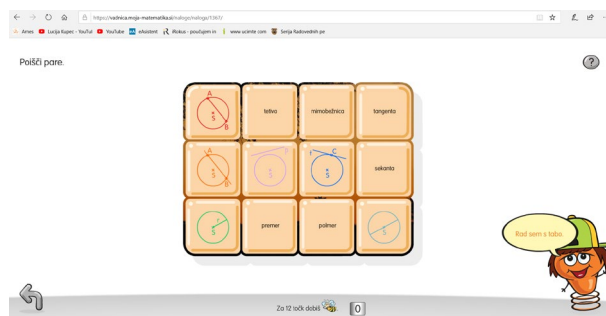
Slika 2: ponovitev učne snovi na Mojamatematika.si.

Za razlago učne snovi koti smo pri merjenju uporabljli e-učbenik in DZ MK za 5 razred. Učenka je lahko sledila risanju z geometrijskim orodjem, saj na straneh, kjer so naloge s tega področja imajo učenci možnost uporabe geotrikotnika, šestila…

Preverjanje znanja ob koncu posameznega učnega sklopa je učenka izvajala preko Google obrazcev, kar je omogočalo njeno samostojnost.

3 REZULTATI

Učenka je v svoje delo vložila veliko truda in energije, da sploh lahko sodeluje pri pouku. Njeno zdravstveno stanje ji ne dopušča, da bi delala več kot 45 minut. Delu sledi osnovne higienske in prehrambene zahteve, pri Kateri potrebuje pomoč. Ravno zaradi tega je izjemno pomembno, da lahko sama opravi delo, reši naloge in sledi razlagi. Učenka je izjemno bistra, potrebuje ustrezne načine, da lahko učno snov osvoji. Pomembna je tudi izkušnja, videti, spoznati učno snov preko različnih poti.

Deklica je zelo motivirana ze delo, želi si sodelovati pri vseh aktivnostih, delati zapise, poročati, vendar ji njeno zdravstveno stanje tega ne dopušča.

Učenka je torej sledila razlagi, reševala naloge in svoje ugotovitve podajala preko Skype. Zapis zanjo ni bil potreben, sposobna je zelo veliko miselnih operacij izvesti na pamet.

Sledilo je samostojno delo. Tu je bilo pomembno, da smo deklici ponudili orodja s katerimi je reševala naloge. Eno izmed orodij s katerimi se je spoprijemala znotraj vsebin krožnice je Geogebra (slika 3), ki ji omogoča samostojno delo.
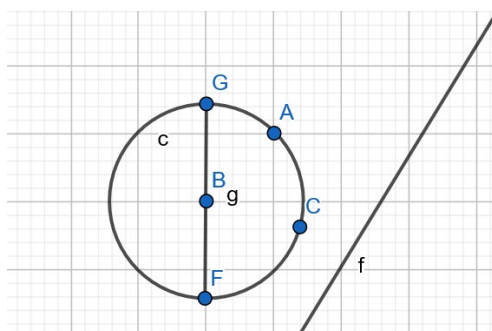
Slika 3: delo z Geogebro po navodilih naloge v učbeniku

Zaradi lažjega rokovanja je pri risanju kotov uporabila interaktivne delovne zvezke Mladinske knjige [3], ki omogočajo, da učenec znotraj strani, kjer so naloge uporablja geometrijsko orodje. Tako je lahko sama načrtovala risanje kotov z različnimi stopinjami. Ta način dela je predstavila tudi sošolcem kot

zanimivost. Ostali učenci so svoje znanje urili z risanjem v zvezek.

Zaradi zdravstvenih težav vedno ni mogla sodelovati pri urah. Razlago smo ji posneli s funkcijo, ki jo omogoča videoklic in poslali preko Skype. Hkrati je dobila tabelsko sliko. Tako, da je preko slušnega in vidnega kanala osvojila učno snov.

Preverjanje in ocenjevanje znanja smo izvedli preko Google obrazcev , v skladu s priporočili [4]. Program in način dela je hitro osvojila. Rezultati njenega dela so bili zelo dobri in razvidni iz slike 4.
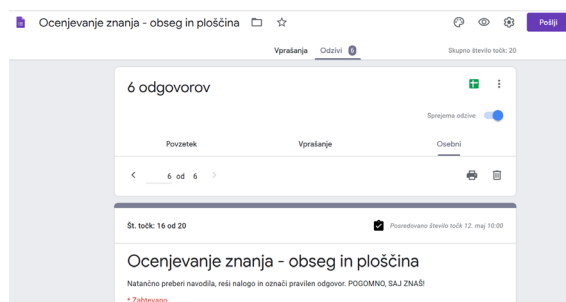
Slika 4: rezultati ocenjevanja znanja

Pogor preko Skypa je omogočal stik s sošolci. Izjemnega pomena zanjo je Skype predstavljal tudi komunikacijo s sošolci. Deklica bi bila odsotna tudi, če ne bi bilo karantene. Zdravstveno stanje ji namreč ne dopušča, da bi v času prehladnih obolenj obiskovala šolo. Pouk, razlaga preko Skype je tudi pomemben socializacijski vidik otrok, ki so veliko časa odsotni. Deklici zelo veliko pomeni pogovor s sošolci, drug drugega vidijo, se pogovorijo kaj je novega na šoli. Učenka je stara trinajst let in ima veliko željo po druženju s sošolci kot ostali njeni vrstniki.

Po koncu karantene se zaradi slabe epidemiološke slike učenka žal ni mogla vrniti v šolo. Šolanje je nadaljevala doma. V času razlage smo se pri matematiki ponovno povezali preko Skype. Razlika je bila to, da so ostali učenci bili v šoli, ona je razlago spremljala preko Skype. Naloge smo reševali na tablo in projicirali na projektor. Tako, da smo s funkcijo obrnjenega zaslona na Skype dosegli to, da je učenka lahko sodelovala pri pouku in bila v stiku z nami.

4   DISKUSIJA

Uporaba omenjenih programov, aplikacij omogoča, da učenki razvijamo digitalno pismenosti, ki ji omogoča lažje doseganje željenih ciljev v času šolanja na daljavo ter lažje doseganje cilje, ko je zaradi počitka ali preventive odsotna dalj časa. Deklica zmore le nekaj preprostih gibov s prsti, ravno toliko, da premika miško in uporablja prste.

Zelo je motivirana za nove oblike dela, da se kaj novega nauči. Hitro osvoji nove aplikacije in programe.

Pri tem je pomembno, da učitelj sam skrbi za razvijanje digitalnih kompetenc. Zakaj je to tako pomembno? Učitelj mora raziskovati in iskati različne aplikacije in poznati posebnosti učenka, da jo lahko uporabi v praksi. Mora zelo dobro poznati prednosti in slabosti programa, aplikacije, da lahko uvidi kaj bo učenec s težko gibalno oviranostjo lahko uporabil, presodil kaj ni primerno za uporabo za učence s tako motnjo, ter da raziskuje vse te aplikacije in programe na spletu.

5   ZAKLJUČKI

Znanje je njeno »orožje«. Na ta način se dokazuje, z znanjem in premikanjem meja nemogočega glede na njeno zdravstveno stanje. Uporabljene aplikacije in programe bo lahko uporabljala in nadgrajevala tudi v prihodnje ter se še dodatno izpopolnjevala na tem področju.

Preteklo delo in številne izkušnje, ki smo jih učitelji dobili na tem področju v času šolanja na daljavo bomo lahko uporabljali tudi v prihodnje. Te izkušnje so res zelo dobrodošle, saj nas čaka negotova prihodnost glede načina poučevanja v prihodnje.

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Spletna varnost pri pouku na daljavo v času epidemije COVID-19

Online safety during class in time of COVID-19 epidemic

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POVZETEK

V času epidemije COVID-19 se je delo izobraževalnih ustanov v veliki meri preseililo na splet. S tem je bilo tudi večje število uporabnikov izpostavljenih spletnim nevarnostnim. Poznavanje delovanja spleta in IKT tehnologij je ključnega pomena za zagotavljanje uporabnikove varnosti. Arnes s svojmi množičnimi spletnimi tečaji želi ponuditi uporabniku znanja, s katerimi bo na spletu deloval varno.

KLJUČNE BESEDE

MOST, internetna varnost, učitelji, spletna učilnica, Arnes, epidemija, COVID-19, izobraževanje na daljavo

ABSTRACT

During the COVID-19 epidemic, work of educational institutions was mostly transferred online. As a consequence, a large number of users became exposed to the dangers of internet. The knowledge of safe web usage and communication technologies is crucial in securing the users safety. ARNES offers massive open online courses, which offer the user knowledge that enables him to stay safe online.

KEYWORDS

MOOC, internet safety, teachers, online classroom, ARNES, epidemic, COVID-19, distance education

1 UVOD

Z namenom varovanja zdravja v času epidemije COVID-19 so pristojne službe prekinile konvencionalno obliko pouka in namesto tega uvedle t.i. izobraževanje na daljavo. Učenci in učitelji tako niso bili več fizično prisotni na izobraževalnih ustanovah, izobraževalne aktivnosti pa so izvajali predvsem s pomočjo IKT in spleta. S povečano uporabo spleta je prišlo tudi do ogroženosti spletne varnosti uporabnikov storitev. Arnes je uporabnike v tem času poskušal še bolje informirati o možnih

pasteh, na katere lahko naletijo pri uporabi popularnih orodij za izvajanje izobraževanja na daljavo. Poleg tega so še večji pomen pridobili tudi Arnesovi spletni tečaji, ki uporabnike izobražujejo o uporabi naših storitev in IKT opreme na izobraževalnem področju. Usposobljen uporabnik namreč ni samo opremljen z znanjem za uporabo določene storitve, ampak se s pridobljenimi informacijami lažje in bolje znajde pri uporabi IKT in spleta na splošno, kar bistveno pripomore k njegovi spletni varnosti. V prispevku bom prek analize preteklih izkušenj in relevantne literature poskušal prikazati, kako je epidemija COVID-19 vplivala na večjo uporabo spleta in IKT pri izvajanju izobraževalnega procesa ter pomen izobraževanja uporabnika za zagotavljanje tako njegove varnosti na spletu kot izpeljave kakovostnega izobraževalnega procesa.

2 POVEČANA UPORABA SPLETA

16. marec 2020 je slovensko šolstvo pričelo z izobraževanjem na daljavo. Arnes je povečano uporabo storitev pričakoval, nakazovala se je že med vikendom, ko so mnogi učitelji pričeli s pripravami na izobraževanje na daljavo. V ponedeljek je tako prišlo do izjemnega zvišanja števila uporabnikov storitev [1]. Do 22. marca 2020 se je količina internetnega prometa na stičišču omrežij SIX in sicer je bila količina prenosa podatkov 130 Gbit/s [1].

3 KATERA ORODJA UPORABITI?

Veliko število šol se je znašlo v situaciji, za katero niso imele v naprej pripravljenega načrta. Postavljene so bile pred dilemo, kako se lotiti izobraževanja na daljavo. Predvsem je težavo predstavljala izbira orodij, ki so uporabni za izvajanje tega tipa izobraževanja. Na voljo je veliko različnih možnosti, s tem pa se pojavljajo za uporabnike tudi varnostna tveganja. Večina šol je iskala videokonferenčni sistem, ki bi omogočal vsaj približek dela v razredu. Veliko učiteljev je hitro pričelo z uporabo orodja Zoom, ki je poleg enostavne uporabe tudi brezplačen, vendar vsebuje nekaj prikritih varnostnih groženj ter pomanjkljivosti pri ohranjanju uporabnikove zasebnosti.

4 PRIKRITE PASTI ORODIJ

Z uporabo brezplačnih orodij, ki jih ponujajo zasebna podjetja, uporabniki pogosto nevede izpostavljajo svojo zasebnost na

spletu. Takšna orodja so brezplačna v striktno monetarnem smislu, saj uporabnik njihove uporabe ne plača z denarno valuto. Podjetja v dobiček spremenijo samo rabo orodij, saj zbirajo vrsto podatkov, ki jih nato prodajo drugim zainteresiranim podjetjem. Uporabnikovo dovoljenje za takšno delovanje pridobijo z njegovim pristankom na pogoje rabe, v katerih so zelo implicitno nakazane možne uporabe različnih podatkov, ki jih podjetje pridobi prek uporabnikovega dela z orodjem. Največja težava takšne prakse leži v dejstvu, da podjetja namerno izpostavljajo zgolj monetarno brezplačnost orodja, pri tem pa uporabnika ne obvestijo neposredno, da bo na drugačen način plačal svojo uporabo [2].

Tisti uporabniki, ki se zavedajo, da bodo uporabo storitev plačali s svojimi podatki, pogosto temu ne namenjajo dovolj pozornosti. Argumentacija je pogosto v smislu »saj ne skrivam ničesar« ali pa »koga sploh zanimam«. V teh primerih gre za lažen občutek varnosti, saj se uporabniku zdi, da je nepomemben ali pa so njegovi podatki nepomembni. Ne zaveda se, da gre dejansko za ogromne količine podatkov, ki so marsikomu, še posebno v oglaševalski industriji zelo zanimivi in uporabni. Na podlagi tega je uporabnik izpostavljen osredotočenemu oglaševanju za določene izdelke. Tu pogosto ne gre za klasični koncept oglaševanja, ki ga uporabnik prepozna, dejansko je podvržen nečemu, kar bi lahko skorajda opredelili kot »psihološko vojskovanje«, oziroma tehnikam, ki uporabljajo takšne elemente za dosego cilja prodaje določenega izdelka, pri čemer je lahko ta »izdelek« tudi določena politika, informacija ali dezinformacija, ali pa je uporabnik mimo njegove vednosti napeljan k spremembi vedenjskih vzorcev, da to olajša prodajo neke storitve [3].

Problematično je tudi dejstvo, da v veliko primerih ne vemo, kje se zbrani podatki fizično nahajo. Pogosto je to na strežnikih, ki so locirani v državah, kjer zakonodaja zelo slabo ščiti uporabnika [4].

Arnes želi s svojim delom pri ozaveščanju javnosti o spletni varnosti uporabnika opremiti z informacijami, na podlagi katerih bo lahko sprejel najboljše odločitve, ki se tičejo njegove varnosti in zasebnosti na spletu. Zastiranje dejanskega mehanizma delovanja brezplačnih orodij je namreč zavajajoče za neinformiranega uporabnika, ki je zaradi tega že v izhodišču potisnjen v smer neoptimalne odločitve. Konča odločitev o uporabi nekega orodja je seveda v rokah posameznika, moralno in etično pa je, da to odločitev sprejme na podlagi kakovostnih informacij, ki so mu na voljo.

Z namenom ozaveščanja uporabnikov pri uporabi storitve Zoom smo to pomlad na naši spletni strani objavili kratek vodič, ki razkriva tako poslovni model Zooma kakor tudi povsem tehnične informacije, kako poskrbeti za varnosti in zasebnost ob uporabi orodja, seveda v okviru zaščite, ki je pri uporabi sploh na voljo uporabniku. Izpostavili smo tudi najpogostejše oblike spletnih incidentov, ki se dogajajo pri uporabi tega orodja. S tem smo želeli uporabnika informirati in mu omogočiti, da takšno brezplačno orodje uporablja varno in z zavedanjem, da uporabo plačuje na drugačen način, in ne z denarjem. Informiranost uporabnika je v takšnih razmerah po našem mnenju ključna [5].

5 SPLETNI INCIDENTI

Varnost posameznika na spletu je skoraj popolnoma v rokah njega samega, čeprav ima uporabnik pogosto občutek, da je tehnologija tista, ki mu povzroča težave. To je v veliki meri posledica nepoznavanja spletnega okolja in jo z ozaveščanjem o potencialnih pasteh uporabe IKT in spleta lahko v veliki meri odpravimo. [6]. Večina spletnih prevar in ostalih groženj za posameznikovo spletno varnost namreč računa na naivnost in nepremišljenost uporabnika. V veliki večini primerov predvsem prevare uporabnika postavijo v položaj, ko se mora hitro odzvati, saj ga prepričujejo, da se mu bo v nasprotnem primeru zgodilo nekaj neprijetnega, denimo da bo izgubil prostor na strežniku za svojo elektronsko pošto ali pa bo nagrada, ki jo je zadel v nagradni igri, na katero se ni prijavil, šla drugi osebi. Tako prevaranti računajo na uporabnikov hiter, čustven in nepremišljen odziv ter na ta način dosežejo svoj namen, ki je lahko raznolik – vse od pridobitve osebnih podatkov do nakazila denarja [7].

Kot smo zapisali v našem vodiču za uporabo orodja Zoom, je ena izmed težav videokonferenčnih sistemov vpadanje nepovabljenih gostov v konferenco. S takim primerom so nas kontaktirali iz slovenske osnovne šole. Pri izvajanju pouka na daljavo prek Arnesovega videokonferenčnega orodja Arnes VID je prišlo do vpada nepovabljenega gosta, ki se je izdajal za Arnesovo tehnično podporo. Ta je učiteljico s pretvezo, da potrebuje njeno sodelovanje za odpravljanje tehnične napake, prepričal, da pritisne bližnjico na tipkovnici, ki zapre delovanje programa. Vse skupaj je storilec predvajal v živo, posnel in objavil na video portalu YouTube. Šola je želela preveriti, če je bila res vpletena naša tehnična podpora, hoteli pa so se tudi ostro odzvati proti storilcu.

Šlo je za potegavščino, ki jo je storilec izvedel za zabavo množice gledalcev na njegovem spletnem kanalu. V tem primeru pride v ospredje poznavanje IKT opreme in delovanja spleta, na dveh področjih. Prvo je zavedanje, da je storilec prišel do dostopa do videokonference s pomočjo enega od udeležencev. Sam namreč ne bi mogel naključno ugotoviti imena konference. V kolikor ima storilec pomoč udeleženca, se lahko izogne ugibanju gesla, če je z njim zaščitena konferenca, saj mu tega priskrbi udeleženec. Šola se lahko s poznavanjem delovanja videokonferenčnega sistema tako nemudoma odzove in začne z zbiranjem informacij udeležencev učne ure, če želi iskati storilca.

Drugo področje pa je splošno poznavanje delovanja IKT opreme oziroma v tem primeru računalnika. Bližnjica na tipkovnici, za katero je napadalec želel, da jo pritisne učiteljica, je znana pri tistih, ki bolje poznajo tehnologijo. Tako lahko vidimo, na kakšen način se akumulira splošno znanje o IKT opremi in delovanju spleta ter vpliv akumulacije znanja na našo spletno varnost. Učiteljica bi denimo lažje prepoznala namero, če bi poznala bližnjico.

Čeprav je šlo za potegavščino učencev, lahko v tem spletnem incidentu prepoznamo veliko večino običajnih mehanizmov, ki jih uporabljajo prevaranti na spletu. Storilec uporablja lažno identiteto, v tem primeru se izdaja za člana Arnesove tehnične podpore, z namero, da pridobi kredibilnost in žrtev prepriča v sodelovanje. Spletni prevaranti se zelo pogosto predstavljajo kot banke, velika podjetja ali druge znane ustanove. [7]. Storilec je prav tako učiteljico postavil v situacijo, kjer je morala reagirati hitro, brez premisleka o njegovi zahtevi. Verjetno ni imela določenega znanja o delovanju računalnika in spleta, zato je bila zaradi tega še lažja tarča. Spletni prevaranti namreč pogosto za svoj namen žrtev silijo v hitre odločitve, prav tako pa jim olajša delo, če žrtev ni podkovana v poznavanju spletnega okolja. Na

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teh primerih lahko vidimo, da bistveno vlogo igra človeški faktor, tehnologija sama po sebi pa ne predstavlja nekega posebnega tveganja. Takšne prevare so pogoste tudi v drugih sferah življenja, spletno okolje je zgolj bolj izpostavljeno zaradi slabšega znanja splošne javnosti o varni uporabi spletne tehnologije. Ker se IKT in splet pogosto prikazuje kot kompliciran in zahteven za uporabo, se s tem ustvarja tudi predsodke, da je sama tehnologije bolj nevarna za uporabnika, kot je v resnici.

6 IZOBRAŽEVANJE ARNESOVIH UPORABNIKOV

Pomemben del Arnesove vloge v raziskovalno-izobraževalni skupnosti je tudi izobraževanje uporabnikov in prenos znanja. Ta poteka v različnih oblikah, od predavanj, letne konference Mreža znanja, priprave strokovnih delavnic, strokovnih pripomočkov in množičnih odprtih spletnih tečajev, ki jih označujemo s kratico MOST (tu gre za prevod izvirnega angleškega naziva MOOC oz. Massive Open Online Course.) [8].

Na Arnesov MOST se lahko prijavi vsak, ki ga obravnavana tematika zanima. Tečaji potekajo na daljavo, udeleženci pa prek spletne učilnice dobijo gradiva in naloge, ki jih je potrebno za uspešno končanje tečaja predelati in opraviti. Za sodelovanje na tečaju je potreben zgolj dostop do spleta [8].

MOST ponuja enostavno in praktično rešitev za vsakogar, ki se želi izobraziti o tematiki, ki je obravnavana v posameznem tečaju. Ker poteka na daljavo, sodelujočim ni potrebno biti prisoten na izbrani lokaciji, kar marsikomu prihrani veliko časa in olajša sodelovanje. Prav tako je velika večina časovnega razporeda v rokah sodelujočega. Tečaji imajo datume začetka in konca ter določene roke za oddaje nalog, če jih tečaj predvideva, sama obdelava gradiv in drugo delo pa si razporedi uporabnik sam. Tako si lahko organizira čas po svojem okusu, saj mu ni treba biti prisoten za računalnikom ob določeni uri, temveč so mu gradiva na voljo takrat, ko so objavljena v spletni učilnici.

Arnesovi MOST-i obravnavajo veliko različnih tem, vsem pa je skupno, da so vezane na uporabo IKT ali spleta. MOST Digitalne identitete obravnava skrb za baze uporabnikov, Vodenje in upravljanje VIZ prikazuje uporabo IKT in spleta za namen učinkovitega vodenja VIZ, Upravljanje brezžičnih omrežij predstavlja, kako čim lažje urediti podporo uporabnikom za dostop do brezžičnega omrežja eduroam, Spletna predstavitev VIZ predstavi ustvarjanje spletišča za uporabnikovo ustanovo, Uporaba mobilnih naprav v VIZ prikazuje smiselno uporabo mobilnih naprav pri pouku, Spletno anketiranje uči ustvarjanje spletnih anket v orodju 1KA, Spletne učilnice predstavljajo uporabo in ustvarjanje spletnih učilnic, E-listovnik seznani uporabnika s funkcionalnostmi in uporabo e-listovnika. Poleg teh naštetih Arnes dvakrat letno izvede tudi MOST Varna raba interneta in naprav, ki obravnava veščine, pomembne za prepoznavanje spletnih nevarnosti in za zaščito uporabnikove varnosti na spletu ter osebnega zdravja. Na temo spletne varnosti je učiteljem na voljo tudi MOST Znam več, varnost na spletu ni nikoli odveč, kjer učitelj prejme v uporabo že opremljeno spletno učilnico in sam vodi skupino učencev čez proces učenja o

tematiki [8]. Poleg naštetih Arnes pripravlja še nove MOST-e, ki bodo obravnavali druge tematike, vezane na uporabo spleta in IKT.

7 ZAKLJUČEK

V času epidemije COVID-19 je bil slovenski izobraževalni sistem prisiljen v vzpostavitev izobraževanja na daljavo do konca šolskega leta 2019-20. S tem so bili učitelji in učenci prisiljeni v uporabo spleta in IKT v izobraževalne namene. S povečanjem števila uporabnikov se je povečala tudi možnost za spletne napade in incidente, še posebno zaradi dejstva, da je bilo veliko novih uporabnikov slabše podkovanih v uporabi spletnih orodij. Želja Arnesa je, da bi vsak od uporabnikov, ki za svoje izvajanje ali sodelovanje v izobraževalnem procesu uporablja splet ali IKT opremo, postal kompetenten in izobražen za uporabo teh tehnologij. Tako bo suveren pri uporabi, izobraževanje bo kakovostno, prav tako pa bo poskrbel za svojo varnost na spletu. S tem namenom Arnes organizira množične spletne odprte tečaje, ki jih izvaja pod kratico MOST. Uporabnik lahko z nabiranjem znanja o uporabi spleta in IKT opreme zagotovi zase in za druge kakovosten učni proces, tako v primeru izobraževanja na daljavo kot običajnega šolskega dela. IKT in splet namreč ob ustrezni rabi bistveno olajšata delo učencem kakor učiteljem ter s tem pripomorejo h kvalitetni izvedbi izobraževalnega procesa.

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Timsko delo kot osnova hipoterapije

Teamwork as a basis for hyppotherapy

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POVZETEK

Hipoterapija je inovativna oblika fizioterapije, ki vključuje uporabo konja kot terapevtskega orodja za učinkovito zdravljenje pacienta, kjer ritem hoje konja s svojim tridimenzionalnim gibanjem nenehno spodbuja pacientovo ravnovesje in pravilno telesno držo. Problemsko stanje nastane pri splošnem poznavanju in razširjenosti hipoterapije v Sloveniji. Naš cilj je posledično celostno predstaviti proces hipoterapije in delovanje celotnega širšega hipoterapevtskega tima z njihovimi ključnimi aktivnostmi in odgovornostmi. Za potrebe raziskave smo uporabili različne metodološke pristope, in sicer, raziskovalni pristop, kritičen pregled sekundarnih virov literature in na osnovi metode sintez prikazali naše ugotovitve, kvalitativni pristop, in sicer intervju/pogovor s strokovnjaki iz okolja, na podlagi katerega smo izoblikovali poslovni model in bogato sliko hipoterapije. Ugotavljamo, da je proces hipoterapije kompleksen, večslojen in dolgotrajen proces. Posledično smo z različnimi načini modeliranja ustvarili učinkovit celostni prikaz hipoterapevtske dejavnosti za rešitev izpostavljenega problema. Predstavljeni prispevek je rezultat timskega sodelovanja študentov več univerz in visokih šol v projektu »Projektno delo z negospodarskim in neprofitnim sektorjem v lokalnem in regionalnem okolju« in je primer alternativnega načina pridobivanja raziskovalnih kompetenc in spretnosti.

KLJUČNE BESEDE

Hipoterapija, organizacijski vidik, hipoterapevtski tim, poslovni model, bogata slika, iterdisciplinarnost

ABSTRACT

Hippotherapy is an innovative form of physiotherapy which includes horses as a therapeutic tool for the patient, where the rhythm of a horse's walking, with its three-dimensional movement, constantly works the patient's balance into the proper posture. There is a lack of general knowledge of hippotherapy in Slovenia. Our goal is to comprehensively present the hippotherapy process and hippotherapy team with their key activities in responsibility. For the purposes of our research, we used several methodological approaches, including the research approach, the review of secondary sources of literature and presented our findings; qualitative approach, interview/conversation with professional. Based on our interview we formed a rich picture of hippotherapy and Business Model Canvas. We conclude that hippotherapy is a complex, multi-layered, and long process. We used a variety of modelling methods to create a comprehensive view of hippotherapy. The presented paper is the result of teamwork of students from several universities and colleges in the project "Project work with the non-profit and non-profit sector in the local and regional environment" and is an example of an alternative way of acquiring research competencies and skills.

KEYWORDS

Hippotherapy, organisational aspect, hippotherapy team, Business Model Canvas, rich picture keywords, interdisciplinarity

1 UVOD

Hipoterapija oziroma terapija s konji je inovativna oblika fizioterapije, ki vključuje uporabo konja kot terapevtskega orodja za učinkovito zdravljenje pacienta, kjer so za pravilno izvajanje potrebni zdravnik, fizioterapevt, vodič, pomočnik ter konj [11]. Ritem hoje konja s svojim tridimenzionalnim gibanjem nenehno

spodbuja pacientovo ravnovesje in pravilno telesno držo [7]. Usposobljen terapevt si s pomočjo različnih aktivnosti prizadeva izboljšati jahačevo splošno koordinacijo in motorične sposobnosti [12]. Ta kombinacija gibanja in aktivnosti pozitivno vpliva na jahačev nadzor telesne drže in funkcije; fizikalni učinki hipoterapije se prav tako kažejo v: normalizaciji mišične napetosti, večanju gibljivosti sklepov, simetriji, krepitvi mišične moči in izboljšanju kardio-respiratorne funkcije [5].

Problemsko stanje nastane pri splošnem poznavanju in razširjenosti hipoterapije v Sloveniji, kot ena izmed inovativnih pristopov in oblik fizioterapije. Naš cilj je posledično celostno predstaviti proces hipoterapije in delovanje celotnega širšega hipoterapevtskega tima z njihovimi ključnimi aktivnostmi in odgovornostmi. Omenjeno bi zelo pripomoglo k rešitvi izpostavljenega problema nepoznavanja hipoterapije. Da bi uspešno dosegli zastavljen cilj je bil za štiri mesece sestavljen interdisciplinarni tim (soavtorji tega prispevka) sestavljen iz študentov Medicinske fakultete, Veterinarske fakultete in Biotehniške fakultete Univerze v Ljubljani, študente študijskega programa Fizioterapije ALMA MATER EUROPAEA-Evropski center, Maribor in študente Fakultete za organizacijske vede Univerze v Mariboru. V projektu je sodeloval Konjeniški klub Gibanje, ki je omogočil praktično izvajanje meritev na pacientih in sodelovanje s strokovnjaki njihovega kluba (hipoterapevti, vodniki konj, oskrbniki, učitelji jahanja, …). V projektu sta nam bila neformalno v pomoč še dva strokovnjaka s področje fizioterapije in konjeništva.

2 METODOLOGIJA

Za potrebe raziskave smo uporabili različne metodološke pristope, za kar najbolj celovit prikaz hipoterapije iz organizacijskega vidika. In sicer, raziskovalni pristop, kritičen pregled sekundarnih virov literature in na osnovi metode sintez prikazali naše ugotovitve, predvsem s področja teoretičnih osnov o hipoterapiji. V nadaljevanju smo uporabili kvalitativni pristop, in sicer intervju oziroma pogovor s strokovnjaki iz okolja, na podlagi katerega smo izoblikovali poslovni model (ang. "Business Model Canvas") in bogato sliko hipoterapije (ang. "rich picture").

Pri prvem metodološkem pristopu smo kratko in pregledno pripravili celovit teoretični pregled s področja hipoterapije. V aprilu 2020 smo izvedli intervju s strokovnjakinjo iz okolja, in pridobili odgovore na vprašanja o poteku hipoterapije, člani hipoterapevtskega tima, njihove naloge/aktivnosti in odgovornosti. Izdelali smo tudi seznam potrebne opreme za uspešno izvedbo hipoterapije.

Na podlagi intervjuja smo izoblikovali poslovni model in bogato sliko. "Business Model Canvas" ali poslovni model prikazuje različne sklope, področja organizacije in na preprost način prikaže organizacijsko strukturo [6]. Deli se na devet enakovrednih sklopov – vsi so ključnega pomena za dolgoročno, uspešno in učinkovito delovanje posla, med seboj pa se seveda povezujejo in dopolnjujejo, zato moramo posamezne elemente področij ustrezno obarvati, da intuitivno prikažemo njihove povezave [4]. S pomočjo omenjenega modela, smo prikazali ključne partnerje, aktivnosti in vire pri hipoterapiji, dodano vrednost, odnose s strankami, prodajne kanale, segmente strank, strukturo stroškov in prihodkov.

Sledilo je izoblikovanje modela v obliki »bogata slika« ali "rich picture". Bogata slika je risba procesa, ki ponazarja glavne elemente in odnose pri hipoterapiji [8]. Sestavljen je iz slik, besedila, simbolov in ikon, ki se uporabljajo za grafično prikazovanje povezav med različnimi člani [14] širšega hipoterapevtskega tima in razmer.

3 RAZISKAVA

3.1 Osnove hipoterapije

Hipoterapija oziroma terapija s konji je inovativna oblika fizioterapije, ki vključuje uporabo konja kot terapevtskega orodja za učinkovito zdravljenje pacienta, kjer so za pravilno izvajanje potrebni zdravnik, fizioterapevt, vodič, pomočnik ter konj [11].

Ritem hoje konja s svojim tridimenzionalnim gibanjem nenehno spodbuja pacientovo ravnovesje in pravilno telesno držo [7]. Usposobljen terapevt si s pomočjo različnih aktivnosti prizadeva izboljšati jahačevo splošno koordinacijo in motorične sposobnosti; ta kombinacija gibanja in aktivnosti pozitivno vpliva na jahačev nadzor telesne drže in funkcije [3].

Fizikalni učinki hipoterapije se prav tako kažejo v: normalizaciji mišične napetosti, večanju gibljivosti sklepov, simetriji, krepitvi mišične moči in izboljšanju kardio-respiratorne funkcije [7]. Poleg pozitivnih učinkov na fizične težave, se pozitivni vplivi terapije s konjem kažejo v telesnem, emocionalnem, duševnem in socialnem razvoju [10]. Hipoterapija se uporablja, ko z drugimi fizioterapevtskimi koncepti obravnave ne dosežemo uspeha oziroma ko oseba v fizioterapevtski obravnavi ne napreduje in nastane zastoj napredka na večjemu številu področij [7].

Nekatere glavne bolezni, zaradi katerih se posamezniki zdravijo s pomočjo hipoterapije:

Multipla skleroza [1]: Primarni cilji hipoterapije pri multipli sklerozi so uravnavanje mišičnega tonusa in dihanja, krepitev mišic trupa, izboljšanje ravnotežja, koordinacije, hoje ter simetrije. Poleg tega, hipoterapija spodbuja komunikacijo, vnaša veselje v življenje ter krepi samozavest.

Cerebralna paraliza [9]. Pozitivni učinki terapije na posameznike s cerebralno paralizo so: stabilnost jedra, nadzor grobe in fine motorike, ravnotežje, drža, mišični tonus (hipotonija in hipertonija), sposobnost dajanja ter sprejemanja vizualnih namigov, senzorične motnje, komunikacijske sposobnosti, socialne spretnosti, zaupanje in samospoštovanje.

Avtizem [2]: Hipoterapija nudi avtističnim posameznikom občutek pripadnosti, hkrati pa pozitivno vpliva na njihov stik in interakcijo z okoljem. Poveča se njihova samozavest in socializacija, saj se učijo komunicirati in delati s svojim konjem.

Downov sindrom [13]: Terapija vpliva na izboljšanje psiholoških, kognitivnih in komunikacijskih sposobnosti. Izpopolni se obnašanje in presoja posameznika, saj se nauči primerno ravnati s konjem. To neposredno izboljša spomin, govor in samozavest.

Ortopedske motnje [15]: Ortopedska hipoterapija predstavlja novo obliko terapevtske vadbe pri zdravljenju segmentnih nestabilnosti ledvene hrbtenice. Tovrstna terapija deluje na načelu, da pacientu posreduje tridimenzionalno nihajno gibanje hrbta konja. Na te gibalne impulze se posameznik odziva s premikanjem navzgor-navzdol, naprej-nazaj in levo-desno.

Zaradi spreminjajoče se tlačne obremenitve med vadbo se izboljša delovanje aktivnih in pasivnih struktur hrbtenice.

Psihična obolenja [2]: Sem spadajo bolezni, kot so na primer: depresija, anksioznost, fobija, manična depresija, razvojna zakasnitev, ADHD, učne težave, motnje govora in zloraba drog. Tesno sodelovanje s konji je pomagalo posameznikom pri premagovanju obrambnega vedenja in starih čustvenih vzorcev ter pri iskanju novih načinov reševanja problemov in razumevanja perspektive ostalih. Terapevtsko jahanje je pomagalo pacientu, da vstopi v meditacijo, v kateri se osredotoča na reševanje problemov v sedanjem trenutku.

3.2 Hipoterapija iz organizacijskega vidika

Na podlagi pridobljenih odgovorov s strani strokovnjakinje iz okolja in študije literature smo izoblikovali naslednja modela, in sicer poslovni model in bogato sliko.

Za nemoteno in kontinuirano izvajanje hipoterapije, potrebujemo kar nekaj virov (materialnih, nematerialnih, človeških) in ustrezne povezave med njimi. S Sliko 1 so v nadaljevanju prikazane ključne aktivnosti in funkcije (vloge hipoterapevtskega tima) ter povezave med njimi. Hipoterapevt tako vodi hipoterapevtske seanse, med njimi mora poskrbeti za dobro komunikacijo z vodnikom konja, pripravi vaje za naslednje termine, svoj kontakt ponuja na spletnih straneh, hkrati pa mora komunicirati s pacientom ter v nekaterih primerih z zdravnikom, s katerim si izmenja diagnozo pacienta in poročilo o napredku.

Glavne aktivnosti vodnika konja v sklopu hipoterapije so vodenje konja med hipoterapijo, komunikacija s hipoterapevtom in dogovor o terminih, hkrati pa mora skrbeti za konjevo psihično in fizično dobrobit. Hipoterapija potrebuje prostor za izvedbo (po navadi pokrita jahalnica), običajno zagotovi konjeniški center, ki skrbi tudi za konje, njihovo hranjenje in hlevljenje in ima dogovor o delu z oskrbnikom konj. Konj seveda potrebuje tudi kovača, ki ga podkuje ali izvede korekcijo kopit, ter veterinarja, ki skrbi za njegovo fizično zdravje. Zadnji akter na sliki je stranka, ki se zdravi s pomočjo hipoterapije, ki mu jo lahko predpiše zdravnik, informacije o njej pa lahko dobi s pomočjo spletnih strani.

Zdravnik je odgovoren za celovito zdravljenje pacienta, spremljanje njegovega napredka in za dobro komunikacijo s hipoterapevtom. Hipoterapevt je odgovoren za izbiro vaj in vodenje hipoterapije, za komunikacijo s pacientom in izbiro primernega konja. Vodnik konja mora med hipoterapijo ustrezno voditi konja, nuditi prvo pomoč v primeru nesreč in poškodb, kontrolirati mora odzive konja na nenavadne zvoke med hipoterapijo, odgovoren je tudi za delo s konjem v maneži in na lonži, med seansami pa mora skrbeti tudi za konjevo psihično in fizično dobrobit ter za sproščanje konja.

Oskrbnik konja skrbi za urejenost jahalnice, za hranjenje in splošno vzdrževanje konj, k čimer spada tudi naročilo kovača in naročilo pregleda konja pri veterinarju. Kovač je odgovoren za primerno podkovanje oziroma korekcijo kopit, veterinar pa skrbi in vzdržuje zdravje konja. Z oskrbnikom komunicira tudi konjeniški center, ki se z njim dogovarja o čiščenju in vzdrževanju, glavna odgovornost centra pa je zagotavljanje jahalnice za hipoterapijo.

Z vidika organizacije, smo hipoterapijo opisali tudi s pomočjo poslovnega modela Slika 2. Orodje prikazuje različna področja organizacije in na preprost način prikaže organizacijsko strukturo, s čimer lahko enostavno prikažemo celotno sliko podjetja ali organizacije. Deli se na devet enakovrednih sklopov, vsi so ključnega pomena za dolgoročno, uspešno in učinkovito delovanje posla, med seboj pa se seveda povezujejo in dopolnjujejo, zato moramo posamezne elemente področij ustrezno obarvati, da intuitivno prikažemo njihove povezave. Elemente smo razporedili v štiri skupine.

Rumena predstavlja vse, kar je povezano z oskrbo in vzdrževanjem konj, vijolična predstavlja terapevtski aspekt in vse kar je povezano z njim, rdeča predstavlja stranke oziroma paciente in njihovo interakcijo v celotnem procesu, zelena barva pa predstavlja ključno aktivnost ter komponente, od katerih je hipoterapija odvisna.

Iz Slike 2 je razvidnih vseh devet, prej omenjenih elementov, in sicer, ključni partnerji: Konjeniški center, zdravstveni strokovnjaki, veterinar, kovač, oskrbnik konj; ključne aktivnosti: izvajanje hipoterapije, iskanje primernih konj, komunikacija s strankami, skrb za fizično in psihično zdravje konja; ključni viri: hipoterapevtska ekipa, terapevtski konji, prostori, konjeniška oprema; dodana vrednost: izboljšava motoričnih, procesnih, komunikacijskih oz. interakcijskih spretnosti; odnosi s strankami: osebni, preko oskrbnika osebe; prodajni kanali: zdravniki, spletna stran, osebni; segmenti strank: otroci, mladostniki, odrasli z različnimi obolenji; struktura stroškov: plače hipoterapevtske ekipe, oskrba konj, vzdrževanje prostorov in opreme, specialna oprema in struktura prihodkov: plačila posameznih ur hipoterapije, javna sredstva.

Materialni pogoji in človeški viri so potrebni za delovanje vsake organizacije. Pri procesu hipoterapije poznamo šest različnih vlog – vsaka je zadolžena za ustrezno izvajanje svojega strokovnega dela. Akterji za to potrebujejo ustrezne predmete dela in delovna sredstva. Izvajalci pri hipoterapiji so lahko notranji ali zunanji, odvisno od strukture organizacije. Za nemoteno in kontinuirano delovanje hipoterapevtske aktivnosti, morajo izvajalci med seboj sodelovati in si poročati o opravljenem delu.

Hipoterapevtsko skupino sestavljajo naslednji člani: hipoterapevt, vodnik konja, zdravnik, oskrbnik konja, veterinar in kovač. Njihovi materialni pogoji se v velikem številu aktivnosti med seboj prekrivajo. Sam proces hipoterapije se prične z diagnozo pacienta. Zdravnik je tisti, ki pacienta napoti na hipoterapijo.

Veterinar in zdravnik za svoje delo potrebujeta podobna delovna sredstva – oba potrebujeta računalnik, razne obrazce, napotnice, ambulanto, laboratorijski pribor, kirurški pribor in zdravila. Veterinarski tehnik je odgovoren za varovanje in izboljšanje zdravja konja, zdravnik pa za evalvacijo rezultatov po opravljenih seansah hipoterapije ter svetovanje glede nadaljnje rehabilitacije.

Veterinar mora biti v rednem kontaktu z oskrbnikom konj, saj mu on sporoča o zdravstvenem stanju konj v konjeniškem centru. Oskrbnik konj prav tako vzdržuje jahalni prostor in konjeniško opremo. Zadolžen je za vsakodnevno čiščenje hlevov ter krmljenje in negovanje konj. V primeru podkovanja ali korekcije kopit je on tisti, ki pokliče kovača. Materialni pogoji vodnika konja in hipoterapevta so zelo podobni in dopolnjujoči. Med njihova delovna sredstva in predmete dela spadajo: terapevtski konj, oprema za čiščenje konja, oprema za jahanje, vzdrževana jahalnica, rampa, prva pomoč in telefon (v primeru poškodb).

Vodnik konja je v procesu hipoterapije odgovoren za preverjanje stanja konja in vzdrževanje njegove kondicije. Zadolžen je za konjevo psihično in fizično dobrobit. Njegovo glavno delo je vodenje konja pod vodstvom hipoterapevta. Mora se seznaniti s pravilno terminologijo za sporazumevanje s hipoterapevtom. Terapevt pred hipoterapijo opravi sklop testiranj s pacientom in se dogovori za ustrezne termine. Prav tako izbira vaje, kontrolira in popravlja konjevo hojo, vzdržuje tempo ter gleda na pravilno držo pacienta. Proces hipoterapije se zaključi s pacientovim dosegom postavljenih ciljev hipoterapevta.

4 UGOTOVITVE IN ZAKLJUČEK

Hipoterapija oziroma terapija s konji je inovativna oblika fizioterapije, ki vključuje uporabo konja kot terapevtskega orodja za učinkovito zdravljenje pacienta. Problemsko stanje nastane pri splošnem poznavanju in razširjenosti hipoterapije v Sloveniji, kot ena izmed inovativnih pristopov in oblik fizioterapije.

Ugotavljamo, da je proces hipoterapije kompleksen, večslojen in dolgotrajen proces. Posledično smo z različnimi načini modeliranja ustvarili učinkovit celostni prikaz hipoterapevtske dejavnosti za rešitev izpostavljenega problema. Menimo, da ima hipoterapija velik potencial v Sloveniji, saj pri posamezniku ustvari številne pozitivne učinke, katere je težje pridobiti z drugimi oblikami fizioterapije in zdravljenja. Glede na predpostavljeno sklepamo, da bo prispevek signifikantno pripomogel k razumevanju organizacijskega vidika hipoterapije v Sloveniji.

V tem prispevku smo povzeli bistvo raziskovalne naloge, ki je podrobneje zapisana v obliki monografije Hipoterapevtski tim in kompetence na sto straneh s podrobnimi opisi in slikovnimi prikazi vseh deležnikov, njihovih nalog in zadolžitev, procesov in sredstev potrebnih za izvajanje hipoterapije. Delo ne temelji le na teoretičnem in raziskovalnem delu temveč tudi na praktičnem delu, ki so ga vsi sodelujoči študenti opravili v praksi v realnem okolju s privolitvijo staršev proučevane pacientke.

Projektno delov v okviru »Projektno delo z negospodarskim in neprofitnim sektorjem v lokalnem in regionalnem okolju« se je pokazalo kot nov način pridobivanja ne le strokovnih temveč tudi znanstvenih kompetenc študentov.

Zaključimo lahko z mislijo Winstona Churchilla: "Nekaj je na zunanjosti konja, kar je dobro za človekovo notranjost." (ang. "There is something about the outside of a horse that is good for the inside of a man.").
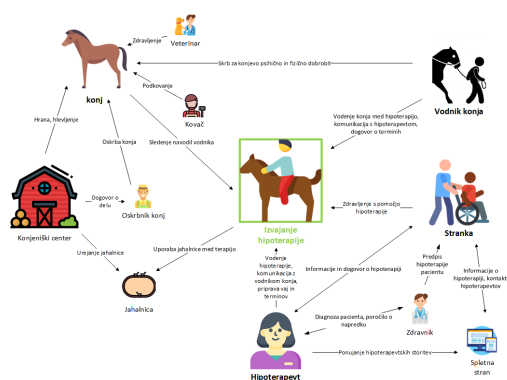
Slika 22: Bogata slika hipoterapije (lasten prikaz)
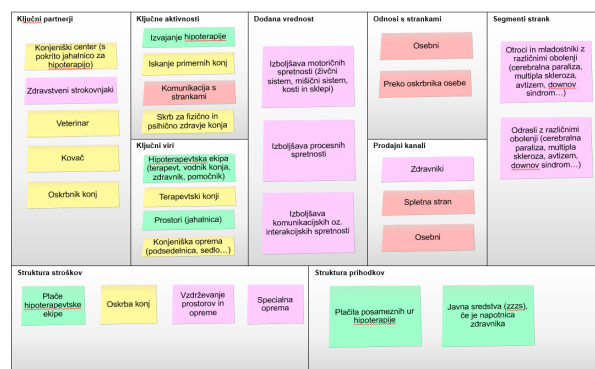
Slika 23: Poslovni model hipoterapije (lasten prikaz)

FINANCIRANJE

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Se igram ali učim? Spletna aplikacija Wordwall

Do I play or learn? Web application Wordwall

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POVZETEK

S spletno aplikacijo Wordwall ustvarimo različne tipe interaktivnih igrificiranih nalog zaprtega tipa. V vnaprej pripravljene igrificirane in atraktivne predloge vnesemo svoje vsebine in v nekaj minutah ustvarimo interaktivno nalogo ali si jo pretvorimo v pdf-datoteko. V procesu učenja, ki je podprto s formativnim spremljanjem, učenci po dejavnosti reflektirajo vsebine in proces, refleksiji pa sledijo nove učne priložnosti za izboljšanje učnih dosežkov.

KLJUČNE BESEDE

Igrifikacija, formativno spremljanje, povratna informacija, refleksija

ABSTRACT

With the help of Wordwall web app it is possible to create different types of interactive, closed-type gamificated tasks. All that needs to be done is to enter the content into attractive, pre-made templates. As a result, it is possible to create an interactive task that can be transformed into a PDF file in just a few minutes. In the learning process, supported by formative assessment, students reflect on the content and process after the activity. Reflection is followed by new learning opportunities for improving learning achievements.

KEYWORDS

Gamification, formative assessment, feedback, reflection

1   UVOD

Da učenje lahko podpremo z igro, ni nek inovativen pedagoški pristop. Na voljo imamo res veliko igrificiranih bolj ali manj privlačnih spletnih orodij, med katerimi izbiramo na podlagi več parametrov, npr. glede na namen (kaj želimo doseči), način (bomo dostopali z računalnikom, mobilnimi telefoni …), nenazadnje tudi ceno itn. Eno izmed njih je Wordwall, katerega sem preizkusila v času izobraževanja na daljavo.

Kot učitelj razmišljujoči praktik se sprašujem: Kako izkoristiti to (sicer tudi katero koli) atraktivno IKT-orodje, da ne le vzpodbudimo, temveč tudi poglobimo proces učenja? Manj privlačne vsebine, kot so npr. zapis z veliko ali malo začetnico, sklanjatveni vzorci ipd., naredimo učencu atraktivnejše, približamo se mu skozi zanj domače okolje, kot je igra. Da pa se učenje ne zreducira zgolj na igranje in z njim doseganje čim boljšega rezultata, se vedno znova vračava v učni proces s ključnimi vprašanji Kje sem? Kam želim priti? Kako do tja? oba,

učitelj in učenec. Na konkretni operativni ravni velja v učni proces vgraditi refleksijo tako vsebine kot procesa, a refleksija sama po sebi ne bo dovolj, če za njo ne bo možnosti akcije.

2   NA KRATKO O ORODJU – PREDSTAVITEV

Wordwall (https://wordwall.net/) je spletna aplikacija, ki v svoji brezplačni različici nudi 18 tipov nalog (v plačljivi 34), med drugim kviz (v različnih oblikah, npr. tipa milijonar), povezovanje, anagram, vislice, križanko, prav/narobe itn. Gre za prednastavljene predloge (angl. template), v katere vpišemo svojo vsebino. Enostavno in hitro, a v brezplačni različici z omejitvijo na 5 aktivnosti in brez možnosti multiplayerja. Isto interaktivno nalogo lahko spreminjamo po temi, s čimer dobimo drugačno grafiko, pisavo in zvoke. Nadaljnja opcija je, da nalogo otežimo s časom in številom življenj ter ravnmi (angl. levels). Izbiramo med pokažem/skrijem dosežene točke za vsakim vprašanjem, na koncu ponudimo ali pa ne nabora vseh vprašanj z odgovori. Če je naloga javna, lahko spremljamo rezultate svojih učencev – po doseženih točkah in času. Ko ustvarimo aktivnost, jo lahko takoj spremenimo v drugo, to možnost imajo sicer tudi igralci. Običajen interaktivni kviz z več odgovori spremenimo v npr. križanko, povezovanje itn. Interaktivne naloge si lahko natisnemo (v pdf-ju) kot učne liste. Do orodja je možno dostopati z različnih naprav. Slovenske različice ni, kar pomeni, da bodo navodila in odzivi v angleščini.

3   DIDAKTIČNI PREMISLEK UČITELJA: ZAKAJ, ČEMU, KDAJ, KAKO WORDWALL?

Wordwall je atraktivno orodje s privlačno grafiko, zvoki, animacijami, kar bo zagotovo pritegnilo tako učenca vizuelca, avditivca kot kinesteta ne glede na njegovo starost. Igra (npr. kviz) s svojo dinamiko motivira, saj takoj dobiš rezultat (točke) pa tudi priložnost, da še enkrat zaigraš in izboljšaš svoje mesto

na lestvici igralcev. Stimulativno za tekmovalne učence, čustvena angažiranost je velika, učenje dolgočasne vsebine, npr. slovničnih pravil, postane zabavno. Učitelju je na tej točki izziv, kako organizirati učenje (med poukom v šoli in doma), da se bo učenec v resnici (na)učil, ne pa samo klikal in se pehal za čim boljšim rezultatom. Nobeno orodje in nobeno okolje sama po sebi ne dajeta poglobljenega znanja, torej ni dovolj, da se zgolj igra neko igrificirano interaktivno vsebino, kot tudi v razredu ni dovolj, da se zgolj rešuje učni list. Rešitev je v tako zastavljenem učnem procesu, da učenec sproti reflektira ne le vsebine, temveč tudi sam proces učenja. Povzeto po Sentočnikovi [1] je refleksija namensko sprožen proces, v katerem učenec ovrednoti naučeno in si zastavi nove cilje. Refleksija sama po sebi ne zadošča, učencu je potrebno neposredno po refleksiji ponuditi nove učne priložnosti za izboljšavo. Dylan Wiliam takšno funkcioniranje slikovito povzame z besedno zvezo refleksija in akcija (angl. Reflection and action!) [4].

Učeči se naj torej opazuje svoje učenje. Refleksija naj bo konkretna: kaj točno sem se učil (vsebina), v čem vse sem zaznal napredek, kje so priložnosti za izboljšanje (kaj mi je delalo težave), kaj konkretno bom za to naredil. Na drugi strani je učitelj, ki naj nenehno reflektira svoje poučevanje in ga, če je potrebno, ustrezno modificira v smislu, da morda poseže v težavnost (sprosti ali oteži), se vrne v namene učenja, individualizira dejavnosti itn. Na tej točki se udejanja formativno spremljanje, ko se transformirava oba, učenec in učitelj.

Kdaj, v katerem delu učne ure ponuditi dejavnosti v Wordwallu – med uvodno motivacijo, utrjevanjem, ponavljanjem? Katero predlogo pri tem izbrati? Pravzaprav kadar koli in kar koli, a s pedagoškim razmislekom, kje učenec v procesu je, kam gre in kako naj pride do tja. V sži didaktičnega premisleka naj ne bo dejavnost sama po sebi, temveč pričakovani dosežki.

Prva različica, ki se je poslužujem, je kviz. Wordwall v neplačljivi obliki mi ponuja dve možnosti.

Prva je običajni interaktivni kviz, ki je podprt z elementi igrifikacije (npr. z glasbo v ozadju, točkovanjem, lestvico najboljših po točkah in času). Kviz z izbiro različnih predlog (angl. template) poustvari neko okolje, npr. džunglo, divji zahod, televizijski kviz, vesolje, duhove itn., podprto je s stimulativnimi zvoki iz dotičnega okolja. Igralci lahko tudi sami spreminjajo ozadje. Tako v vprašanje kot v odgovore lahko dodajamo slike ali sestavimo kviz samo s slikami, kar bi bilo smiselno za mlajše učence. Kviz otežimo z omejitvijo časa, številom življenj, lahko premešamo vprašanja po naključnem vrstnem redu. Če kviz ponudimo v fazi utrjevanja, ko se učenci še učijo, je smiselno nastaviti možnost, da se v primeru nepravilnega odgovora pokaže zraven pravilna rešitev. Učitelj mora premisliti, koliko vprašanj bo sploh postavil (najmanj 1 in največ 100), pri vsakem vprašanju je potrebno tudi premisliti, koliko odgovorov ponuditi (Tri, štiri, pet …?), kaj ponuditi kot nepravilne možnosti, da ne izzveni v izločanje nepravilnih odgovorov. Premisliti velja tudi glede možnosti, ali vprašanja premešati. Če sestavljamo po težavnosti, od lažjih primerov k težjim, bi bilo verjetneje smiselno, da v prvi fazi učenja nastavimo opcijo, da se vprašanja ne nizajo naključno, kasneje jih ponudimo premešana. Ali na koncu pokazati vsa vprašanja skupaj s pravilnimi odgovori? Da, a z refleksijo. Učenec naj skupaj s sošolci analizira: S katerimi vprašanji sem imel težave in zakaj? Kateri odgovori so bili ponujeni? Kateri med njimi so nepravilni? Zakaj je ta odgovor (ne)pravilen?

Druga možnost znotraj nalog izbirnega tipa je kviz tipa milijonar (angl. Gameshow quiz). Še vedno gre za interaktivni kviz, torej za zaprto nalogo z vprašanjem in več možnimi odgovori, vendar pa je predloga tehnično še bolj v vodah igrifikacije. Igralec dobi točke za pravilen odgovor, obenem se ga nagradi še z dodatnimi točkami za čas (za vsako sekundo dodatna točka). Igralec ima možnost vplivati na tekmovanje, saj si lahko polovico nepravilnih odgovorov izloči (gumb 50 : 50), s pravilnim odgovorom točke podvoji, potroji (gumba x2 Score, x3 Score), lahko si podaljša čas (gumb Extra Time), enkrat v igri si razkrije pravilen odgovor (gumb Cheat). Po približno 4 vprašanjih se kviz samodejno prekine, tekmovalca se motivira z dodatnimi točkami in nagradami. Tudi ta predloga je podprta z atraktivno animacijo. Tehnično tako nastavljenega milijonarja ne ponujam kot učne priložnosti v fazi utrjevanja, temveč je smiselno ga ponuditi v preverjanju.

Pri kakršni koli obliki (interaktivnega) kviza se je potrebno zavedati, da gre za nalogo objektivnega tipa z več izbirami, torej bo prej ko ne na ravni nižjih taksonomski znanj. Konec koncev učimo tudi znanja na (naj)nižjih taksonomskih stopnjah pomnjenja in razumevanja. So vsebine, ki se jih je potrebno zapomniti in potegniti iz spomina. Vsekakor bi se dalo nastaviti distraktorje na ravni višjih taksonomskih ravni, a če imamo nalogo omejeno s časom reševanja, oboje skupaj pedagoško ne vzdrži.

Pri (interaktivnem) kvizu učeči se dobi takojšnjo povratno informacijo v smislu števila oz. odstotka (ne)pravilnih odgovorov, pogosto tudi z naborom konkretnih (ne)pravilnih rešitev. Po Nykvistu (v Wiliam [3]) gre za t. i. skromno povratno informacijo, tj. informacijo v obliki ocen ali informacijo tipa poznavanja rezultatov (pravilnih odgovorov). Dylan Wiliam [2] in [3] v svojih raziskavah dokazuje, da bo ta, kot sicer velja za vse povratne informacije, relativno nekoristna, saj ima povratna informacija globok učinek na učenje le, ko učenca motivira za nadaljnje premišljene dejavnosti. Tu vstopi učitelj, ki učenje z interaktivnimi nalogami vgradi v proces učenja tako, da se učenci vedno znova vračajo k pričakovanim dosežkom, operirajo z nameni učenja in merili uspešnosti, ki so osnova povratnim informacijam, dokazi o učenju (v tem primeru kviz) pa so izhodišče refleksiji in nato nadaljnjemu učenju.

V Wordwallu imamo na voljo še druge predloge (angl. template), s katerimi naredimo učenje na pamet res atraktivno. Po mojih izkušnjah je predloga Udari krta! (angl. Whack-a-mole) takšna, da zmotivira prav vsakega učenca v razredu. Gre za taksonomski stopnji poznavanja in razumevanja preko naloge objektivnega tipa prav/narobe. Potrebno je izbrati pravilno rešitev ob ponujenih nepravilnih odgovorih. Predloga Udari krta! je visoko igrificirana, enako tudi njena različica Poči balon! (angl. Baloon pop). Tekmovalec se prebija iz začetne ravni v vse težje in zahtevnejše (skupno vseh je 20), pri čemer se zahtevnost stopnjuje s števili primerov, hitrostjo, v kateri je potrebno odreagirati, z nepravilnim odgovorom se točke odbijejo, igra se navidezno prekinja, tako da ima tekmovalec iz ravni v naslednjo raven (ang. level) možnost, da izboljša rezultat. Zelo stimulativno za tekmovalne učence. Ena od možnih izpeljav je, da organiziramo tekmovanje v dvojicah ali skupini treh na i-tabli pred sošolci.

Ker je orodje Wordwall z velikim naborom predlog izjemno enostavno, ga je možno izkoristiti tudi v smislu, da je učenec tisti, ki sestavi novo igrificirano interaktivno nalogo. V tem primeru izkazuje svoja vsebinska znanja na nivoju uporabe, na primer sestavi naloge z zapisom velike in male začetnice. Če pri pouku razvijamo veščino sodelovanja, naj oblikujejo v paru/skupini naloge na izbrani vsebini. V vsakem primeru jih podpremo s procesom FS-ja: ciljno jih usmerimo tako na veščino kot vsebino, z njimi oblikujemo merila uspešnosti, podpiramo jih s povratno informacijo, svoje dokaze o učenju naj objavljajo na forumu, ki je prostor diskusije oz. učnega pogovora. Dokazi o učenju, ki nastajajo (v tem primeru naloge, ki jih sestavijo sami), naj bodo nenehno vzorčni izdelki v smislu, kaj je dobro, na katerem delu pa bi se dalo še izboljšati.

Wordwall nam torej ponuja kar precej uporabnih igrificiranih predlog, s katerimi lahko pripravimo svoja interaktivna gradiva. Ker je veliko gradiva že pripravljenega s strani drugih izobraževalcev, velja pregledati za svoje področje, kaj uporabnega se najde. Že narejeno namreč lahko predelamo.

4 ZAKLJUČEK

Ali je spletna aplikacija Wordwall uporabna? Nedvomno, učenca z elementi igrifikacije in atraktivno grafiko, zvoki ipd. zelo pritegne. Učitelj naj premišljeno sestavi nalogo, nato pa naj znotraj procesa učenja dejavnosti sledi refleksija vsebine in procesa, tej pa vedno znova akcija – učenec naj ima torej učno priložnost, da izboljša svoje učenje. Potem ko se učenec z interaktivno nalogo formativno preveri, je smiselno, da se ne zadovoljimo s povratno informacijo tipa poznavanja rezultatov, ampak nastavimo proces tako, da se sproži nadaljnje učenje.

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Laboratorijske vaje pri fiziki – izzivi in možne rešitve pri poučevanju na daljavo

Physics laboratory work - challenges and possible solutions for online learning

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POVZETEK

Razglasitev epidemije v marcu 2020 zaradi velikega števila okužb s SARS-CoV-2 (COVID-19) nas je pripeljala do točke, ko smo morali začeti razmišljati o podajanju učne snovi na drugačen način, kot smo bili vajeni. Marsikaj, kar se nam je zdelo samoumevno, logično in edino prav, je sedaj postalo izziv. Predstavljam področje poučevanja, pri katerem sem se sama, kot profesorica fizike na splošni gimnaziji, srečala z največ izzivi; fizikalne laboratorijske vaje oz. njihova izvedba. V prispevku predstavim tri načine s katerimi lahko laboratorijske vaje predstavimo, izvedemo in posredujemo na daljavo. V zadnjem delu prispevka predstavim še rezultate ankete, ki sem jo izvedla konec šolskega leta 2019/2020 in se je nanašal na izvedbo vaj na daljavo.

KLJUČNE BESEDE

Poučevanje na daljavo, fizika, laboratorijske vaje

ABSTRACT

The declaration of a COVID-19 epidemic in March 2020 brought us to the point where we started thinking about teaching in a different way that we were used to. Many things that seemed self-evident, logical and right to do, has become difficult to achieve. As Physics teacher, in general grammar school I present area that I found most challenging. Physical laboratory exercises and their implementation. In this paper, I present three ways in which those experiments can be presented, implemented and transmitted in online learning. In the last part of the article, I present the results of a survey about the implementation of laboratory work that took place at the end of the 2019/2020 school year.

KEYWORDS

Online learning, physics, laboratory work

1 POUK NA DALJAVO

Učenje na daljavo vsekakor ni nekaj novega. Prvi zapisi o učenju na daljavo so znani iz Združenih držav Amerike iz leta 1800, kjer so bili učitelji in učenci iz Univerze v Čikagu na različnih lokacijah. Učenje je potekalo preko dopisnih tečajev. Prvo znano spletno učenje na daljavo je bilo izvedeno sredi osemdesetih let dvajsetega stoletja. Spletno poučevanje je nato začelo naraščati in razdalje med učitelji ter učenci so postajale nepomembne [1]. Vsekakor pa je zelo važno, da se učitelj zaveda, da je za uspešno poučevanje treba upoštevati nekaj načel [2]. Učitelj mora spodbujati učenčevo udeležbo, spodbujati mora njegovo sodelovanje, aktivno učenje ter podajati povratne informacije o napredku. Učitelj mora podariti čas, ki je predviden za posamezne naloge, upoštevati diferenciacijo ter pristope, ki jih učenci uporabljajo za učenje [3].

Tudi v Sloveniji pouk na daljavo poteka že kar nekaj časa. Uporabljajo ga dijaki, ki imajo status vrhunskega športnika ali kulturnika in zaradi obveznosti zaradi treningov in vaj ne morejo biti prisotni pri pouku. Učitelji so tem dijakom že sedaj ponujali učenje na daljavo. Vendar v teh primerih govorimo o individualnih načrtih. V marcu 2020 smo se v Sloveniji prvič vsi učitelji srečali s poučevanjem na daljavo v večjem obsegu. Izkazalo se je, da na to nismo bili pripravljeni, prav tako nismo poznali opreme, računalniških programov, ki bi nam to omogočali. Vsak učitelj se je poskušal znajti po svoje. Aktivno sodelovanje med šolskimi aktivi je omogočilo hitro napredovanje v znanju učenja na daljavo.

Pri predmetu fizika je v prvih treh letih v programu splošnih gimnazij je na letnem nivoju predvidenih 10 ur laboratorijskih vaj dijakov [4]. Področja iz katerih si učitelj vaje izbere so lahko poljubna in prosta izbira učitelja, saj je izvedba vaj odvisna od eksperimentalne opreme, ki je dosegljiva v šoli. Pri učenju na daljavo je bila možnost izbire vaj še večja prednost, kot sicer. Na ta način lahko učitelj izbere laboratorijske vaje, kjer zagotovi opremo doma, vajo posname, poišče simulacijo, ki mu omogoča prikaz fizikalnih zakonitosti ali pa razmisli o opremi, katera je dosegljiva tudi dijakom doma in si vajo pripravijo iz domačih pripomočkov. Sama sem tekom poučevanja na daljavo preizkusila tri možnosti, ki so v nadaljevanju opisane.

2 LABORATORIJSKIE VAJE NA DALJAVO

2.1 Posnetek laboratorijske vaje

Prva možnost, ki jo predstavljam, je posnetek vaje. Vajo, ki jo želimo predstaviti dijakom posnamemo, ko jo sami izvajamo v razredu [slika 1]. Dijakom posnetek vaje posredujemo ter pripravimo pripadajoče učne liste, kjer dijaki s pomočjo posnetka ugotavljajo glavne zakonitosti.
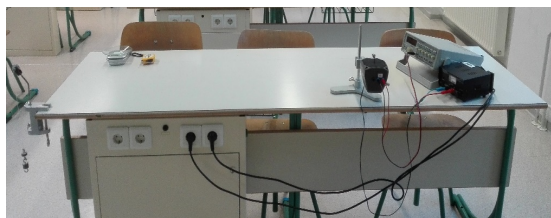
Slika 24. Izsek iz posnetka laboratorijske vaje, ki sem jo posnela v šoli s šolskimi pripomočki; vaja: Stoječe valovanje na vrvi.

Prednosti, ki bi jih izpostavil pri tem podajanju vaje je, da se izognemo težavam z opremo. Dijakom posredujemo vajo, ki je bila že v začetku predvidena. Posnetek vaje lahko posredujemo dijakom preko ustaljenega komunikacijskega kanala. S tem ne povzročamo dodatnih stresorjev. Prednost je tudi, da vajo posnamemo na način, da dijaki pravilno vidijo pojav, na katerega se osredotočamo ter vaja v tem pogledu vedno »uspe«. Vsi dijaki imajo enake podatke in na ta način lažje primerjajo pridobljene rezultate, kar pa je hkrati lahko tudi slabost. Enaki rezultati so lahko pridobljeni na način, ki ni primeren - prepisovanje. Slabost, ki bi jo nadalje izpostavila je, da dijaki nimajo stika z opremo. Ravnanje z opremo in inštrumenti je del učenja, ki ga v tem primeru izgubimo. Prav tako učitelj nima nadzora nad postopkom usvajanja znanja. Postavljanje vprašanj med vajo namreč ni mogoče. Vse nejasnosti, vprašanja in dileme se lahko razrešijo šele, ko je ura namenjena diskusiji rezultatov.

2.2 Računalniška simulacija laboratorijske vaje

Dijaki lahko vaje izvajajo tudi preko simulacij. Našla sem kar nekaj virov vaj, ki jih lahko posredujemo preko simulacij. Na univerzi v Coloradu Boulder so leta 2002 izdelali brezplačne simulacije iz fizike na portalu PHET. Omenjene simulacije sem uporabljala že pred pričetkom pouka na daljavo. Takrat nisem imela primerne opreme za izbrano vajo. V času učenja na daljavo so se simulacije izkazale za izvrstno orodje [slika 2]. Glavna prednost izvajanje vaj preko računalniških simulacij je, da dijaki raziščejo več fizikalnih pojavov sočasno. Dijak izvaja vajo v njemu ustreznem tempu, prednost je tudi, da vajo lahko ponovi ter sam spreminja parametre. Hkrati pa je spreminjanje velikega števila parametrov tudi manjša slabost. Vaja s spreminjanjem vseh spremenljivk postane dolga, ali celo nepregledna. Dijak izgubi rdečo nit vaje.
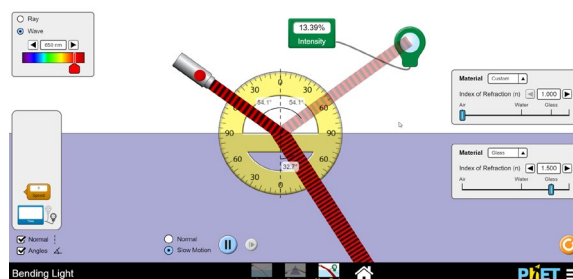
Slika 25. Posnetek zaslona računalnika, kjer je prikazana simulacija iz portala PHET; vaja: Lomni in odbojni zakon.

2.3 Naredi sam

Zadnja možnost, ki jo predstavljam v tem prispevku je izvedba laboratorijske vaje na način "naredi sam". Pri izvedbi te vaje mora biti učitelj zelo pozoren na izbiro vaje ter pripomočkov, ki jih morajo učenci imeti doma. Pri izbiri teh vaj je po mojem mnenju učitelj najbolj omejen na izbiro fizikalnega področja, kjer je vaja izbrana. Vsekakor ima tip laboratorijske vaje "naredi sam" kar nekaj prednosti. Poudarila bi, da morajo dijaki aktivno razmišljati že pri postavitvi vaje, ki jo bodo izvajali. Izkazati se morajo pri izbiri priporočenih pripomočkov ter sami izvedbi vaje. Če učitelj pripravi učne liste za pripadajočo vajo, dijaki relativno natančno raziščejo fizikalne lastnosti. Pri vajah tega tipa, ki sem jih posredovala dijakom, so dijaki meritve izvajali s pomočjo aplikacije Phyfox [slika 3], ki so si jo namestili na pametne telefone. Izvedba teh vaj je bila zelo zanimiva in je dala uporabne rezultate. Bistvena prednost tega pristopa so zelo natančne meritve in dostopna tehnologija. Dotična aplikacija je brezplačna. Dijaki pa imajo skoraj vsi, brez izjeme, ustrezne pametne telefone. Hkrati pa so pri uporabi telefonskih aplikacij zelo vešči. Slabost te vaje je nedostopnost vseh pripomočkov pri dijakih doma. S tem nekaterih fizikalnih področij ni mogoče izvesti oziroma so težje izvedljiva. Tak primer je npr. dušeno nihanje, saj večina dijakov doma nima primerne vzmeti.
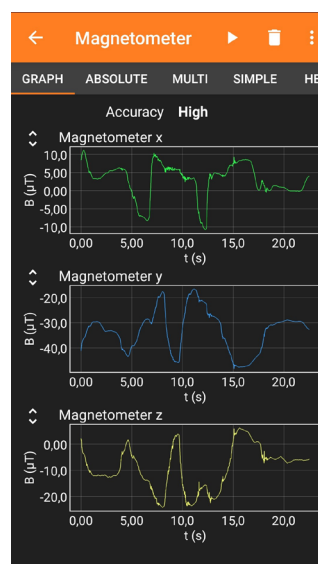
Slika 26: Posnetek zaslona pametnega telefona pri uporabi aplikacije Phyfox; vaja: Raziskovanje zemeljskega magnetnega polja.

3 MNENJA DIJAKOV

Zaradi lastne izkušnje s poučevanjem na daljavo, me je po končanem šolskem letu 2019/2020 zanimalo, kako so ta način poučevanja občutili dijaki. Predvsem me je zanimalo, katera od zgoraj opisanih oblik laboratorijskih vaj se jim je zdela najučinkovitejša. Vprašalnik sem poslala vsem dijakom, ki sem jih v šolskem letu 2019/2020 poučevala. 80% dijakov je anketo v celoti izpolnilo. 85% teh dijakov je posredovane vaje ocenilo, kot dobre ali zelo dobre. Najbolj všeč jim je bila vaja podana kot računalnička simulacija. Najmanj jim je bilo všeč iskanje podatkov iz posnete vaje.

ZAHVALA

Zahvaljujem se aktivu matematike in fizike na Gimnaziji Franceta Prešerna, ki me je v času učenja na daljavo podpiral.

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ACM Tekmovanja – Pišek, tekmovanje v programiranju z delčki

ACM Competitions – Pišek, visual programming language competition

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POVZETEK

Vzpodbujanje k učenju računalništva preko računalniških tekmovanj je razširjeno povsod po svetu, tudi v Sloveniji. V zadnjih nekaj letih je ACM Slovenija s tekmovanji pokrila skoraj celotno populacijo učečih se, od najmlajših udeležencev do študentov. Vendar podatki kažejo, da se število udeležencev na prehodu od osnovnošolskih do srednješolskih tekmovanjih zelo zmanjša. Zato smo pripravili novo tekmovanje Pišek – tekmovanje v programiranju z delčki, ki naj bi povezoval tekmovanje v računalniškem mišljenju in tekmovanje v programiranju.

Večji del članka predstavlja tekmovanje samo. Navedenih je nekaj podatkov o poskusnih tekmovanjih, ki smo ju izvedli v letu 2020, ter opisano, kako smo prišli do take strukture tekmovanja. Članek zaključimo s predstavitvijo tekmovanja, kot ga načrtujemo v šolskem letu 2020/2021.

KLJUČNE BESEDE

Računalniško tekmovanje, programiranje z delčki, Blockly, poučevanje programiranja

ABSTRACT

Promoting computer science through programming competitions is widespread all around the world, also in Slovenia. In the last years ACM Slovenia established almost a complete vertical line of competitions aimed from the youngest up to the university students. As a huge gap in attendance between primary and secondary school, we started to prepare a new competition, named Pišek - Programming with Blocks Competition with the goal to address the area between Computational thinking and problem solving with programming and algorithms.

The main part of the paper is the presentation of the competition. We discuss some of the decisions about its structure. Some data about the two trial competitions we conducted in 2020 are presented. We conclude with a description of our plans for school year 2020/2021.

KEYWORDS

Programming competition, visual programming language, Blockly, teaching programming

1 UVOD

Splošno velja, da je sodelovanje na različnih tekmovanjih lahko koristna učna izkušnja. Kot pravi Katz v [5] lahko tekmovanje naredi poučevanje različnih predmetov bolj privlačno. Enako velja tudi za poučevanje in učenje računalništva. Dagiene v [3] trdi, da so računalniška tekmovanja lahko ključ k novemu znanju in atraktiven način za povezovanje tehnologije in izobraževanja.

Zasledimo lahko različne oblike tekmovanj, ki pokrivajo različna področja računalništva od robotike, umetne inteligence do uporabe pisarniških orodij. Prav tako se izvajajo v različnih oblikah (glej npr. Plohl [7]). Lahko so enodnevna tekmovanja, lahko zasnovana kot večmesečna priprava in predstavitev izdelka, lahko kot reševanje določenega skupka nalog. V strokovnih krogih se vodi živahna razprava, kakšna oblika je najprimernejša v povezavi z učnim procesom. Vendar je še vedno prevladujoča oblika računalniških tekmovanj reševanje programerskih nalog, torej oblika, kot jo uporablja Mednarodna olimpijada iz informatike (IOI [4]). Tekmovalci rešujejo naloge, ki zahtevajo rešitev določenega algoritmičnega problema v obliki programov. Pravilnost teh programov se preverja avtomatsko in temelji na primerjavi izhodnih rezultatov.

2 RAČUNALNIŠKA TEKMOVANJA V SLOVENIJI

Računalniška tekmovanja imajo v Sloveniji zavidljivo zgodovino. Vse se je začelo že leta 1977 z idejo o organizaciji tekmovanja, ki bi dopolnjevalo poučevanje računalništva, ki so ga od šolskega leta 1971/1972 poskusno izvajali na nekaj srednjih šolah [11 šola, Batagelj/Krapež …]. Kot kažejo podatki v Tabeli 1, povzeti iz [1], je bilo tekmovanje zelo dobro sprejeto.

Kot pravi Grobelnik v [2] "se je na slovenskih srednješolskih računalniških tekmovanjih prekalilo veliko generacij dijakov, ki dandanes po večini predstavljajo okostje slovenske računalniške skupnosti. Bivši tekmovalci so dandanes profesorji na univerzah,

raziskovalci na institutih, predvsem pa si brez njih ni mogoče predstavljati slovenske računalniške industrije."

Tabela 6. Število tekmovalcev v prvih letih

1977	47
1978	79
1979	92
1980	88
1981	101
1982	101
1983	137
1984	213

V teh štirih desetletjih je poučevanje računalništva dosegalo svoje vzpone in padce, pojavljala so se različna mnenja glede vsebine predmetnika in oblike izvedbe z računalništvom povezanih predmetov. Top je vsekakor vplivalo tudi na tekmovanja in danes lahko slovenski učenci, dijaki in študenti sodelujejo na zelo različnih tipih računalniških tekmovanj. Omejili se bomo na tekmovanja, ki potekajo v sklopu ACM Slovenija (Slika 27).
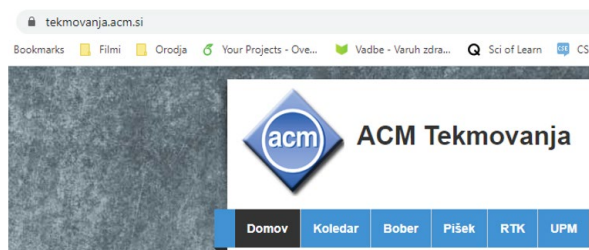
Slika 27. Tekmovanja v okviru ACM Slovenija

Trenutno so uradna tekmovanja pod okriljem ACM Slovenija tri:

- Bober - Mednarodno tekmovanje iz računalniškega razmišljanja

- RTK - Srednješolsko tekmovanje ACM iz računalništva in informatike

- UPM - Univerzitetni programerski maraton

Prvi dve tekmovanji sta namenjeni predvsem osnovno in srednješolcem, tretje pa univerzitetnim študentom. Vsa so po svoji osnovni obliki zasnovana in vpeta v mednarodna tekmovanja (Bebras, IOI in ACM ICPC). V Tabeli 2 so zbrani podatki zadnjih 10 let tekmovanj. Ker imajo tekmovanja različne nivoje, so podatki dani za prvi, najmnožičnejši, šolski nivo. Tam ni omejitve glede števila udeležencev.

Kot kažejo podatki, obstaja precejšen "prepad" med številom sodelujočih na tekmovanju Bober in na tekmovanju ACM RTK.

Tako sta A. Brodnik in M. Lokar od leta 2015 dalje imela številne razgovore o tekmovanju za "vmesno stopnjo", še posebej pa po uvedbi izbirnega predmeta Računalništvo v drugi triadi OŠ. Primarna naloga tega tekmovanja naj bi bila popularizacija učenja programiranja.

Tabela 7. Število tekmovalcev osrednjih tekmovanj ACM v zadnjih letih

leto	Bober	RTK	UPM
2011/2012	3380	273	174
2012/2013	8147	234	153
2013/2014	11653	278	159
2014/2015	16797	306	210
2015/2016	24714	309	186
2016/2017	29124	351	171
2017/2018	29561	310	156
2018/2019	33356	341	126
2019/2020	28803	306	123

Skupna ugotovitev še z drugimi kolegi je bila tudi ta, da naj bi bilo to tekmovanje v reševanju problemov z zapisom algoritmov, kjer bi kot programski jezik uporabljali programski jezik z delčki, kot so na primer Scratch, Snap in podobni. Predvsem na pobudo J. Demšarja je bila sprejeta odločitev, da pri tekmovanju ne bi uporabili jezika Scratch, pa čeprav je bil (in je še) ta po slovenskih šolah med vsem jeziki, ki omogočajo programiranje z delčki, najbolj razširjen. Podlaga za to odločitev je bilo prepričanje, da Scratch prvenstveno ni programski jezik, namenjen reševanju problemov in zapisu algoritmov, ampak bolj jezik in okolje, namenjeno ustvarjalnemu izražanju učencev. Prav tako je pri Scratchu velik poudarek na medsebojnem sodelovanju učencev, deljenju izdelkov in njihovemu spreminjanju ([6]).

Zelo smeli načrti glede tekmovanja so bili taki, da bi poskusili zajeti med četrtino in polovico sodelujočih na tekmovanju Bober. Ker to pomeni, da naj bi sodelovalo med 8 in 14 tisoč tekmovalci, je bilo očitno, da je potreben sistem, ki bi omogočal avtomatsko preverjanje pravilnosti rešitev.

Na srečo smo leta 2017 na mednarodni delavnici za pripravo nalog za tekmovanje Bober navezali stike s kolegi iz Francije. Spoznali smo njihov sistem Algorea (http://www.france-ioi.org). Ta izstopa med tistimi redkimi sistemi za preverjanje pravilnosti programskih rešitev, ki podpirajo jezike za programiranje z delčki.

V sodelovanju s kolegi iz Francije smo njihov sistem priredili za uporabo tudi v slovenskem jeziku, ga poimenovali Pišek in postavili na spletni naslov https://pisek.acm.si/. Pri prevajanju in postavitvi sistema so sodelovali G. Jerše, M. Lokar in J. Vičič, G. Anželj pa je prispeval prevod jezika Blockly.

Naslednjega leta, 2018, so v okviru ŠPIK projekta ProNAL študentje različnih fakultet Univerze v Ljubljani pod vodstvom M. Lokarja in G. Jeršeta sestavili nekaj nalog za Piška in pokazalo se je, da bi na sistemu Pišek lahko vzpostavili tekmovanje, ki bi bil most med Bobrom (tekmovanjem v računalniškem razmišljanju) in ACM RTK-jem (tekmovanju v algoritmih).

Konec leta 2018 sta dva študenta (K. Špenko in Ž. Flajs) v sodelovanju z M. Lokarjem dodala vrsto nalog. Prav tako so se uvedli novi tipi nalog. Še bolj pa je Pišek postal uporaben spomladi 2019, ko so v okviru novega ŠPIK projekta Pišek študentje pod vodstvom M. Lokarja, G. Jeršeta in K. K. Ošljak v sam sistem dodali preko 300 različnih nalog.

3 PIŠEK – TEKMOVANJE V PROGRAMIRANJU Z DELČKI

3.1 Priprava poskusnega tekmovanja

Ker smo s šol dobivali zelo pozitivna mnenja glede uporabe sistema Pišek in ker je želja, premostiti omenjeni prepad v številu udeležencev res velika, smo se odločili poskusiti s tekmovanjem.

Septembra 2019 je M. Lokar na sestanek povabil učitelje z osnovnih in srednjih šol ter profesorje s fakultet, ki so že prej sodelovali pri tekmovanjih ACM. Odzvalo se jih je 19, iz zelo različnih ustanov – osnovnih šol, srednjih šol, z univerz, Zavoda RS za šolstvo. Decembra 2019 je ACM Slovenija formalno ustanovil Programski svet Tekmovanja Pišek.

Razdelili smo se v skupine, določili vodje in začeli priprave. Poleg najbolj očitnega, torej nalog, smo potrebovali še tekmovalce.

Slika 28. Spletišče tekmovanja Pišek

3.2 Izvedba prvega poskusnega tekmovanja

V šolskem letu 2019/2020 smo načrtovali tri poskusna tekmovanja, preko katerih bi lahko dobili čim več izkušenj, na podlagi teh pa bi v šolskem letu 2020/2021 pripravili prvo »pravo« tekmovanje.

Večina sodelujočih pri organizaciji tekmovanja smo bili hkrati tudi mentorjih učencem in dijakom. Povabili pa smo še nekaj učiteljev osnovnih in srednjih šol, vendar smo pazili, da število ne bi bilo preveliko, saj nismo poznali zmožnosti francoskega strežnika. Vedeli smo tudi, da nas po tekmovanju čakajo obsežnejše vsebinske analize. Zanimalo nas je predvsem, kako smiselno razdeliti tekmovalce v kategorije in katere programske koncepte uporabiti.

Tekmovanje smo izvedli v petih kategorijah glede na starost tekmovalcev:

- 4. in 5. razred osnovne šole,
- 6. in 7. razred osnovne šole,
- 8. in 9. razred osnovne šole,
- 1. in 2. letnik srednje šole,
- 3. in 4. letnik srednje šole.

Tekmovalci so imeli na voljo 40 minut, naloge so lahko oddajali večkrat, sistem pa jim je takoj javil, ali je naloga rešena pravilno ali ne.

Slika 29. Primer naloge za 4. in 5. razred

Večina nalog za osnovno šolo je bila v obliki naloge na mreži, kjer se glavna figura premika in izvaja »naloge«. Pogosto smo uporabili tudi naloge z želvjo grafiko.

Pri sestavljanju nalog se je pokazala tudi prednost uporabe jezika Blockly, saj ta omogoča, da v programsko okolje dodajamo delčke s čisto novimi ukazi kot npr. poberi lešnik, naberi med, izvedi pirueto … Tako so delčki, ki so sicer konceptualno enaki (na primer, naredi nekaj s predmetom, ki je na polju, kjer je trenutno lik), v različnih nalogah poimenovani različno (poberi plastenko, pojej deteljico …) Prav tako pri sestavljanju naloge tvorimo nove delčke in tako v posamezni ukaz "skrijemo" določeno kompleksnost (npr. v nalogi uporabimo delček "nariši kvadratek" ali pa "preberi podatke v tabelo")

Prav tako smo sledili določenim dognanjem s področja didaktike računalništva in med nalogami večkrat uporabili tudi tipe nalog, kjer problem že vsebuje napisan program, ki pa ga je bilo potrebno ali popraviti ali pa le urediti.

Pri prvem poskusnem tekmovanju februarja 2020 je sodelovalo 10 osnovnih in 7 srednjih šol oz. 374 učencev in 269 dijakov. Njihov odziv je bil odličen. Tekmovalce in mentorje smo pozvali, da po tekmovanju izpolnijo anketo, s katero smo pridobili povratne informacije. Mentorji so pohvalili sistem, pripravljenost, obveščanje, tekmovalci so bili večinoma zadovoljni z nalogami in si takega tekmovanja želijo.

Tabela 8. Rezultati prvega poskusnega tekmovanja

Kategorija	Št. tekm.	Št. možnih točk	Povp. št. doseže-nih točk	Št. tekm. z vsemi točkami	Št. tekm. z 0 točkami
4. in 5. razred	179	600	417	92	24
6. in 7. razred	167	600	233	7	18
8. in 9. razred	48	600	252	1	10
1. in 2. letnik	203	500	59	4	131
3. in 4. letnik	66	500	59	0	42

3.3 Priprava in izvedba drugega poskusnega tekmovanja

Pri načrtovanju drugega poskusnega tekmovanja smo upoštevali rezultate tekmovanja ter mnenja, ki smo jih dobili preko anket, ki so jih izpolnili tekmovalci in mentorji po prvem poskusnem tekmovanju. Tako smo upoštevali dejstvo, da so bili tekmovalci v nekaterih kategorijah izjemno uspešni (npr. v kategoriji 4. in 5. razred je izmed 179 tekmovalcev kar 92 njih prejelo vse točke), v nekaterih kategorijah pa so bili rezultati zelo slabi (v kategoriji

3. in 4. letnih dveh nalog ni rešil nihče od tekmovalcev, v kategoriji 1. in 2. letnik več kot polovica tekmovalcev ni dosegla nobene točke) – več prikazuje Tabela 8. Prav tako smo imeli številne razgovore glede primernosti starostne razdelitve v luči besedil nalog ter kako upoštevati zelo različno predznanje učencev istih starostnih kategorij. Zato smo se odločili, da spremenimo kategorije. Med tekmovalci v osnovni šoli so velike razlike, ki pa niso odvisne od njihove starosti, ampak predvsem od tega, koliko let so obiskovali izbirni predmet računalništvo. Seveda je treba upoštevati tudi kognitivni razvoj otrok in učni načrt v šoli. Tako so nastale nove kategorije:

- 4.-6. razred osnovne šole – začetniki
- 4.-6. razred osnovne šole – napredni
- 7.-9. razred osnovne šole – začetniki
- 7.-9. razred osnovne šole – napredni
- Srednja šola – začetniki
- Srednja šola – napredni
- Srednja šola – poznavalci

Drugo poskusno tekmovanje je bilo načrtovano v mesecu aprilu 2020, vendar je prišlo do epidemije in smo morali najti novo rešitev. Izpeljali smo poskusno odprto spletno tekmovanje, ki pa žal ni bilo tako obiskano, kot smo si želeli. Prav tako smo preko anket dobili precej manj povratnih informacij s strani mentorjev in tekmovalcev. Sodelovalo je 296 tekmovalcev, večina med njimi se je preizkusila v več kategorijah. Oglejmo si povzetek rezultatov tekmovanja po kategorijah (vsi rezultati so objavljeni na spletni strani https://tekmovanja.acm.si/?q=node/618):

Tabela 9. Rezultati drugega poskusnega tekmovanja

Kategorija	Št. tekm.	Št. možnih točk	Povp. št. dosežemih točk	Št. tekm. z vsemi točkami	Št. tekm. z 0 točkami
4.-6. razred začetniki	170	500	269	35	17
4.-6. razred napredni	54	500	103	3	23
7.-9. razred začetniki	80	600	136	7	40
7.-9. razred napredni	35	600	100	2	24
srednja šola začetniki	63	500	198	12	29
srednja šola napredni	12	500	291	3	2
srednja šola poznavalci	10	600	300	4	4

Kot vidimo, je daleč največ tekmovalcev sodelovalo v kategoriji 4.-6. razred ZAČETNIKI, kjer je tudi največ tistih, ki so dosegli vse možne točke. Nekoliko zaskrbljujoče je dejstvo, da v več kategorijah polovica tekmovalcev ni dobila nobene točke, v kategoriji 7.-9. razred – napredni pa je takih skoraj 70 %. Vendar je podrobnejša analiza zapisov tekmovalnega sistema pokazala, da velika večina teh sploh ni poskusila nalog reševati »zares«, ampak so si naloge le ogledali. Možno je tudi, ker je tokratni način omogočal, da so se z istim uporabniškim imenom lotili reševati naloge v več kategorijah, da se med tekmovanjem v eni in drugi kategoriji niso odjavili in ponovno prijavili in jim je zato zmanjkalo časa.

Število doseženih točk je precej bolj enakomerno razporejeno kot pri prvem poskusnem tekmovanju, zato ustvarjalci tekmovanja ocenjujemo, da smo bolj primerno razvrstili kategorije in izbrali naloge, ki so omogočale realno razvrstitev.

Zelo malo tekmovalcev se je odločilo za reševanje nalog v najtežji kategoriji Srednja šola – poznavalci, zato smo se odločili, da v prihodnjih tekmovanjih te kategorije verjetno ne bo. Verjamemo pa, da, ko se bodo učenci, dijaki in mentorji sistema navadili, da se jih bo več opogumilo in se preizkusilo v najtežjih kategorijah. Hkrati pričakujemo, da se bodo tisti najspretnejši raje udeležili tekmovanj, kjer se programira v »pravih« programskih jezikih, s tem pa bo naš cilj, da zapolnimo vrzel med Bobrom in RTK tekmovanjem izpolnjen.

3.4 Tretje poskusno tekmovanje

Tretjega poskusnega tekmovanja iz očitnih razlogov nismo izpeljali. Kljub vsemu smo se odločili, da bomo v šolskem letu 2020/2021 izpeljali pravo tekmovanje. Predvideni termin je februar 2021.

Vse naloge z obeh poskusnih tekmovanj so dostopne na spletni strani https://pisek.acm.si, kjer objavljamo tudi naloge za pripravo na tekmovanje.

4 TEKMOVANJE V ŠOLSKEM LETU 2020/2021

Oglejmo si nekaj vodil, ki sestavljavce vodijo pri načrtovanju in izbiri nalog za tekmovanje.

4.1 Kategorije in programski koncepti

Ob določitvi sedmih tekmovalnih kategorij smo določili tudi, kateri programski koncepti bodo uporabljeni v izbranih tekmovalnih nalogah za posamezno kategorijo. Seznam je objavljen na spletni strani tekmovanja, na https://tekmovanja.acm.si/?q=pisek/tekmovalne-kategorije. Seveda ni nujno, da bodo v nalogah za posamezno tekmovanje pokriti vsi našteti koncepti.

Tako bodo mentorji lažje svetovali svojim tekmovalcem pri izbiri kategorije.

4.2 Naloge

Posamezna kategorija vsebuje 5 ali 6 nalog. Naloge so različnih tipov. Tako določene naloge zahtevajo, da tekmovalci sestavijo program. Spet druge so naloge Parsonsovega tipa, torej morajo tekmovalci dane ukaze urediti v ustrezno zaporedje, pri tretjih pa je potrebno v danem programu poiskati in odpraviti napake.

Naloge vsebujejo različne programske koncepte in so različnih težavnostnih stopenj. Praktično pri vseh kategorijah pazimo, da je vsaj ena naloga taka, da jo lahko rešijo vsi tekmovalci,

Naloge za osnovno šolo so večinoma naloge na mreži (Slika 30).

Slika 30. Naloga na mreži z več testi

Pogoste so tudi naloge z želvjo grafiko (Slika 31).
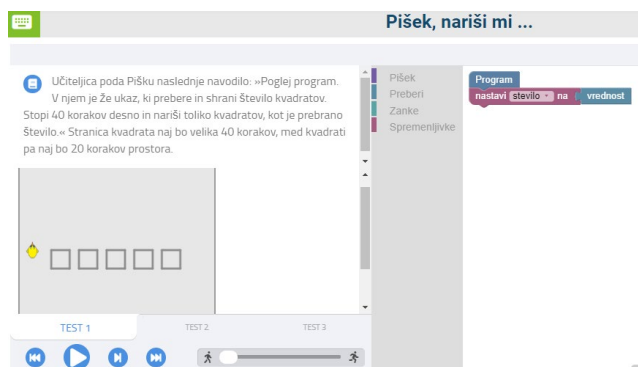
Slika 31. Naloga z želvjo grafiko

Nekaj (predvsem med nalogami za srednjo šolo) pa je tudi "klasičnih" programerskih nalog, kot je na primer ta, prikazana na Slika 32.

Slika 32. "Klasična" programerska naloga

Naloge lahko otežimo na različne načine. Predvsem pri mlajših kategorijah se je pokazalo, da je precejšnja razlika, če pri nalogi ponudimo tudi nepotrebne delčke (in jih morda še "skrijemo" v kategorije – npr. naloga na Slika 30) ali pa so dani le delčki, potrebni za rešitev (npr. naloga na Slika 33).

Prav tako lahko nalogo otežimo, če omejimo število delčkov, ki jih lahko uporabi program (glej podatek desno zgoraj pri nalogi na Slika 33).

Slika 33. Naloga z omejitvijo števila delčkov

Tako je naloga *Pišek pospravlja smeti* rešljiva le z uporabo delčkov, ki se nanašajo na premikanje ter z delčkoma poberi plastenko in pospravi plastenko. Vendar bi v tem primeru tekmovalec potreboval 18 delčkov. A pri tej nalogi piše, da je na voljo le 11 delčkov. Torej mora tekmovalec uporabiti zanko ponavljaj in s tem zmanjšati število ukazov v svojem programu. Kakor hitro program porabi preveč delčkov, sistem rešitve ne sprejme, niti je ne »pregleda«. Takrat le zapiše, »Uporabljaš preveč delčkov!« (Slika 34).

Slika 34. Opozorilo ob uporabi prevelikega števila delčkov

Prav tako pri nalogah, ki preverjajo zahtevnejše programske koncepte, pogosto uporabimo več testov. Vsi so tekmovalcem vidni. Prav tako sistem označi, kateri testi so bili opravljeni in kateri ne (**Error! Reference source not found.**). Z uporabo več testov se izognemo temu, da bi tekmovalci rešili nalogo, ki bi delovala izključno za dane vhodne podatke.
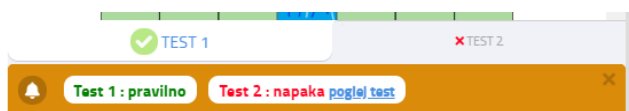
Slika 35. Rezultati testov

Primer take naloge je *Pišek gre čez reko*.

Slika 36. Naloga z več testi – Test 1

Slika 37. Naloga z več testi – opozorilo

Na Slika 36 vidimo, kako bi tekmovalec lahko rešil prvi test zgolj z osnovnim poznavanjem zaporedja ukazov. Vendar pa to zaporedje ne reši drugega testa. Ko program zaženemo, se izpiše opozorilo, da je ob izvajanju drugega testa prišlo do napake (Slika 37).

Opozoriti velja, da je zasnova tekmovanja taka, da delne rešitve (in s tem del točk) niso predvidene. Naloga mora biti rešena v celoti.

4.3 Termin tekmovanja

V koledarju je že veliko tekmovanj. Določiti primeren termin je precej zahtevno. Poleg tekmovanj so tu obdobja, ko so učenci, dijaki in učitelji dodatno obremenjeni z ocenjevanjem, nacionalnimi poskusi znanja, maturo, ali pa so celo odsotni zaradi obvezne prakse. Po obširnem usklajevanju smo se odločili, da bomo izvajali tekmovanje v februarju. Glede na to,

da bo tekmovanje potekalo (tako kot tekmovanje Bober) vsaj teden dni (posamezen mentor bo sam izbral enega ali več terminov v sklopu odprtosti tekmovanja) menimo, da bodo vsi, ki jih sodelovanje zanima, lahko tekmovali. Pri določitvi datuma smo upoštevali, da bomo v prihodnjih letih tekmovanje morda nadgradili tudi s tekmovanjem na državni ravni.

5 ZAKLJUČEK

Želja ustvarjalcev Piška in organizatorjev ACM tekmovanja v programiranju z delčki ni organizirati še eno tekmovanje, ki bi le preverjalo poznavanja programiranja, temveč ta, da bi se čim več učencev in dijakov sploh srečalo s programiranjem in ugotovilo, kako zabavna dejavnost je to lahko.

Celotna organizacija tekmovanja poteka na povsem prostovoljni osnovi. Sodelujejo študentje, učitelji in profesorji, ki verjamejo, da je programiranje veščina, ki nam pride prav na vseh področjih in ki želijo, da bi stavek »Programiranje je težko.« zamenjal stavek »Programiranje je zabavno.«.

Vse, ki vas sodelovanje pri tekmovanju na kakršen koli način zanima (sestavljanje nalog, prispevanje idej za naloge, sodelovanje pri organizaciji, pri tehničnem razvoju portala Pišek, pri razgovorih o primernosti določene naloge…), vabimo, da nam pišete na naslov pisek@acm.si. Prav vsak sodelavec je resnično dobrodošel!

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Uporaba Sistema Pišek pri pouku neobveznega izbirnega predmeta računalništvo

Teaching elective subject computing using system Pišek

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POVZETEK

V članku je v prvem delu predstavljen Sistem Pišek, spletna storitev, ki vsebuje bogato zbirko nalog s samodejnim preverjanjem pravilnosti rešitev. Naloge rešujemo s pomočjo programskega jezika Blockly, ki omogoča programiranja z delčki. V drugem delu prispevka je opisan način uporabe Piška pri poučevanju osnovnih konceptov programiranja pri neobveznem izbirnem predmetu računalništvo, ki se izvaja v drugi triadi OŠ. Pri tem je predstavljeno tako delo v razredu, kot tudi uporaba Piška v drugem delu šolskega leta 2019/2020, ko je bil pouk izvajan na daljavo.

KLJUČNE BESEDE

Poučevanje, osnovna šola, programiranje, programski koncepti, programiranje z delčki, delo na daljavo, Blockly

ABSTRACT

The first part of the article presents Pišek, a system with a rich collection of automatic verifiable problems. Problems are being solved in visual programming language. The second part of the article describes the usage of the system in teaching basic programming concepts in the elective subject Computing attended by pupils in the second triad of the primary school. The article presents work in classroom as well as the usage of Pišek in the second part of the school year 2019/2020 when distance learning has been used.

KEYWORDS

Teaching, elementary school, computer programming, programming concepts, visual programming languages, distance learning and teaching, Blockly

1 UVOD

Programiranje je veščina. Od posameznika zahteva natančnost in doslednost. Lastnosti, ki nam pogosto prideta prav v življenju, vsekakor pa tudi učencem pri poljubnem predmetu v šoli. In pri

tem navajanju na natančnost in doslednost lahko izrabimo lastnosti računalnika. Ta ne upošteva čustev in obrazne mimike, ne bere misli, ne predvideva, kaj smo želeli povedati, pa smo se samo nerodno izrazili in podobno. Računalnik naredi le tisto, samo tisto in točno tisto, kar smo mu »ukazali«.

V osnovni šoli je eden od ciljev pri neobveznem izbirnem predmetu računalništvo, ki se izvaja v drugi triadi, tudi ta, da znajo učenci algoritem zapisati s programom v nekem programskem jeziku. Programski jeziki, kot so Java, C, Python in podobni, so za osemletnike, ki se prvič srečujejo s programiranjem, izredno zahtevni. Poleg tega, da se morajo naučiti »programerskega« razmišljanja, morajo usvojiti še sintakso in semantiko, ki sta pri vsakem jeziku drugačni. Učenja programiranja pri najmlajših (in tudi pri starejših začetnikih) se je veliko lažje lotiti s programskimi jeziki, kjer programa ne tipkamo, ampak ga zložimo iz predpripravljenih delčkov. Na ta način se izognemo tipkarskim napakam, napačni uporabi presledkov, uporabi velikih in malih črk, manjkajočim podpičjem na koncu vrstic in drugim sintaktičnim napakam. Učenci se lahko osredotočijo le na pomembnost vrstnega reda ukazov, uporabe zank, pogojnih stavkov in podobno.

Pri učenju je eden od najpomembnejših elementov povratna informacija. Hitrejša in natančnejša je, bolj je smiselna in uporabna. A pri reševanju problemov s programiranjem je pogosto več poti do rešitve. Zato večinoma splošna in enovita povratna informacija ni možna. To pomeni, da mora učitelj pregledati vsako oddano nalogo posebej. Če ima v razredu 25 učencev, je precej nemogoče hitro pregledati vse, kar so učenci v eni uri ustvarili in jim hitro dati kvalitetno povratno informacijo. Zato so orodja, ki učitelju pomagajo pri pripravi povratnih informacij tako pomembna.

2 O SISTEMU PIŠEK

Sistem Pišek je portal, namenjen uporabi v slovenskem šolskem prostoru kot pomoč pri poučevanju programiranja. Je javno dostopen in njegova uporaba je povsem prosta.

Osnutek portala je nastal leta 2018 na osnovi francoskega sistema Algorea, ko so v okviru ŠIPK projekta ProNAL študenti pod vodstvom M. Lokarja in G. Jeršeta sestavili prvih nekaj nalog za Piška. Sam sistem pa je postal uporaben za splošno rabo, ko se je leta 2019 v sklopu projekta Naloge za poučevanje in učenje računalniškega mišljenja – Portal Pišek (NPUR), pri katerem so sodelovali Fakulteta za matematiko in fiziko Univerze v Ljubljani, Kreativni center Poligon ter Code Week

Slovenija, močno razširila baza nalog, ki jih lahko rešujemo na Pišku.

Nadaljnji razvoj Sistema Pišek je v letu 2019/2020 potekal v sklopu priprav na izvedbo ACM Tekmovanja v programiranju z delčki. Sama priprava na tekmovanje in izvedba dveh poskusnih tekmovanj so močno razširili obstoječo zbirko nalog. Prav tako je sistem dobil novo podobo, nov grafični vmesnik.
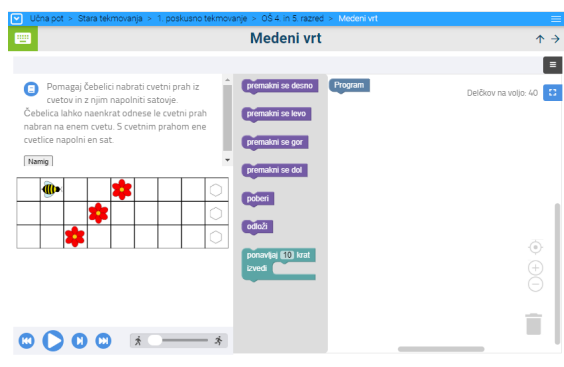
Slika 38. Naloga v posodobljenem grafičnem vmesniku

Podrobneje si o samem konceptu Piška in njegovem razvoju lahko preberete v prispevku [2], tukaj pa si oglejmo nekaj poudarkov:

- Na levi strani posamezne naloge je besedilo, ki opisuje problem. Desni del je namenjen sestavljanju programa. Najprej je stolpec, kjer so navedeni delčki, ki so na voljo. Od sestavljavca naloge je odvisno, ali bo navedel le delčke, ki so potrebni za rešitev, ali bo dodal še kakšne nepotrebne. Prav tako lahko te delčke razporedi v kategorije (Slika 39) ali ne (Slika 38).
- Večina nalog je tipa "naloge na mreži" (glej npr. primer na Slika 38). Vse se dogaja na praviloma pravokotni mreži, kjer se liki gibljejo po mreži in opravljajo določene akcije. Program je napisan pravilno, če je končno stanje na mreži tako, kot je zahtevano
- Zaradi uporabe jezika Blockly so delčki, ki so sicer konceptualno enaki (na primer, naredi nekaj s predmetom, ki je na polju, kjer je trenutno lik), v različnih nalogah lahko poimenovani različno (poberi plastenko, pojej deteljico). Prav tako lahko sestavljavec naloge tvori nove delčke in tako v posamezni ukaz "skrijem" določeno kompleksnost (npr. v nalogi je delček "nariši kvadratek"). Ustvarjanja funkcij, ki so za to potrebne, v jezikih, kot je npr. Scratch, ne moremo "skriti".
- Sistem omogoča zelo različne tipe nalog. Pri tem bi posebej izpostavili naloge tipa "zloži delčke v pravi program" (primer je prikazan na Slika 47). Gre za tako imenovan Parsonsov tip problemov ([4]) za katerega so raziskovalci pokazali (glej na primer [5]), da precej pripomore k lažjemu in hitrejšemu osvajanju osnovnih programskih konceptov.

Slika 39. Delčki, razporejeni v kategorije

3 UPORABA SISTEMA PIŠEK PRI POUKU

Za začetnike v učenju programiranja je ključno dvoje: sistem, ki omogoča ukvarjanje z vsebino problema in sistem, ki omogoča takojšnjo povratno informacijo. Sistem Pišek zajema oboje.

Sistem Pišek je lahko učitelju v veliko pomoč, saj v razredu omogoča diferenciacijo in individualizacijo. Vsebuje naloge čistih začetkov in naloge, ki zahtevajo kompleksnejša znanja. Ker so enake naloge pripravljene v različnih težavnostnih stopnjah, lahko učenci rešujejo le najlažje ali najtežje. Ker sistem sam javi, ali je naloga opravljena ali ne, se lahko učitelj posveti tistim učencem, ki imajo težave. Učenci lahko sami po uspešno opravljeni nalogi nadaljujejo z drugo nalogo in jim ni treba čakati, da učitelj nalogo pregleda. Ker sistem omogoča tudi prijavo z uporabniškim računom, ima učenec (in učitelj) pregled nad opravljenim delom in lahko rešuje vedno nove naloge.

3.1 Zasnova sistema
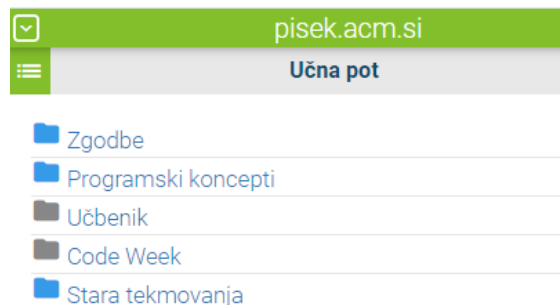
Slika 40. Učna pot

Sistem je zasnovan tako, da se lahko učitelj posveti le enemu programskemu konceptu ali pa naredi ponovitev različnih konceptov. V prvih urah učenja programiranja je pomembno, da učenci usvojijo zaporedje ukazov, kasneje to nadgradijo z zankami, pogojnimi stavki, spremenljivkami in drugimi programskimi koncepti.

Slika 41. Seznam programskih konceptov

Ko imajo osnovno znanje, se lahko nalog lotijo »po zgodbah«. Te so zelo uporabne, ko želimo ponavljati različne koncepte in utrjevati znanje ali učence pripraviti na tekmovanje. Nekateri bodo raje reševali naloge z roboti, drugi naloge z gosenico, za dekleta bo morda najbolj zanimiva plesalka. V Zgodbah je deset tematsko urejenih poglavij: Pišek, Robot, Ples, Tabornik, Zmajček, Gosenica Eva, Avto, Gasilka, Ladja ter Pišek in želva (Slika 42).

Ko učenec zaključi z eno zgodbo, nadaljuje z drugo in se pri tem kljub utrjevanju istih programskih konceptov ne dolgočasi ([2]).

Slika 42. Učenci si lahko sami izberejo junaka, s katerim se bodo učili

Slika 43. Sklop Code Week

V četrtem sklopu so izbrane naloge razvrščene glede na starostne skupine otrok oziroma težavnosti. Kot predlaga že ime sklopa, je ta v prvi vrsti namenjen izvajanju dejavnosti v okviru Slovenskega tedna programiranja – Code Week, ko učitelji ter mentorji prostovoljci iz vse Slovenije poskrbijo, da čim več otrok spozna programiranje.

3.2 Usmerjanje učencev pri ustrezni izbiri nalog

Predvsem ob ponavljanju konceptov lahko pustimo učencem proste roke. Sistem ima naloge zložene tudi po zgodbah, v katerih nastopajo različni junaki in vsak učenec gre lahko v svoj domišljijski svet. Pri tem bo občutek, da igra igrico, še večji, čeprav bo sestavljal program in utrjeval programersko razmišljanje. Junakov je na voljo dovolj, deset. V primeru, da učenci izrazijo željo po novem junaku, lahko stopimo v stik z ustvarjalci sistema in predlagamo še kakšnega.

3.3 Povratna informacija za učenca in učitelja

Zaradi takojšnje povratne informacije, bodisi pravilne (Slika 51), bodisi napačne (Slika 50), lahko učenec samostojno rešuje naloge v svojem lastnem tempu. Učitelj mu pomaga z usmeritvami. Če gre učencu težje, lahko rešuje samo naloge na prvi stopnji, če mu gre zelo dobro, jih lahko rešuje na vseh ali pa samo na zadnji.

Sistem poleg pravilnosti rešitev pregleduje tudi optimizacijo programa (z omejitvijo števila delčkov, ki jih sme učenec uporabiti, je prisiljen v uporabo zank, senzorjev, pogojnih stavkov). S tem učitelju ni treba pregledati vsakega programa posebej, ampak se lahko posveti tistim posameznikom, ki imajo težave oz. potrebujejo dodatno pomoč.

Sistem omogoča tudi prijavo in s tem shranjevanje dosežkov. Tako lahko vsak učenec nadaljuje tam, kjer je ostal, učitelj pa ima s tem pregled opravljenih nalog za vsakega posameznega učenca.

Slika 44. Sistem omogoča prijavo

Slika 45. Pregled uspešnosti reševanja

Ob seznamu nalog (**Error! Reference source not found.**) so različne oznake. Hitro je vidno, ali je naloga v celoti rešena ali delno, vidi se tudi, ali se je učenec naloge že lotil ali pa sploh še ne.

4 Uporaba Piška na OŠ Koseze

Na OŠ Koseze smo Sistem Pišek začeli uporabljati ob koncu šolskega leta 2018/2019, pri učencih 4. in 5. razreda predvsem kot utrjevanje že osvojenih konceptov, pri učencih od 7.-9. razreda pa kot uvod v programiranje.

V šolskem letu 2019/2020 so učenci 4. razreda s pomočjo Sistema Pišek usvojili koncepta zaporedje ukazov in zanke ponavljaj. Prvo uro, ko so se srečali s sistemom Pišek, smo si pogledali, kako je stran sestavljena, kako se delčki sestavljajo, da so nekje delčki »skriti« v kategorije ipd. Opozorjeni so bili, da morajo natančno prebrati navodilo naloge in da morajo biti pozorni, na kakšen način se junaki premikajo (Slika 46). Učenci so na spletni strani http://pisek.acm.si/ izbrali Programski koncepti (Slika 40) in Zaporedje ukazov (Slika 41) in reševali naloge. Najprej so morali rešiti prve tri (zato, da so začeli delati in da niso samo pregledovali nalog), potem pa so lahko izbrali katero koli nalogo na seznamu. Malo pred koncem ure so pokazali, kako uspešni so bili, torej, koliko nalog jim je uspelo rešiti (sistem tudi brez prijave beleži uspešnost reševanja kot je prikazano na sliki Slika 45 dokler ne zapremo okna brskalnika).

Ker so bili učenci v sistem prijavljeni, so se njihovi rezultati shranili in so lahko naslednjo uro nadaljevali z nalogami, ki jih še niso rešili. Podobno smo naredili pri programskem konceptu Zanke. Učenci 5. in 6. razreda pa so ta dva koncepta ponovili in svoje znanje nadgradili s pogojnim stavkom in senzorji. Zato so izbrali Zgodbe (Slika 40) in si izbrali svojega junaka (Slika 42), naloge pa so morali reševati po vrsti, saj so na seznamu praviloma razporejene po težavnosti. Ko so prišli do nalog, ki jih še niso znali rešiti, so si izbrali drugega junaka. Ker so bili v sistem prijavljeni, so videli, katere naloge so že reševali v prejšnjem šolskem letu in so jih lahko spustili.

Ker se je na začetku tako pri četrtošolcih, ki so čisti začetniki, kot pri petošolcih in šestošolcih, ki so se s temi nalogami že srečali, izkazalo, da imajo težave z razumevanjem načina premikanja junakov, je smiselno, da pred začetkom uporabe sistema oziroma posamezno pri vsaki od prvih nekaj nalog, učence večkrat opozorimo na način premikanja po mreži, na kateri je zastavljena večina nalog. Na sliki Slika 46 sta prikazana dva sklopa ukazov za premikanje – uporabljamo pa lahko tudi druge, npr. premike glede na smeri neba. Z učenci lahko naredimo tudi vajo »v živo«, tako da se učitelj ali učenec premikata po navodilih kot so na delčkih. Tako si najlažje predstavljajo razliko med »obrni se desno« in »premakni se desno«.
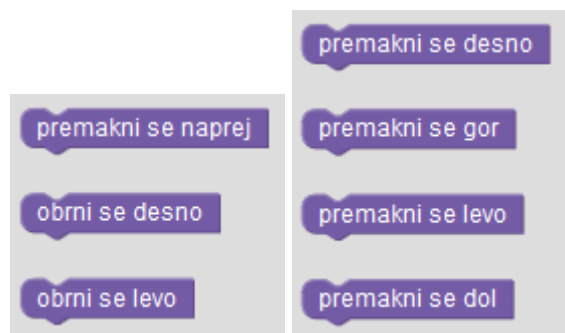
Slika 46. Delčki z ukazi za premikanje

Predno se učenci lotijo samostojnega sestavljanja programov, je smiselno, da najprej rešijo naloge, kjer so vsi ukazi že podani, vendar »razmetani« in jih morajo pravilno zložiti (Slika 47). Ker gre za programiranje z delčki, sintaktične napake niso možne. Učenci pri teh nalogah pogosto zbrišejo že podane ukaze in se programa lotijo »od začetka«. Še posebej se to pojavlja pri učencih, ki se prej niso srečali s takim tipom nalog, zato v prvih urah te naloge zahtevajo malo več usmerjanja s strani učitelja.

Podobno je pri nalogah tipa popravi napako. Učenec mora ugotoviti, kaj je narobe (npr. lahko manjka ukaz, lahko je kakšno število v zanki ali funkciji preveliko). Ker imamo delčke, se res ukvarjamo samo z vsebinskimi napakami.

Pri vsem tem je treba omeniti, da so učenci ob uri, ko smo uporabljali sistem Pišek, pogosto rekli, da igrajo igrico. Opažamo, da jeziki, ki podpirajo programiranje z delčki, pripomorejo k lažjemu razvijanju računalniškega mišljenja, sistemi s povratnimi informacijami pa učitelju olajšajo delo.
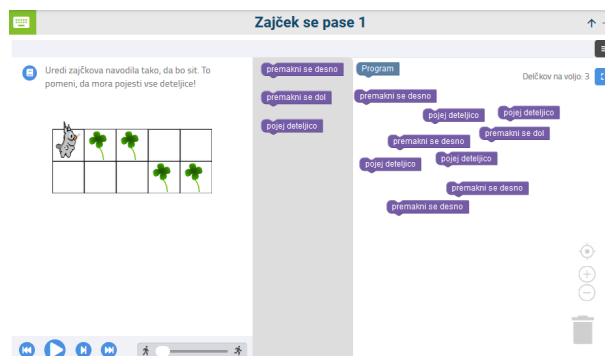
Slika 47. Primer Parsonsovega tipa naloge

Kot smo že omenili, jezik Blockly omogoča avtorjem, da dodajajo delčke s čisto novimi ukazi kot npr. "poberi lešnik", "naberi med", "izvedi pirueto". S tem se ognemo uporabi funkcij, ki so v tem starostnem obdobju še preveč abstraktne. Po drugi strani pa smo opazili, da to pripomore tudi k navajanju na natančnejše branje navodil. Tako je v nekaterih nalogah dovolj, da junak pride na mesto s predmetom in ga s tem samodejno pobere, v drugih pa mora za to uporabiti ukaz.

Sistem se je izkazal za izredno koristnega tudi v času šolanja na daljavo, saj so učenci lahko reševali naloge, primerne svojemu predznanju, in pri tem takoj dobili povratne informacije. Učitelju so poslali zaslonsko sliko uspešnosti (**Error! Reference source not found.**), da je lahko spremljal njihov napredek. Če kakšne naloge niso znali rešiti, so poslali povezavo do naloge in zaslonsko sliko njihove rešitve, učitelj pa jih je usmeril k pravilni rešitvi.

Učenci od 4. do 9. razreda, ki obiskujejo neobvezne oz. obvezne izbirne predmete računalništva ali robotiko z elektroniko in elektrotehniko z robotiko, so se v šolskem letu 2019/2020 udeležili dveh poskusnih tekmovanj v programiranju z delčki Pišek. Tekmovanje je zastavljeno tako, da se lahko izvede v času pouka. Ima več kratkih nalog z različnimi programskimi koncepti in različnih težavnosti, tako da lahko učenci (in mentorji) dobijo celostno povratno informacijo o svojem znanju. Ker ima tekmovanje različne kategorije, je primerno za vse starostne stopnje ter za različna predznanja. Mentor ima tukaj pomembno vlogo, da tekmovalca pravilno usmeri v ustrezno izbiro kategorije. Ker je bilo drugo poskusno tekmovanje ravno v času šolanja na daljavo, je bilo vzpodbujanje in usmerjanje učencev toliko težje. Pojavilo se je tudi nekaj osnovnih težav, ker učenci niso dobro sledili navodilom (termin tekmovanja, prijavni podatki, dostop do nalog), kar pa nam je dalo dodaten zagon in nove ideje za načrtovanje pouka za naslednje šolsko leto.

Več o samem tekmovanju si lahko preberete v [3].

4.1 Primer poučevanja zanke

V ilustracijo konkretne uporabe sistema pri pouku, si poglejmo, kako smo razmišljali pri pripravi na poučevanje koncepta zanke. Program je zaporedje ukazov. To učenci hitro usvojijo. Prav tako hitro spoznajo, da je za uspešen program pomemben vrstni red ukazov.

Prve težave se pojavijo, ko jih želimo naučiti program optimizirati, torej da namesto štirih enakih ukazov uporabijo zanko »ponovi štirikrat«. Program bo seveda deloval pravilno v

obeh primerih, želimo pa si, da bi sistem sam preveril, ali zna učenec uporabljati zanke.

Slika 48. Primer osnovne optimizacije

Učenci sicer razumejo, da je učinek zgornjih dveh delov programa popolnoma enak. Kljub temu pa se večina, ko pišejo oz. sestavljajo program, ne spomni, da bi sami od sebe uporabili zanko. Pred Piškom smo delali v Scratchu in ker je program deloval ne glede na to, ali so uporabili zanko ali ne, jih veliko tega koncepta ni usvojilo. V sistemu Pišek jih lahko k temu "prisilimo" tako, da sestavimo nalogo, ki ima omejitev števila delčkov, ki jih lahko uporabijo pri sestavljanju programa.

Slika 49. Primer naloge z omejitvijo števila delčkov

Učenec sicer lahko začne z zlaganjem več enakih delčkov, vendar bo kmalu ugotovil, da se mora naloge lotiti drugače (Slika 50). Sistem tako omogoča, da je edina prava rešitev, ko učenec uporabi zanko.

Slika 50. Primer reševanja brez uporabe zanke

Ko učenec odda program s pravilno rešitvijo in z upoštevanimi omejitvami, dobi povratno informacijo z usmeritvijo za reševanje naslednjih nalog.
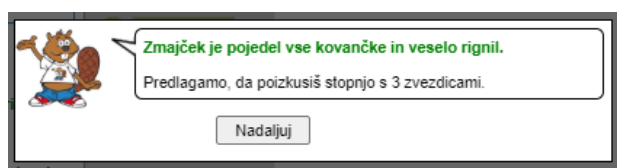
Slika 51. Povratna informacija ob pravilni rešitvi

Ko se učenci naučijo osnovne uporabe zanke ponavljaj, jo nadgradimo z »zanko v zanki«.
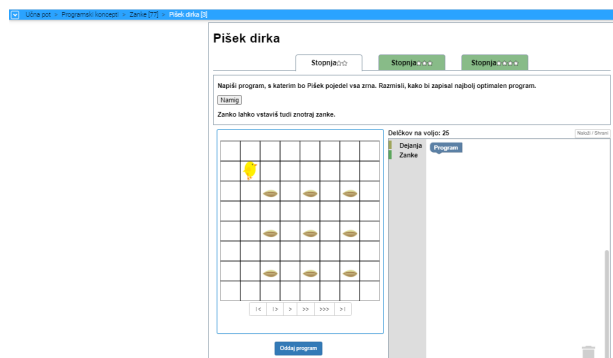
Slika 52. Primer naloge z ugnezdenimi zankami

Večina nalog je sestavljena na treh različnih stopnjah. Različne stopnje preverjajo poznavanje istih programskih konceptov, razlika je največkrat v dolžini programa. Ko učenec reši stopnjo, se zvezdice obarvajo rumeno (Slika 53), kar omogoča učitelju, da hitro vidi, kako učenec napreduje (da ni kakšne naloge oz. stopnje preskočil).
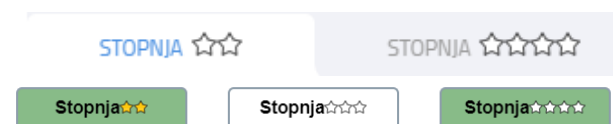
Slika 53. Oznake stopenj

4.2 Preverjanje pravilnosti programa po korakih

Sistem omogoča tudi, da učenci svoj program preverjajo po korakih, vsak ukaz oz. delček posebej. Tako naj bi hitreje našli napako v svojem programu. Na naši šoli se je pokazalo, da je v splošnem za učence osnovne šole to precej težko in si s tem ne znajo pomagati. Pri iskanju napak po korakih potrebujejo veliko vodenja in usmerjanja učitelja. Je pa koristna možnost, da je pri izvajanju po korakih na mreži sproti pokazan učinek, v samem programu pa označen ukaz, ki se bo izvedel naslednji (glej označene dele na Slika 54).
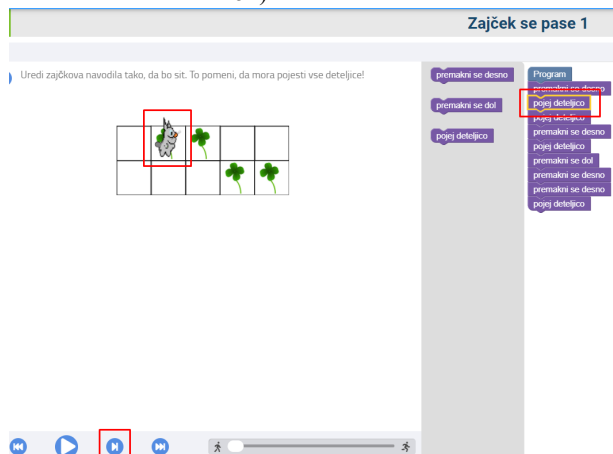
Slika 54. Izvajanje po korakih

5 ZAKLJUČEK

Pri neobveznem izbirnem predmetu računalništvo, ki se izvaja v drugi triadi OŠ, se srečujemo z nemalo težavami. Že to, da imamo lahko skupino 28-tih učencev različne starosti in s popolnoma različnim predznanjem, saj so nekateri pri predmetu prvo leto, nekateri pa že tretje, zahteva od učitelja veliko inovativnosti pri načrtovanju pouka. Kako narediti predmet zanimiv in koristen in ne prezahteven, ko pa so si učenci tako različni? In to predmet, ki je po eni strani izbirni, po drugi strani pa uči veščine, ki so nujno potrebne v vsakdanjem življenju.

V takih situacijah nam je lahko IKT v veliko pomoč, saj nam res omogoča nujno potrebno individualizacijo in diferenciacijo. S sistemom za avtomatsko preverjanje pravilnosti rešitve pa učitelju omogoča, da lažje prepozna učence s težavami in mu zagotovi čas, ki ga potrebuje za pomoč in usmerjanje.

Uporaba jezikov, ki omogočajo programiranje z delčki, samemu programiranju seveda ni na neki čarobni način odvzelo zahtevnosti. Vendar opažamo, da je učencem blizu in jih spominja na igranje igric. In učenje skozi igro je tisto, ki je pri otrocih najpomembnejše in gradi osnove za druge, višje oblike učenja in razvoj mišljenja.

Zato so orodja, kot je Sistem Pišek, pomembna. Lahko jih uporabljamo zgolj kot vir idej za naloge in še vedno uporabljamo svoj izbrani programski jezik (na primer Scratch) in/ali svoje okolje (na primer MakeCode). Lahko pa Sistem Pišek

uporabljamo kot celoto in izkoristimo možnost samodejnega preverjanja pravilnosti rešitev.

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Uporaba IKT pri urah športa kot pripomoček za izboljšanje izvajanja osnovnih elementov pri skokih na mali prožni ponjavi

The use of ICT during physical education lessons to improve the performance of basic technical elements on trampoline

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POVZETEK

Prispevek opisuje rabo IKT pri pouku športa. S pomočjo elektronske/interaktivne table (v nadaljevanju table), kamere, interaktivnega projektorja in računalnika so učenci izvajali vaje na mali prožni ponjavi. Po vsakem skoku so preko programa Sportswatch delay pogledali svojo izvedbo in sami opazovali svoje napake. Z vsakim skokom so te napake poskušali odpraviti. V prispevku je opis izvedbe ure športa od učnega sklopa podajanja novih informacij, preko utrjevanja, do preverjanja in na koncu tudi ocenjevanja. S pomočjo interaktivnega projektorja, table in snemanja pouka, izvajamo vizualni in kinestetični stil učenja. Pri takem načinu dela učenci sami vrednotijo svoje delo. Vloga učitelja je demonstracija in usmerjanje učencev na bolj pomembne dele posameznega elementa. Učenci pri takem načinu dela opravijo več kvalitetnih ponovitev, kar dvigne kvaliteto motoričnega učenja. Seveda je pomemben tudi faktor varnosti. Poskusno smo preverjali tudi znanje in na koncu so se učenci med seboj ocenjevali. V pomoč so jim bile v naprej pripravljene preglednice. Po zaključku sklopa gimnastike, ki je opisan v prispevku, sem poskusno opravil tudi vaje med košarko in odbojko. Učenci na tak način vidijo svoj napredek, kar jih motivira za nadaljnje delo in jim dviguje samozavest pri izvajanju elementov. Na tabli lahko označimo cilje tudi za manj sposobne učence in jim s tem prilagodimo delo. Po končanih urah smo skozi pogovor prišli do zaključka, da so učencem take ure zelo zanimive in jih imajo radi.

KLJUČNE BESEDE

IKT, interaktivna/elektronska tabla, računalnik, interaktivni projektor, kamera, Sportswatch delay, pouk športa, gimnastika, skoki na mali prožni ponjavi

ABSTRACT

The article describes the use of ICT during sport lessons. Students practised on a trampoline and at the same time an electronic/interactive board, a camera, an interactive projector and a computer were used. After every jump, the students looked at their jump with the help of the Sportswatch delay program. They could notice their mistakes and try to correct them in their next jump. The article describes a PE lesson – giving new information, practice, checking and marking. With the help of an interactive projector, a board and filming of the lesson, we support the visual and kinaesthetic styles of learning. Students also evaluate their own work. The role of the teacher is to demonstrate and guide students to the more important parts of an individual element. Students get to do more quality repetitions which subsequently increases the quality of motoric learning. The safety factor of course is also very important. We checked knowledge and at the end of the lessons and students graded each others work with the help of pre-prepared charts. After the gymnastics lesson, which is described in the article, I have also tried the same approach with basketball and volleyball. Students can see their progress which motivates them for future work and raises their confidence when performing an element. On the board we can also mark the goals for students with lower abilities and thus adjust work for them. After the lessons a conclusion was reached through conversation that students like such lessons very much and that they find them very interesting.

KEYWORDS

ICT, interactive/electronic board, computer, interactive projector, camera, Sportwatch delay, PE lessons, gymnastics, jumps of a trampoline

1 UVOD

Uporaba IKT v športu sega že zelo daleč nazaj, seveda v drugačni obliki. Začela se je kot uporaba videokamer pri procesu treniranja. Trener je posnel trening in po treningu je bila video analiza. Trener je izpostavil napake in dobro izvedene elemente. Na naslednjem treningu so športniki poskušali te napake odpraviti. Tak način dela smo že pred 25 leti uporabljali v zimski šoli v naravi. Glede na razvoj tehnologije je področje IKT zelo

napredovalo in podoben, seveda naprednejši način dela se je prenesel v učilnice. Sedaj imajo nekatere športne dvorane že vse pripravljeno za video analize treningov in tekmovanj. Tudi pri urah športa se to vse več uporablja [1]. Uporaba je odvisna od računalniških zmožnosti posamezne šole in digitalne pismenosti športnih pedagogov. Glede na to, da je IKT vse bolj prisoten v vsakdanjem življenju, se zdi smiselno tudi vključevanje le-tega v poučevanje športa, Prav tako učenje s pomočjo sodobne tehnologije učence motivira, popestri pouk in usmerja delo v hitrejše in kakovostnejše doseganje ciljev. Seveda ga ne smemo enačiti z neposrednim odnosom učitelj-učenec. Kljub vsemu je še vedno prva dobra ustna povratna informacija, ki jo učitelj da učencu. Uporaba IKT je kot dodaten učni pripomoček, ki dvigne motorično učenje na višji nivo [2].

2   INTERAKTIVNI SKLOP

Komplet učnih pripomočkov, ki jih uporabljamo med poukom zajema:

- Interaktivna tabla
- Projektor
- Spletna kamera
- Prenosni računalnik
- Računalniški program Sportswatch delay [3]

Pri pouku lahko uporabljamo seveda tudi ostale oblike računalniške tehnologije. Dovolj je že kamera in TV. Za kvalitetno delo je dobro, če so omenjeni elementi na voljo v telovadnici in da s postavljanjem ne izgubljamo preveč časa. Naš pripomoček je postavljen na vozičku in s postavljanjem in priključevanjem ne izgubljamo časa. Sklop, ki ga uporabljamo pri našem pouku je Hitachijev interaktivni sklop.
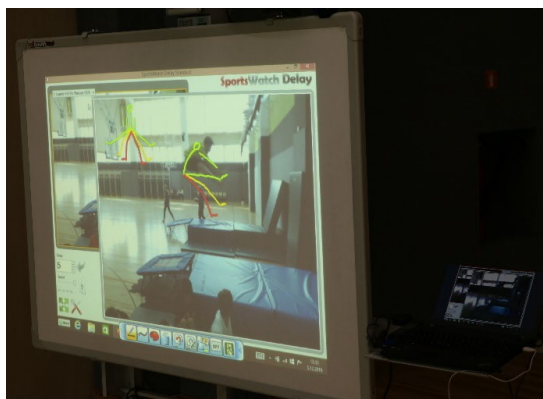
Slika 1: IKT sklop z interaktivnim projektorjem

2.1   Izpeljava učne ure športa z uporabo IKT

Tema učne ure je bila gimnastika – osnovni skoki na mali prožni ponjavi (v nadaljevanju MPP). Postavil sem dve MPP, da so lahko opravili več ponovitev. Na eni je bila postavljena kamera in projektor. Cilj ure je bil, da učenci izvedejo osnovne skoke, se pri tem opazujejo in poskušajo izvedbo izboljšati. Osnovni skoki, ki smo jih izvajali so naslednji:

- skok iztegnjeno,

- skok raznožno,
- skok skrčno,
- skok prednožno,
- skok z obratom za 180o in za 360o.

Vsak skok sem na začetku demonstriral, oz, za to uporabil učenca, ki to zna. Kamera je snemala skoke s 5 sekundnim zamikom. Vsak učenec se je po skoku pogledal, jaz pa sem mu povedal bistvene napake. Napake, na katere sem jih v prvi fazi ure opozarjal so:

- naskok in odriv z MPP,
- višina skoka,
- položaj telesa v zraku,
- doskok.

Ko je vsak opravil po pet ponovitev vsakega skoka, smo vse skoke posneli in jih skupaj pogledali. Opozoril sem jih na bistvene napake in pohvalil dobre faze skoka. Za ta del ure smo si vzeli nekaj časa, saj smo posnetek tudi ustavili in analizirali skok. Po tem so učenci še enkrat izvedli vaje. Uro smo zaključili z razteznimi vajami in pogovorom o uporabi kamere.

Na drugi učni uri smo izvedli utrjevanje naučenih elementov. Še vedno je na začetku sledila demonstracija posameznih skokov. Potem sem jim na tablo narisal položaj telesa pri posameznem skoku. Pri skoku so učenci poskušali svoj položaj telesa čimbolj približati narisani figuri (slika 3). Figura je bila narisana z zeleno barvo. Manjša odstopanja sem narisal z rumeno barvo, večja z rdečo. Osredotočili smo se predvsem na bistvene napake pri skokih, to so npr:

- iztegnog in rok, ravno telo (ne uleknjeno),
- dvig kolen (pri skoku skrčno),
- iztegstopal (špičke),
- dvig iztegnjenih nog pri skoku prednožno,
- ravno telo, roke in noge pri obratih,
- doskok v čep z iztegnjenimi rokami.

OCENA/SKOK	IZTEGNJENO	SKRČNO	RAZNOŽNO	PREDNOŽNO	OBRAT
ZELENO - 2					
RUMENO - 1					
RDEČE - 0					

Slika 2: Tabela točkovanja

Učenci so po skoku pogledali ali so v zelenem, rumenem ali v rdečem območju. Učence je to zelo motiviralo, saj so se čimbolj želeli približati zeleni barvi. Ta del ure lahko traja dalj časa, učenci so aktivni in izvedejo veliko kvalitetnih ponovitev. Bistvo je, da ne ponavljajo napak.

Pri naslednji uri sem učence razdelil v pare. Vsak par je dobil list s tabelo, na kateri je so bili napisani skoki in v katerem polju je izvedel posamezni skok (zeleno, rumeno ali rdeče). Vsak par je nalogo izvajal tako, da je en učenec skočil, drugi je zapisal križec v ustrezno barvno polje. Po vsakem skoku sta zamenjala vlogi. Nekateri so to izvajali tako, da je eden izvedel vse omenjene skoke, potem sta naredila menjavo.

Ko so končali, je vsak učenec seštel svoje točke. Skok v zeleno polje prinese 2 točki, v rumeno 1 točko in v rdeče polje 0 točk. Ravno tako ne dobi točk, če skoka ne izvede ali izvede

napačen skok (razsnožno namesto skrčno). Tako je maksimalno število točk 10. Učenci so pri tem načinu točkovanja zelo skoncentrirani pri vsakem posameznem skoku. Tako se tudi zmanjša verjetnost poškodb, saj ne skačejo »kar tako«.

2.1.1 Preverjanje in ocenjevanje

Po treh izvedenih urah sem učencem napovedal preverjanje in ocenjevanje omenjenih skokov. Večina učencev je to z veseljem pričakovala, saj so v treh urah izvedli že veliko skokov in so vedeli kaj zmorejo. Učenci so se zopet razdelili v pare in dobili liste s tabelami skokov. Enako kot na prejšnjih urah so izvedli skoke in sešteli svoje točke.

Ob koncu tega dela ure sem zbral tabele in skupaj z učenci smo pregledali točke.

Kriterij, ki smo ga uporabili:

Točke	Ocena
9-10	5
7-8	4
5-6	3
3-4	2
0-3	1

Preden sem zapisal ocene, je imel vsak možnost, da ponovno skoči skok, pri katerem je dobil najmanj točk, oz. se mu je skok ponesrečil.

Opazil sem, da se učenci med seboj zelo realno ocenjujejo. Zgodi se, da sem pri katerem učencu podvomil o njegovih točkah, saj sem jih pri skokih opazoval in sem vedel kako skočijo. Ti učenci so opravili še dodaten skok, da sem preveril njihovo izvedbo. Težav pri tem delu ni bilo.

2.2 Opažanja in pozitivni učinki

Učenci so se odlično odzvali na tak način dela. Predvsem jim veliko pomeni to, da opazijo lasten napredek. Opazil sem zavzetost pri delu tudi pri učencih, ki sicer ne vidijo motivacije v lastnem napredku. Težav pri posameznih nalogah ni bilo. Z veseljem so skakali in pisanje točk v tabelo jih je še dodatno motiviralo. Ob koncu ure sme vsak učenec izvesti skok po lastni izbiri. Pravilo je le, da skok ni prevrat naprej ali preval letno. Vsak skok si ogledamo, kar prinese veliko dobre volje.

Opazna je razlika pri takem načinu dela, kot pa pri klasičnih skokih, kjer učitelj ustano popravlja vsakega učenca posebej. Tudi učitelj ne vidi vseh napak, saj je skok izveden v zelo kratkem času in lahko opozoriš le na bistvene napake. Učencem pa ustne informacije niso tako v pomoč kot če se vidijo. Ravno tako pri takem delu opravijo večje število ponovitev.

Za popestritev ure lahko naredimo tudi tekmovanje med dvema ali tremi skupinami, med posamezniki ali pari.

Učenci so tak način dela zelo dobro sprejeli. Učenci se s takim delom vključeni v vrednotenje lastnega znanja, kar jih še dodatno motivira.

Pri slabših ocenah se ne pojavi slaba volja, saj je ocenjevanje zelo pregledno. Tudi učenci, ki zberejo nižje število točk, vidijo, da je temu tako. Na splošno se zelo redko pojavi nižja ocena od 3.

Kljub vsemu ni bil glavni namen uporabe IKT ocenjevanje, temveč kvalitetnejše delo, motivacija učencev in napredek v znanju.

2.3 Možnosti za delo v prihodnje

Po uspešni izpeljavi učnega sklopa skokov na mali prožni ponjavi, razmišljam o uporabi tudi pri drugih učnih vsebinah. Seveda ne pri vseh in ne vsako uro, vsekakor pa je vizualna povratna informacija pomembna pri kvalitetnejšem delu in napredku učencev.

Možnosti so tudi v različni obliki ure, kjer si del učencev izbere, izvede in posname poljubno vajo, označijo napake, drug del učencev poskuša to ponoviti.

Uspešna je bila tudi uporaba pri individualnem delu s slabšimi učenci. Na ta način lahko večina učencev dela nekaj drugega, tisti, ki določene naloge niso uspešno izvedli, sami vadijo nalogo in se opazujejo.

2.3.1 Uporaba interaktivnega sklopa pri drugih učnih vsebinah

Moje delo z omenjenim interaktivnim sklopom je bilo v začetku usmerjeno na skoke na mali prožni ponjavi. Uporabil sem ga tudi pri drugih učnih vsebinah.

Nekaj primerov uporabe:

- Košarka, met na koš, opazujemo višino loka žoge in pravilno gibanje roke.
- Odbojka, položaj rok in telesa pri spodnjem odboju.
- Atletika, položaj telesa pri nizkem štartu.

3 ZAKLJUČEK

Pri uvajanju takega načina dela je potrebno učencem razložiti zakaj se to uporablja, kaj so prednosti in kako naj to uporabijo pri napredovanju. Izkazalo se je, da skoraj vsi učenci sprejmejo z zanimanjem in željo po napredku. Seveda pri tem učitelj ne sme biti le kot opazovalec ampak se mora aktivno vključiti v delo in učence še dodatno motivirati. Pomembno je tudi, da s postavitvijo takega interaktivnega sklopa ne izgubljamo časa med uro. Če je možnost, naj bo že postavljen v dvorani. Lahko rečem, da tak način dela uspešno in dinamično popestri ure športa.

Nekaj opažanj:

- Učenci so pri izvajanju skokov napredovali bolj kot pri običajnem načinu dela.
- Skoke izvajajo bolj zavzeto in z večjo koncentracijo.
- Ker se med seboj opazujejo, se bolj potrudijo, da skok izvedejo čim bolje.
- Nekateri med seboj tekmujejo, kdo bo večkrat v »zelenem območju«.
- Otroci si med seboj izmenjujejo informacije, ki jih včasih lažje razumejo, kot če jim jih preda učitelj.

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      html

Uporaba aplikacije mCOBISS v 8. razredu

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POVZETEK

Sodobni čas in napredna tehnologija zahtevata od knjižničarja sodobni pristop pri delu z učenci. Kar pomeni, da tudi knjižničar uporablja sodobno informacijsko in komunikacijsko tehnologijo (IKT) in s tem učencem pokaže možnosti uporabe novih elektronskih naprav v izobraževalne namene. V učni uri, ki sem jo izvedla v 8. razredu osnovne šole, sem z učenci uporabila mobilni telefon, s pomočjo katerega smo spoznali aplikacijo mCOBISS (mobilni Kooperativni online bibliografski sistem in servisi; je mobilna aplikacija, ki omogoča dostop do informacij o gradivu v knjižnici). Učenci so s seboj prinesli telefone (android ali iPhone) in vodeno spoznavali možnosti uporabe te aplikacije. Predhodno sem pripravila vse ustrezne elemente, da je učna ura potekala tekoče. Najprej je bilo potrebno urediti interni wi-fi in geslo, nato v kataložni bazi OSDFHO (akronim interne baze Osnovne šole Dušana Flisa Hoče) urediti gesla vsem učencem, s katerimi sem to uro izvedla. Predpogoj za vse pa je bila članska izkaznica s številko uporabnika šolske knjižnice. Šele po vseh teh pripravah je bila mogoča registracija v aplikaciji. Učenci so hitro in brez večjih težav dostopili do aplikacije: jo namestili in se registrirali. Tudi sama uporaba aplikacije jim je bila zanimiva in so spretno brskali po njej ter spoznavali možnosti, ki jim jih ponuja. Namen uporabe je bil, da učenec samostojno poišče knjigo najprej v aplikaciji, nato pa pristopi do knjižnih polic in poišče ustrezno knjigo. Pri tem mora poznati tudi način postavitve leposlovja in poučne literature. Seznanila sem jih tudi z možnostmi v aplikaciji, ki jih sicer v šolski knjižnici nimajo: s podaljševanjem gradiva, z nastavitvami potisnih informacij ter z možnostjo članstva v različnih knjižnicah.

KLJUČNE BESEDE

Knjižnično informacijska znanja, iskanje gradiva, COBISS+, mobilni telefoni (android, iPhone), aplikacija mCOBISS

ABSTRACT

Modern times and advanced technology require the librarian to take a modern approach to working with students. Librarians use modern information and communication technology (ICT) and thus show students the possibilities of using new electronic devices for educational purposes. In the lesson presented we used mobile phones with the 8th grade students of primary school and so they got to know the mCOBISS application (mobile Co-operative online bibliographic system and services; is a mobile application that provides access to information about the material in the library). Students brought phones (android or iPhone) with them and learned about the possibilities of using this application. I had previously prepared all the relevant material to keep the lesson running smoothly. First it was necessary to arrange the internal wi-fi and password, in the OSDFHO catalog (an acronym for the internal database of the OŠ Dušana Flisa Hoče) database the passwords of all students, with whom I led this lesson, were organized. However, each student needed to have a membership card with the number of the school library user. Only after all these preparations it was possible to register in the application. Students quickly and easily accessed the application: installed it and registered. The use of the application itself was also interesting to them and they skillfully browsed through it and learned about the possibilities it offers. The purpose of the lesson presented was for the student to independently find the book first in the application, then access the bookshelves and find the appropriate book. To achieve this goal, students needed knowledge about where literature and educational literature in the library could be found. I also acquainted them with the possibilities in the application that they do not have in the school library: how to extend the library books, with the settings of push notifications and with the possibility of membership in various libraries.

KEYWORDS

Library information knowledge, material search, COBISS +, mobile phones (android, iPhone), mCOBISS application

1 UVOD

Pouk v osnovni šoli je potrebno prilagoditi družbenim razmeram, spremembam vzgoje in posledično spremenjeni populaciji učencev, napredku sodobne tehnologije in drugim sferam sodobnega življenja. Strokovni delavci v vzgoji in izobraževanju se zavedamo lastnega permanentnega izobraževanja, da lahko sledimo novim generacijam učencev, ki so »zahtevnejši«, bolj obdani z informacijami, uporabljajo sodobno tehnologijo že od malih nog in preživijo del svojega življenja tudi v virtualnem svetu.

Da bi se v njem lažje znašli, da bi znali presojati informacije in uporabljati tehnologijo tudi v izobraževalne namene, potrebujejo učitelje, knjižničarje in druge strokovne delavce na šoli, da jim pri tem pomagamo. Tako sem v eni izmed medpredmetnih učnih ur v okviru Knjižnično informacijskih znanj in slovenščine izvedla učno uro, v kateri so učenci spoznali in uporabljali mobilno aplikacijo mCOBISS.

Aplikacija je zelo priročna in uporabna, saj nudi hiter dostop do knjižničnega gradiva, kar pa je za današnji čas zelo pomembno. V sedanjem in nadaljnjem izobraževanju bodo učenci potrebovali še mnogo knjižničnega gradiva za usvajanje znanj z različnih področij. Da bi čim hitreje prišli do informacij, si lahko pomagajo tudi s to aplikacijo. Namestitev, dostop in uporaba so enostavni. Učencem je dostop do virtualnih vsebin blizu, saj jih nenehno uporabljajo.

2 IZOBRAŽEVALNE USTANOVE V DIGITALNI DOBI

Veliko je govora o tem, da so izobraževalne ustanove zastarele in da je potrebno vnesti korenite spremembe, da ne bi izgubile pomen in veljavo. Don Tapscott in Anthony Williams v svoji kratki razpravi *Univerzo 21. stoletja je treba na novo iznajti: Skrajni čas je že.* [6] poudarjata, da splet nezadržno postaja prevladujoča infrastruktura znanja. Pojavi se izraz digitalni domorodci, ki poimenuje generacije ljudi, rojenih po letu 1980 in ki so zrasli skupaj z računalnikom in internetom kot samoumevnima sestavinama okolja. Digitalni domorodec ima svojo domovino v digitalnem svetu sodobne informacijske tehnike.

Za nove generacije to pomeni povsod dostopne in na internetu sloneče tehnologije in aktivno ukvarjanje s temi novimi tehnologijami. Tipično zanj je, da je večino časa na spletu, z drugimi komunicira po e-pošti, z SMS-i in na socialnih omrežjih. Pogosto posluša glasbo poleg drugih opravil, zvečer igra video igrice ali gleda televizijo, zjutraj pa mu namesto budilke zvoni mobilni telefon. Spitzer [6] pravi, da glede na upoštevanje delovanja možganov zagotovo sledi, da bo to pustilo posledice na življenju digitalnega domorodca.

Anderson in Rainie sta optimistična in govorita o pozitivnih posledicah: možgani bodo leta 2020 večopravilno vodenih najstnikov in mlajših odraslih »ožičeni« povsem drugače kakor možgani ljudi starejših od 35 let. Ti naj bi se več naučili in zato bili bolj sposobni najti odgovore na globoka vprašanja, ker so učinkovitejši pri iskanju informacij na spletu. Torej spremembe v učnem vedenju in mišljenju mladih po njegovo vodijo do pozitivnih učinkov in če bi omejili mobilnost mladih, bi zmanjšali njihovo sposobnost razvijanja socialnih spretnosti. Seveda pa obstajajo mnenja in dokazi tudi v nasprotno smer: o propadu osnovnega mišljenja, resničnega zanimanja in socialnih spretnosti v stvarnih osebnih odnosih ter o odvisnosti od tehnike. [6]

3 MLADI IN SPLET

Mlajši predstavniki digitalnih domorodcev (rojeni po letu 1993) ne poznajo časa brez računalnikov in spleta. So »generacija Googla« in imajo posebne sposobnosti in spretnosti pri rabi informacijske in komunikacijske tehnike (IKT). Spleta ne uporabljajo zgolj za iskanje informacij ali samo za učenje. Večji del uporabe interneta je namenjen komunikaciji med prijatelji, znanci in sošolci, nalaganju glasbe s spleta in igranju iger. Splet uporabljajo bolj ustvarjalno in bolje kot njihovi starši in učitelji, vendar le v določene namene.

V eni od raziskav o védenju mladih ljudi pri iskanju informacij se je pokazalo, da to védenje pri mlajših ni večje kot pri odraslih ljudeh ter da so tako mladi kot starejši uporabniki postali nagnjeni k površnosti. Naslednja raziskava pravi, da mladi težko ločijo dobre vire od slabših. Po navadi to počno zgolj površno, niso pa pripravljeni podati natančne ocene. Torej znanje o iskanju informacij se pri mladih ni izboljšalo, kar je pogojeno s preprostostjo uporabe digitalnih sistemov. In ker mladi ne vedo, kako so informacije med seboj povezane (povezanost z logičnimi operaterji) in ne ločijo med pomembnim in nepomembnim, pri iskanju po spletu niso preveč uspešni. Za iskanje na internetu je zato potrebna solidna osnovna izobrazba in predznanje na področju, na katero je usmerjeno iskanje, sicer tudi Google ne bo v pomoč. Tisti, ki pa nasprotno že veliko vedo, si lahko z Googlom le še pomagajo do zadnje informacije, ki je še potrebna. Na osnovi dobrega predznanja lahko tako izmed številnih zadetkov na iskalniku izločijo take, ki so pomembni in vodijo k uspehu.

Na koncu še spoznanje o tem, da nam zavest, da lahko vsakršno informacijo hipoma najdemo na spletu, preprečuje, da bi shranjevali podatke v možgane. Kar je škodljivo, ker se tako strokovnega védenja naučimo bistveno manj kot nekdo, ki ni tako naravnan pri iskanju informacij.

Rowlands [6] pravi, da pri generaciji digitalnih domorodcev ne gre za izvedence na področju iskanja informacij in da ti nimajo boljših (tudi ne slabših) sposobnosti, kako ravnati z informacijami, ampak da gre po mnenju avtorjev študije za generacijo »cut and paste«.

4 SPLET V IZOBRAŽEVALNE NAMENE

Izhajajoči iz prejšnjih raziskav, lahko ugotovimo, da mladi vseeno še potrebujejo voden izobraževalni proces, v katerem pridobijo osnove za nadaljnjo uporabo spletnih vsebin. Vendar pa mora ta proces vključevati sodobne učne oblike in metode, s katerimi učencem približamo izobraževalne vsebine.

Ena izmed sodobnih učnih oblik je ravno uporaba novih naprednejših tehnologij in spletnih vsebin oz. storitev, ki omogočajo hitrejši dostop do informacij. V našem primeru gre za uporabo računalnika in lastnih telefonov ter knjižničnega kataloga COBISS z različnimi storitvami, ki se iz leta v leto izpopolnjujejo in nadgrajujejo.

Za osnovnošolce, ki kmalu vstopajo v srednješolsko izobraževanje, so primerne predvsem naslednje storitve:

COBISS+ - omogoča online dostop do naslednjih baz podatkov:

- vzajemna bibliografsko-kataložna baza podatkov COBIB.SI – skupni katalog slovenskih knjižnic, ki sodelujejo v sistemu COBISS.SI,
- lokalne baze podatkov – katalogi knjižnic v sistemu COBISS.SI.

Moj profil COBISS/Moja knjižnica – je vezan na posamezno knjižnico, in uporabniški profil, ki omogoča številne nastavitve uporabniškega vmesnika ter druge prilagoditve.

mCOBISS – je različica COBISS+, ki je prilagojena mobilnim napravam. Aplikacija izkorišča prednosti sodobnih telefonov, ki delujejo na sistemih Android (npr. Samsung Galaxy, Sony Xperia, HTC One), iOS (iPhone, iPad in iPod Touch) in Windows.

V učni uri, ki je predstavljena v nadaljevanju, je bila uporabljena predvsem storitev mCOBISS, seveda pa se ni dalo izogniti storitvi COBISS+, ki je osnova za način iskanja informacijskih virov. Storitev Moja knjižnica je bila učencem predstavljena zgolj informativno in se bodo z njo srečali kasneje.

5 UPORABA APLIKACIJE MCOBISS V 8. RAZREDU OŠ

Učna ura je bila izvedena v 8. razredu osnovne šole. Namen te učne ure je bil, da učenec: spozna globalno informacijsko omrežje, pojmuje knjižnice kot del globalne informacijske mreže, spozna različne dostope do katalogov, spozna vzajemni katalog COBISS/OPAC, uporablja signaturo za iskanje knjižničnega gradiva v prostem pristopu, pozna osnovne bibliografske podatke, pomembne za pridobitev vira, spozna organizacijo informacij v katalogu in ga uporablja za osnovno informiranje o izbiri in dostopnosti virov, uporablja storitve na informacijskem omrežju (COBISS+), uporablja storitev mCOBISS.

Učencem najprej na kratko predstavim COBISS. Razložim, da je to vzajemna baza slovenskih knjižnic, da je vanj vključenih večina knjižnic po Sloveniji in da lahko v njem pridobijo podatke o knjižničnem gradivu vseh knjižnic polnopravnih članic COBISS-a. Povem, da je tudi naša knjižnica del tega sistema.

Na i-tabli predstavim spletno stran COBISS – storitve COBISS+, Moj COBISS, Moja knjižnica. Večina učencev že pozna te storitve, nekateri so zanje slišali, drugi jih že uporabljajo. S pomočjo računalnika in projekcije na i-tabli hitro preletim osnovno in izbirno iskanje po COBISS+, ki je osnova za naše nadaljnje delo. Nato pokažem še, kako izgleda okolje Moje knjižnice in katere možnosti ponuja. Žal jim nekatere storitve preko šolske knjižnice niso omogočene, če pa so člani še kakšne druge knjižnice npr. Mariborske knjižnice, pa bodo to lahko uporabili. Gre za storitve kot so podaljšanje in rezerviranje gradiva, aktivacija obveščanj o poteku roka izposoje, o prispelem rezerviranem gradivu itd.

Osrednja tema te učne ure pa je namestitev aplikacije mCOBISS in njena uporaba. Učenci so zato s seboj prinesli mobilne telefone. Sicer je uporaba na šoli prepovedana, vendar jih občasno uporabimo v učne namene.

Pripravila sem učni list, na katerem so zbrane informacije o tem, kaj je mCOBISS, kaj omogoča in kako izgleda virtualno okolje (Priloga 1).

Razdelim učni list, kjer si učenci pogledajo, kaj vse jim omogoča ta storitev in kako izgleda virtualno okolje.

Nato najprej uredijo dostop do interneta – poiščejo ustrezni wi-fi in vpišejo geslo. Predhodno sem pripravila interni brezžični router, ki ga na šoli uporabljamo za učne namene. Sicer imamo vse učilnice in knjižnico povezane na Eduroam. Vendar če bi učencem zaupali geslo, bi učenci skrivoma uporabljali telefone in internet ter bi preveč obremenili omrežje.

Po mojih navodili si namestijo mobilno aplikacijo. Učenci z iPhoni dostopajo do aplikacije preko App Store, medtem ko tisti, ki imajo androide dostopajo preko google trgovina play. Registrirajo se tako, da vpišejo akronim knjižnice OSDFHO, številko članske izkaznice in geslo (Slika 1). V ta namen učencem razdelim članske izkaznice, ki so sicer shranjene v knjižnici in jih ne odnašajo domov, ker bi jih sicer večina izgubila. Predhodno sem jim v računalniku dodelila gesla. Ta so najmanj 8 mestna, in sicer vsebujejo številke ter velike in male črke. Gesla sem jim zapisala na samolepilni listič in prilepila na izkaznice. Ob koncu ure so mi izkaznice z gesli vrnili. Učiteljica pomaga pri nastavitvah.

Slika 1: Uporaba aplikacije mCOBISS na lastnih telefonih

Ko učenci dostopijo do virtualne knjižnice, se jim najprej odpre seznam izposojenega gradiva. Ta seznam je zelo dolg, ker imajo seveda izposojene tudi učbenike. Učenci so začudeni, presenečeni, opažajo, da imajo v zgornjem delu ekrana vsi sliko fanta, čeprav so prisotna tudi dekleta. Na vse načine želijo spremeniti sliko.

Vodeno brskajo po aplikaciji in spoznavajo možnosti uporabe:

1. **Članstvo** – Najprej si pogledajo članstvo. Povem, da je lahko za druge knjižnice, razen šolske zelo uporabna storitev, saj ne potrebujejo s seboj izkaznice, ker imajo na telefonu kodo članske izkaznice. Tudi nastavitve potisnih sporočil so zelo uporabne, saj nas spomnijo na pravočasno vračanje izposojenega gradiva in prevzem rezerviranega gradiva, na potek članstva itd. Prikažejo se na ikoni v spodnjem delu ekrana na zvoncu.

2. **Zgodovina** – Ker rezervacije niso možne v šolski knjižnici, to rubriko preskočimo in gremo na zgodovino, kjer si pogledajo, kaj so brali do sedaj. Lahko tudi iščejo po zgodovini in omejijo datum izposoje.

3. **Iskanje gradiva -** Nato pogledamo v zgornji del ekrana in se osredotočimo na iskanje gradiva, kar bo naša osrednja naloga v tej učni uri. Razložim, da s tem splošnim brskalnikom iščemo gradivo po celotni COBIB bazi, zato bomo raje uporabili puščico v desno

in prešli na podrobno iskanje. Iščemo po naši knjižnici OSDFHO, v oddelku Knjižnica, ker imamo še oddelek podružnična šola in dva oddelka v vrtcih. Nato poiščemo knjigo, ki jo bodo imeli za naslednje domače branje. Iščemo po naslovu in avtorju, omejimo vrsto gradiva na knjige ter jezik na slovenski (Grafenauer, Skrivnosti, knjige, slovenski). Dobimo več zadetkov. Učenci povedo, kaj pomenijo ti zadetki – število enot ali različne izdaje. Nato odpremo enega od zadetkov. Razložijo bibliografske podatke, ki jih vidijo, nato povedo koliko enot imamo te izdaje, koliko je prostih, koliko izposojenih. Nazadnje si pogledamo oznako postavitve ali signature (Knjižnica otroci 82-1 GRAFENAUER N. Skrivnosti IN:000000213). Pojasnim, da je knjižnično gradivo ločeno za učence in učitelje, zato je na prvem mestu lahko Knjižnica otroci – za učence ali Knjižnica strokovna – za učitelje in druge strokovne delavce. Postavitev 82-1 pomeni poezija, kar si pogledamo tudi na oznaki na knjižnih policah. Nato sledi priimek avtorja, ker leposlovje iščemo po začetni črki avtorjevega priimka, ter naslov in inventarna številka. Učenci sedaj samostojno poiščejo vsak svoje leposlovno književno delo, najprej s pomočjo aplikacije, nato prosto pristopijo k knjižnim policam in po pravilih s pomočjo kazalke poiščejo knjigo ter označijo mesto na polici. Knjigo prinesejo k mizi in primerjajo signaturo na zaslonu in na nalepki.

4. **Deli -** Nato odprejo ikono tri modre pike povezane z dvema črtama in pomeni deli. Razložim, da si vrstniki pogosto med seboj izmenjajo informacije o zanimivih knjigah. Eden izmed načinov je tudi preko te storitve. Dobijo nalogo, da to knjigo, ki jo imajo pred seboj z nekom v skupini podelijo preko katerekoli storitve (SMS, Facebook, Tweet, Viber idr.) Pogledajo, kako izgleda sporočilo, ki so ga prejeli. Opozorim, da lahko v sporočilu zapišejo tudi nekaj spremnih besed.

5. **Moja polica –** Učence povabim, da si ustvarijo svojo polico, na katero bodo nanizali knjige, ki so jih z veseljem prebrali. Odprejo tretjo ikono spodaj, storitev Moja polica. Desno zgoraj imajo tri bele krogce, ki jim pomagajo pri ureditvi police. Kliknejo nanje in ustvarijo novo polico, tako da zapišejo ime police. Ponovno poiščejo knjigo, ki jo imajo pred seboj in z enakim znakom kot prej dostopajo do police ter nanjo namestijo knjigo.

6. **Lokacija** – Pogledamo še uporabnost zadnje ikone v spodnjem delu ekrana. Pod njo se skrivajo telefonska številka, mail, spletni naslov in lokacija na zemljevidu.

7. **Članstvo v različnih knjižnicah** - Povem še, da lahko dostopajo tudi do drugih knjižnic, npr. Mariborske knjižnice, le da si morajo pridobiti člansko izkaznico in geslo.

Učenci lahko vprašajo, če je še kaj nejasnega, če si kakšnega koraka niso zapomnili. Sicer jih povabim, da čim več uporabljajo aplikacijo in zaključim učno uro. Učenci pospravijo knjige na police, kazalke na svoje mesto in seveda izklopijo in pospravijo telefone, da ne bo kakšnih nevšečnosti pri naslednjih urah pouka.

6 VREDNOTENJE UČNE URE IN UPORABNOST APLIKACIJE MCOBISS

Po izvedbi učne ure v vseh oddelkih sem pripravila tudi anketni vprašalnik za učence (Priloga 2).

Z njim sem ugotavljala, kako so bili učenci zadovoljni z izvedbo učne ure, ali je aplikacija zanje uporabna ali ne, kar so morali tudi utemeljiti, in kaj bi lahko bilo drugače.

Rezultati so bili nekako pričakovani, vendar v določenih segmentih presenetljivi. Anketo je izpolnilo 61 učencev. Od tega jih je bilo 60% zelo zadovoljnih z učno uro, 35% zadovoljnih in 5% nezadovoljnih. Največ jih je odgovorilo, da je aplikacija srednje uporabna, in sicer 64%, 30% jih meni, da je zelo uporabna in le 6, da je neuporabna. Najbolj pa me je presenetil podatek, da aplikacije 70% učencev po tej učni uri ni več uporabljalo. Tisti, ki so jo še uporabljali, so jo največ uporabili za pregled izposojenega gradiva ter za iskanje knjig, veliko manj za ostale navedene možnosti.

Glede na rezultate bi bilo smiselno, da bi se učno uro izvedlo v prihodnje v 9. razredu, ob koncu šolskega leta, da bi znanje o tej aplikaciji dobili časovno čim bližje srednješolskemu izobraževanju, saj bo verjetneje v srednješolskih letih in kasneje v študijskih letih aplikacija pogosteje uporabljena.

7 SKLEP

Z učno uro so učenci pridobili veščine uporabe mobilne aplikacije mCOBISS. Spoznali so različne možnosti, ki jih ponuja aplikacija, kot so pregled izposojenega gradiva, zgodovino izposojenih enot, možnost rezervacije v drugih knjižnicah, iskanje virov v knjižničnem katalogu COBISS, kreiranje Moje police z lastnim izborom knjig ter deljenje zanimivih naslovov knjig s prijatelji. Vse te možnosti so praktično preizkusili z uporabo lastnih telefonov, številko izkaznice in dodeljenim geslom. Dobili so tudi geslo za interni wi-fi, ki je posebej namenjen izobraževalnemu procesu na šoli.

Pridobljena znanja bodo lahko nadalje uporabili pri iskanju virov za seminarske naloge, referate, domača branja ipd. Kot člani večjih knjižnic bodo lahko spremljali sezname izposojenega gradiva po posameznih enotah in potek roka izposoje. V drugih knjižnicah bodo lahko gradivo tudi rezervirali ali podaljšali.

PRILOGI

Priloga 1: Učni list

VPRAŠALNIK ZA UČENCE 8. RAZREDA - mCobiss

1. **Kako bi ocenil učno uro mCOBISS?** Izberi en znak in ga pobarvaj.

   ☺   😐   ☹

2. **Se ti zdi, da je aplikacija uporabna?** Ustrezno obkroži.
   ZELO   SREDNJE   SPLOH NE

3. **Ali si po učni uri mCOBISS še uporabil aplikacijo?** Ustrezno obkroži.

   JA   NE

4. **Zakaj ja/ne?** Ustrezno obkroži/odgovori.

   Ja,…
   a) Pregledal/-a sem izposojeno gradivo.
   b) Poslal/-a sem sošolcu/-ki naslov dobre knjige.
   c) Izdelal/-a sem si novo poličko.
   d) Pogledal/-a sem zgodovino izposoje.
   e) Poiskal/-a sem knjigo.
   f) Namestil/-a sem si še za SIKMB.
   g) Drugo:_____

   Ne,…
   a) Nimam časa.
   b) Se ne znajdem.
   c) Ni uporabna.
   d) Ne smem uporabljati telefona.
   e) Me ne zanima.
   f) Drugo:_____

5. **Kaj bi lahko bilo drugače v tej uri?** Odgovori.

   _____
   _____

Priloga 2: Anketni vprašalnik

VIRI IN LITERATURA

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Veščine poučevanja na daljavo in praktični nasveti

Distance learning skills and practical advice

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POVZETEK

V obdobju učenja na daljavo je mnogim učiteljem težko zasnovati in organizirati svoje delo. Kako učence motivirati za učenje matematike na daljavo ter jim učenje le-te tudi osmisliti? Kaj zanima učence in kako jih napeljati, da so zainteresirani za samostojno izvrševanje nalog in aktivno komunikacijo? Ta vprašanja so me pripeljala do iskanja novosti in inovativnosti pri poučevanju v danih okoliščinah.

Priprava pouka na daljavo ima svoje posebnosti, učitelji pa lahko imajo težave z neizkušenostjo pri uporabi IKT orodja ali nezmožnostjo aktivnega vključevanja učencev. V tem prispevku je nekaj razmišljanj o teh težavah in osebnih izkušnjah uporabe orodij in priprave učnih gradiv, ki sem jih predstavila kot krožni proces učenja. Skratka, ni orodja, ki bi delovalo točno tako, kot želimo, vendar to tudi ni pomembno, ker svoje cilje lahko dosežemo na več različnih načinov.

KLJUČNE BESEDE

Učenje, poučevanje na daljavo, IKT, orodja, učna gradiva, motivacija, komunikacija

ABSTRACT

During the period of distance learning, many teachers find it difficult to design and organize their work. How to motivate students to learn mathematics at a distance and make their learning meaningful? What interests students and how to persuade them to be interested in independent task performance and active communication? These questions led me to search for news and innovation in teaching in given circumstances.

The preparation of distance learning has its own peculiarities, and teachers may have problems with inexperience in using ICT tools or the inability to actively involve students. In this paper, I bring some reflections on these problems and personal experiences of using tools and preparing learning materials, which I have presented as a circular learning process. In short, there are no tools that works exactly in the way we want them to, but it doesn't matter because we can achieve our goals in a number of different ways.

KEYWORDS

Learning, distance learning, ICT, tools, learning materials, motivation, communication

1 UVOD

Pouk na daljavo nas je naučil veliko novega. Poleg tega, da smo učitelji imeli priložnost, da utrdimo svoje IKT kompetence, smo v obdobju pouka na daljavo zelo hitro ugotovili, da ne obstaja perfektno digitalno okolje ali edinstveno IKT orodje, ki bo lahko rešilo vse naše učiteljske pomisleke in ki se bo lahko univerzalno uporabilo pri vseh učnih področjih - predmetih.

Pripombe staršev, da je otrokom težko slediti pouku na več različnih okoljih, temeljijo predvsem na nezadostni obveščenosti staršev in začetnem, pogosto neutemeljenem strahu, da se niti starši niti otroci ne bodo mogli spoprijeti z morjem različnih informacij.

Ta strah je popolnoma legitimen - imamo ga tudi učitelji. Vendar je zelo pogosto neutemeljen.

Naloga učitelja je, da razišče in se seznani s tehnološkimi in avdiovizualnimi komunikacijskimi viri in orodji ter različnimi tehnikami in jih na smiseln način uporabi v razredu. Pestra ponudba orodij lahko naredi učitelja sposobnega učenja z uporabo različnih pripomočkov [1].

Kaj potrebujemo, da bomo začeli učiti matematiko na daljavo? Kako ustvariti dobro zgodbo in urediti svoje lastno IKT okolje, ki bo dobro funkcioniralo? Poleg tega obstajajo primeri, kako je IKT orodje že bilo uporabljeno v učnem okolju, kot tudi predloge o tem, kako uporabiti različna orodja.

2 DOBER RAZLOG ZA KAKOVOSTNO IKT UČENJE NA DALJAVO

Eden izmed parametrov za ocenjevanje kakovosti šolskega pouka je uporaba različnih učnih metod. Enako mora kakovostni učni proces vključevati različna IKT okolja za učenje in uporabo različnih spletnih orodij. Pri izbiri okolja in orodij je bistveno predvsem, kako preprosta je njihova uporaba, seveda pa jih prilagajamo predvsem predmetu in učni temi. Vsi se izogibamo orodjem, kjer je potrebna dolga registracija, nato pa še oblikovanje nekega močnega dolgega gesla in podobno. Prav tako nekatera okolja delujejo kot nadzorna plošča "vesoljske

ladje", kjer se prvotno navdušenje v petih minutah spremeni v razočaranje, saj ne vemo, kje naj začnemo.

3 PRIMER UČNEGA PROCESA

Skratka, ni orodja, ki bi delovalo točno tako, kot si želimo, ampak sploh ni pomembno, ker lahko lastne cilje dosežemo na več načinov [2]. Vizualno lahko celoten postopek od ideje do izvedbe in uporabe materialov prikažemo kot ponavljajoči se proces. S ponavljanjem in eksperimentiranjem obenem izboljšujemo svojo prakso.

Načrtovanje dela (Slika 1):

- Izbira IKT okolja (v katerem boste vi in učenci nemoteno komunicirali)
- Metodološko-didaktična in strokovna priprava učitelja
- Izbira IKT orodij ali orodja (ki bo uporabljeno pri določeni enoti ali v širšem pomenu - pri določenem predmetu)
- Priprava poteka dela in predvidevanje možnega scenarija
- Izdelava samega gradiva
- Komunikacija z učenci in povratna informacija
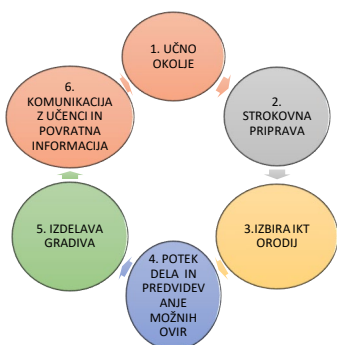
Slika 1. Koraki pri postopku izdelave gradiv za pouk na daljavo

4 IZBIRA UČNEGA OKOLJA

Najprej naj povem, da je na začetku najbolj pomembna izbira nekega splošnega okolja, v katerem bo pouk na daljavo sploh potekal. Organizacijska IKT okolja ali platforme pomagajo vsem učencem šole ali enega razreda (ožje – v okviru enega predmeta), da se zberejo in sodelujejo na enem mestu. Uporabniki morajo biti vpisani v določeno okolje (povezava in dostop sta lahko omejena). Obvestila, vsa gradiva in povratne informacije so na določenem mestu dostopna za vse deležnike. V preglednici predstavljam nabor največkrat uporabljenih okolji (Preglednica 1).

Preglednica 2. Primer – največkrat uporabljena IKT okolja

OKOLJE	TIPI / MODELI	OPIS	POVEZAVA
Organizacija, splošne lastnosti temeljijo na dostopnosti in varnosti; Objava gradiv, obvestil …	Moodle Arnes	Številne in različne vsebine – dostop ... omejen le na učence	https://moodle.org/?lang=sl https://www.arnes.si/storitve/ splet-posta-strezniki/arnes-ucilnice/
GOOGLE okolje Google Classroom Google Drive Dropbox	Različne vsebine, istočasno sodelovanje – v povezavi z Google Drive, Google Doc, Google Meet in ostalimi Googlovimi aplikacijami – sodelovanje in spremljanje podatkov v oblaku	https://classroom.google.com/u/0/h https://www.google.com/drive/ https://www.dropbox.com/
Microsoft okolje (MS Teams OneNote o365)	Različne vsebine – v povezavi z Microsoftovimi orodji – Ekipe, OneNote, Microsoft Whiteboard, Sway … Spremljanje podatkov in istočasno sodelovanje	https://www.microsoft.com/sl-si/microsoft-365/microsoft-teams/group-chat-software https://www.microsoft.com/sl-si/microsoft-365/onenote/digital-note-taking-app?ms.url=onenotecom&rtc=1 https://www.microsoft.com/sl-si/microsoft-365/onedrive/online-cloud-storage
Web stranica (WordPress, HTML)	Enostavno objavljanje vsebin	https://wordpress.org/
YouTube	Okolje za objavo video posnetkov	https://www.youtube.com/

5 STROKOVNA PRIPRAVA UČITELJA

Ne glede na vrsto poučevanja, na katero se pripravljamo (na daljavo ali v živo), je najpomembnejša strokovna priprava, ko

razmišljamo, katere cilje želimo doseči. V mojem primeru gre za pripravo matematičnih vsebin za učence. Pripravo oblikujemo na podlagi že obstoječih gradiv (stare priprave, spletna gradiva, učbeniki). Velikokrat si pri določeni temi pomagamo z izkušnjami (npr. kakšne težave so učenci imeli pogosto pri obdelavi določene snovi). Veliko matematičnih gradiv najdemo lahko tudi, če preprosto o določeni snovi pobrskamo na spletu. Potem že obstoječe priprave prilagodimo in popestrimo z določenimi primeri glede na potrebe učencev. Izkušnje so mi pokazale, da ima vsaka vsebina določeno stopnjo možnosti, da postane uporabna za učence v primeru, če dobro določimo, kaj je v tej vsebini bistveno za naše učence. Znotraj določene snovi lahko pripravimo dodatne izzive za učence s pomočjo različnih orodij (papir, tabla, igra, kviz, vprašalnik, interaktivna predstavitev ipd.). Ne smemo pozabiti, da če je določena snov dolgočasna za učitelja, je tudi učencem, kot poslušalcem, gotovo manj zanimiva.

6   IZBIRA IKT UČNIH PRIPOMOČKOV

Ko so osnovnošolci seznanjeni in navajeni IKT okolja, v katerem izmenjujemo informacije, lahko dodajamo oz. uporabljamo še določene interaktivne dodatke. Znotraj določenega in znanega okolja za učenje je to lažje. V mojem primeru sem uporabljala okolje MS Teams znotraj o365 za izmenjavo informacij z učenci, oddajanje obvestil, videoposnetkov, reševanje domačih nalog, komunikacijo itd. Za obogatitev samih učnih vsebin pa sem izbirala med številnimi spletnimi učnimi pripomočki (npr. Geogebra, Excelove preglednice, Google Sheets, MS Forms, Quizziz, Kahoot, Padlet …) (Preglednica 2).

Preglednica 2. Različni primeri pogosto uporabljenih IKT orodij/pripomočkov/aplikacij

IKT učni pripomočki	OPIS	POVEZAVA
Geogebra	Prosto dostopna aplikacija za predstavljanje matematičnih grafov, 3D modelov, geometrije …	https://www.geogebra.org/?lang=sl
MS Excel	Matematične preglednice, ustvarjanje formul za računanje …	https://www.microsoft.com/en-us/microsoft-365/excel#pivot-forPersonal
Google Sheets	Sodelovanje pri delu	https://docs.google.com/spreadsheets/u/0/
Quizziz, Kahoot Plickers	Izdelava on-line kvizov	https://quizizz.com https://kahoot.com https://get.plickers.com/
Google Docs MS Word Meeting Word	Obdelava besedila (online in offline)	https://www.google.com/docs/about/ https://www.microsoft.com/sl-si/microsoft-365/word http://meetingwords.com/
Prezi Sway Padlet MS Powerpoint	Predstavitve (online in offline)	https://prezi.com/ https://sway.office.com/my https://padlet.com/ https://www.microsoft.com/sl-si/microsoft-365/powerpoint
Classtools	Spletno mesto za ustvarjanje izobraževalnih iger, testov in kvizov	https://www.classtools.net/
MS Forms Google obrazci	Izdelava kvizov in preizkusov znanja	https://forms.office.com/Pages/DesignPage.aspx https://www.google.com/intl/sl_SI/forms/about/
Showme MS Whiteboard Google jamboard	Izdelava predstavitve s snemanjem glasu, pisanjem in risanjem	https://www.showme.com/ https://www.microsoft.com/sl-si/microsoft-365/microsoft-whiteboard/digital-whiteboard-app https://edu.google.com/products/jamboard/?modal_active=none

7 POTEK DELA IN PREDVIDEVANJE MOŽNIH OVIR

Ko začnemo pripravljati določeno učno snov za učence, sledi strokovna in tehnična priprava za izdelavo gradiv. Če ustvarjamo video, se moramo bolj natančno pripraviti, kot če stojimo v razredu pred tablo. Predvidevati moramo, kaj bomo natančno povedali. Skrbeti moramo za kratko, jasno in jedrnato izražanje ter za uporabo barv, slik in drugih podrobnosti. Predvidevati moramo tudi odzive učencev na podano snov in jim znotraj tega ponuditi priložnost za samostojno razmišljanje, raziskovanje in aktivno učenje [3].

Če pripravljamo kviz ali kratko preverjanje znanja, gremo skozi fazo načrtovanja, predvidevanja in izdelave. Nekatera IKT orodja imajo bogate lastnosti in včasih med načrtovanjem odkrijemo, da lahko naredimo veliko bolje, če spremenimo načrt. Včasih je izbrano orodje takšno, da ugotovimo, da ni možno, da izpeljemo to, kar smo si zastavili. To je tudi del učenja in tolaži me, da ob izkušnjah z določenimi orodji (npr. MS Forms ali Google obrazci) postopek postane lažji (Slika 2).
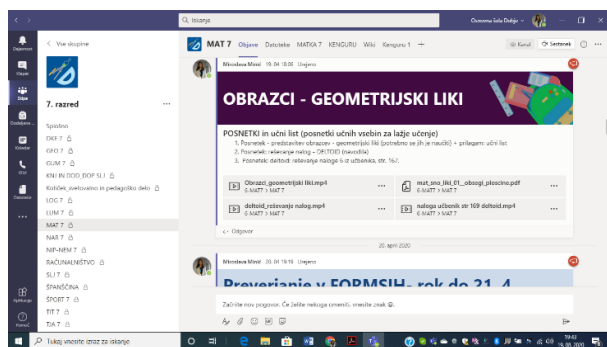
Slika 2. Delitev posnetka z učenci znotraj določenega IKT okolja

8 IZDELAVA GRADIV

Pri izdelavi gradiv moramo biti pozorni na cilj, da želimo pritegniti in zadržati pozornost naših učencev. Pomembna je kvaliteta narejenega gradiva [4]. Npr. pri posnetku je zelo pomembna tudi kakovost tona in slike, hitrost govora, naš glas, rokopis, pavze, ponavljanja in tudi morebitne napake. Potrebno je vnaprej pripraviti določene pripomočke za snemanje in jih vnaprej preizkusiti. Primerno je narediti nekakšen seznam nalog in primerov, ki jih bomo obdelali. Pripraviti je potrebno še podrobne rešitve in dodatne opombe.
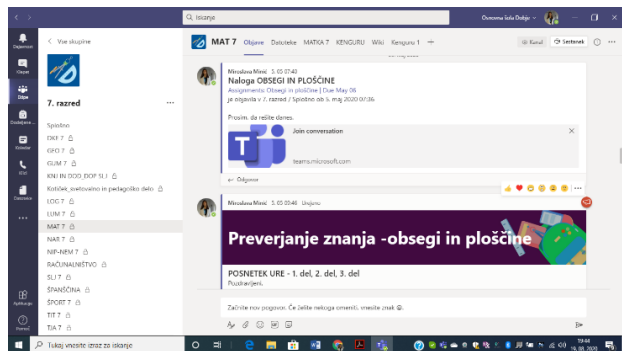
Slika 3. Primer zastavljanja nalog za učence v okolju Teams

9 KOMUNIKACIJA Z UČENCI IN POVRATNE INFORMACIJE

Komunikacija z deležniki in povratne informacije sta bistveni del v tem učnem ciklu. Kar smo naredili, podelimo z učenci in čakamo na povratne informacije in odzive. Zato moramo biti najprej prepričani, da je postavljeno okolje za delo dostopno in razumljivo vsem sodelujočim. Z ustvarjenim poskušamo motivirati učence in tudi spodbuditi njihovo radovednost. Če nam to uspe, je učenje učinkovitejše, dolgotrajnejše in na koncu bolj prijetno. Tekmovalno učenje je včasih učinkovito, prisilno učenje pa v takšnem okolju skoraj nemogoče.

Radovednost in aktivno sodelovanje učencev lahko spodbudimo z zanimivo temo ali igro, vendar se moramo nujno zavedati, da so pri učencih lahko prisotne različne ovire, ki so zunaj našega dosega in moči: utrujenost, stres, zasebne težave …

Koliko smo resnično uspešni, lahko ugotovimo, če priskrbimo povratne informacije [5]. Te se lahko pridobijo v obliki klepetov, video komentarjev, anket, e-poštnih sporočil, krajših preizkusov ali vprašalnikov (Slika 3). Moja izkušnja je, da so videokonferenčna srečanja z razredom oz. skupinami učencev in učiteljem najboljši nadomestek poučevanja v živo. Neposredna komunikacija je bolj spontana in zmanjšuje psihološko nepripravljenost postavljanja vprašanj. Pri meni se je dobro pokazala uporaba videokonferenčnega srečanja v kombinaciji z deljenjem namizja in bele table obenem. Na ta način so bili učenci direktno vključeni v razlago snovi in so lahko komentirali ter obenem sodelovali pri pisanju na tablo, kot v razredu pri pouku v živo. Na podlagi takšnega sodelovanja nisem imela večjih težav tudi pri samem ocenjevanje takšnega dela. Zdi se mi pomembno prisluhniti pripombam in kritikam vseh, ki so deležni učnega procesa. Učenje na daljavo je zagotovo priložnost za krepitev vezi med učiteljem in učencem z namenom iskanja in zadovoljevanja skupnega cilja - pridobivanja znanja. Pri samem ocenjevanju učencev se mi zdi pomembno, da v ospredje postavimo cilj: učenje iz radovednosti s ciljem pridobivanja znanja in poskušamo motivirati čim več učencev k čim večji ažurnosti in vključenosti.

10 ZAKLJUČEK

Pri poučevanju na daljavo se srečujemo z različnimi preprekami. Največja težava pri poučevanju na daljavo je pomanjkanje spremljanja direktnega oz. osebnega odziva učencev ter direktno spremljanje učenčeve motivacije. Pri izvedbi pouka na daljavo se moramo v prvi vrsti zavedati sposobnosti učencev. V razredu imamo zelo različne učence, ki živijo v različnih domačih okoljih. Pri tem se držimo načela manj je več v okviru učnih načrtov. Ne smemo pa pozabiti tudi na bolj vedoželjne učence za katere je pomembno pripraviti kakšno dodatno nalogo ali izziv.

Učenci morajo kljub temu, da se šolajo na daljavo, redno spremljati pouk in sodelovati na način predpisan s strani učitelja ali šole. Pred pričetkom dela mora učitelj preveriti IKT kompetence učenca. Šele, ko ima vpogled, kakšne so situacije pri učencih, lahko načrtuje izvedbo pouka s pomočjo predstavljenih IKT oblik okolja in izbranih IKT pripomočkov. Pri samostojnem delu je pomembno, da učitelj poda jasna, konkretna navodila in da učence vodi pri njihovem delu na način, da sprotno preverja njihovo delo in jim daje redne povratne informacije, ki bodo učencu omogočale napredovanje po njihovih zmožnostih. To je

tudi pomembno za učence, ki ne znajo načrtovati svojega časa učenja in so za učno delo manj motivirani.

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Izdelovanje preprostih zemljevidov s programom Google Earth pri pouku geografije

Simple map making using Google Earth program in teaching geography

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POVZETEK

Pri poučevanju geografije so zemljevidi zelo pomembni, morda celo najbolj. Z njimi prikazujemo pomanjšano in posplošeno ponazoritev celotne Zemlje ali njenih izbranih delov. Na ta način lahko učencem približamo oddaljene kraje, ki so nam v obliki šolskega dela (in tudi sicer) pogosto nedosegljivi. Opazovanje je namreč temeljna metoda dela v geografiji, ki jo izvedemo posredno, kadar neposrednega opazovanja ni mogoče izvesti. Eden od pomembnih ciljev geografije je razvijanje orientacije in kartografske pismenosti. Pri tem je smiselno, da osnovne spretnosti orientacije in risanja zemljevidov nadgradimo z digitalno obliko, ki je pravzaprav današnji jezik mladih. Izdelovanje zemljevidov v Google Earth programu nudi zanimivo izkušnjo spoznavanja Zemlje. Delo poteka individualno, vsak učenec uporablja svoj računalnik, tempo dela si po potrebi prilagaja. Poudarek je tudi na odgovornem pristopu posameznika do dela, da pravočasno in natančno opravi osnovne naloge in zmore kasneje določene naloge izdelati samostojno. Pri delu je pomembno opozoriti tudi na varno in odgovorno rabo interneta.

KLJUČNE BESEDE

Zemljevid, Google Earth, geografija, medpredmetno povezovanje, digitalne kompetence

ABSTRACT

Maps are very, if not most important in teaching geography. They are used as a generalized illustration of the entire Earth or its selected parts. Using maps, we can bring distant, inaccessible places closer to students. Observation has always been a fundamental method in geography and can be performed indirectly when direct observation cannot be used. One of the important goals of geography has been to develop orientation and cartographic literacy. It makes sense that the basic map orientations are upgraded with a digital form, which is actually today's language of young people. Creating maps in Google Earth offers an interesting Earth exploration experience. Each student uses their own computer, they can adjust the pace of work as needed, with the emphasis on every student being responsible for completing the work in the designated time and being able to do some of the tasks independently later. The teacher also needs to address the issue of internet safety.

KEYWORDS

Map, Google Earth, geography, cross-curricular integration, digital competences

1 UVOD

Raziskovanje Zemlje je že od nekdaj privlačilo človeka. Svoje poti in spoznanja je beležil sprva s preprostimi skicami in risbami, kasneje pa so nastali zemljevidi, kot jih razumemo danes. »Vsem zemljevidom, starim ali najsodobnejšim, elektronskim in interaktivnim je skupno, da prikazujejo pokrajino na poseben geografsko-kartografski način.« [1]

Spoznavanje in doživljanje neke pokrajine v živo je nemogoče menjati zgolj z opazovanjem satelitskih posnetkov in zemljevidov, so pa ti odlično sredstvo za popestritev in spoznavanje sveta pri geografiji. Vsebine, ki jih na zemljevidih prikažemo, so lahko tudi tematske in služijo spoznavanju obravnavane teme pri določenem predmetu (pogosto zgodovini, lahko tudi angleščini, slovenščini, gospodinjstvu ipd.). Tak način medpredmetnega povezovanja je predstavljen tudi v prispevku.

S pomočjo programa Google Earth lahko učenci raziskujejo Zemljo in izbrana območja ter izdelajo lastne digitalne zemljevide, na katerih prikažejo vsebine, ki jih želijo predstaviti. Prednost takega načina je, da lahko na prikazan zemljevid nanizamo poljubne elemente, jih po potrebi skrijemo, dodajamo, spreminjamo, dokler nismo s svojim izdelkom zadovoljni. Končni izdelek je lahko del predstavitve ali zaključen zemljevid (slika), ki ga lahko natisnemo, posredujemo, prav tako pa lahko posredujemo tudi samo posamezne elemente zemljevida (točke, območja, črte).

2 METODE DELA

Geografija je v program osnovne šole umeščena zato, da učencu pomaga pridobiti znanje, sposobnosti in spretnosti, s katerimi se lahko orientira. Pri pouku geografije učenci razvijajo sposobnosti za uporabo preprostih geografskih raziskovalnih metod, s

katerimi pridobivajo informacije o okolju. Usposabljajo se za rabo različnih sredstev in medijev, pri čemer je še posebej pomembna informacijska tehnologija. Učenci z IT tudi samostojno zbirajo in obdelujejo geografske informacije in jih predstavljajo. [2]

V članku je predstavljeno delo s programom Google Earth (Google Zemlja), ki omogoča učencem spoznavanje in raziskovanje območij Zemlje, ki jim sicer ne bi bila dostopna. Kadar ne moremo neposredno opazovati obravnavane pokrajine, poskušamo ustvariti predstave s pomočjo projekcije, ki je ena temeljnih metod pri pouku geografije. Za izdelavo zemljevidov v Google Earth programu uporabimo grafično metodo. Učne metode razumemo kot najboljše poti in načine pridobivanja znanja, sposobnosti in navad z dobrim sodelovanjem učitelja in učenca. Obe metodi uvrščamo v metode posrednega opazovanja. [3]

2.1 Metoda projekcije

Opazovanje je temeljna metoda dela v geografiji. Med sodobna sredstva, s katerimi opazujemo in raziskujemo pokrajino našega planeta, uvrščamo tudi letalske in satelitske posnetke. Slednji so nam na voljo v Google Earth. Satelitski posnetki, ki jih omogoča program, razširjajo paleto geografskih didaktičnih sredstev.

Google Earth ali Google Zemlja je program, ki je večini zelo dobro poznan. Uporablja se ga za iskanje in načrtovanje poti, prikazovanje pokrajin, pogled na svet v 3D tehniki. Najbolj zanimiv za učence je ulični (street view) pogled, možno pa je izdelati tudi prava potovanja (povezati določene točke in slike v nekakšen video posnetek) in preproste zemljevide.

Z uporabo satelitskih posnetkov lahko učenci samostojno raziskujejo določeno območje. Smiselno pa je, da jih vsaj od začetka pri tem usmerjamo, saj je informacij ogromno. Učenčevo opazovanje naj ne bo samo preprosto gledanje, ampak zavestna dejavnost. Projekcija je najpomembnejša pri usvajanju znanja, saj z njo oblikujemo jasne, pravilne predstave o pokrajinah, ki jih nismo nikoli videli. [3]

2.2 Grafična metoda (risanja)

Tudi metoda risanja je za geografijo zelo pomembna. Omogoča nazornost, preglednost, pri pouku geografije ne moremo mimo uporabe različnih prostorskih prikazov. Metoda risanja omogoča hitrejše in lažje razumevanje geografskih vsebin. Med temeljno risanje spada tudi risanje geografskih zemljevidov. [3]

Zemljevid je pomanjšana podoba Zemljinega površja, narisana na ravno podlago, največkrat na papir. Kartografi izdelujejo zemljevide s pomočjo računalniških programov in letalskih oziroma satelitskih posnetkov površja. Ti jim služijo kot vir podatkov in osnova za risanje v ptičji perspektivi, v kateri je narisana večina zemljevidov. Vsak zemljevid mora biti ustrezno opremljen z naslovom, merilom in legendo, ki je potrebna, da simbole razume vsak, ki zemljevid uporablja. [1] Pri izdelavi zemljevida poskrbimo, da učenci čim bolj pravilno in natančno izdelajo svoj zemljevid. Zemljevidi morajo ustrezati razvojni stopnji učencev, ne smejo biti preveč poslošeni, upoštevati pa moramo tudi estetskost pri oblikovanju.

Satelitski posnetki, ki jih omogoča program Google Earth, omogočajo pogled na pokrajino, jo povezujejo z zemljevidom, zato jih lahko uporabljamo tudi kot pomoč pri uvajanju v razumevanje zemljevidov. Uporaba slik iz zraka je za učence v

začetku precej zahtevna. Niso navajeni perspektive, zato je interpretaciji takih slik in pri risanju zemljevidov na tako podlago potrebno posvetiti precej pozornosti. Po njihovi uporabi je učencem veliko lažje razumeti zemljevide z njihovimi abstrakcijami in simboli. [3]

V nadaljevanju je prikazan postopek za izdelavo zemljevidov v Google Earth programu.

3 POTEK DELA

3.1 Izvedba ure

Ura je v celoti izvedena v računalniški učilnici, kjer vsak učenec lahko dela na svojem računalniku. Če je računalnikov manj in delo poteka v paru, vsak učenec opravi nekaj nalog. Program Google Earth je že naložen na računalnikih, učenci pa si ga doma lahko naložijo sami.

Učencem predstavimo končni cilj: izdelan zemljevid z vsemi osnovnimi podatki, ki ga shranijo v obliki slike. Za učence sedmega razreda, ki se običajno prav pri geografiji prvič srečajo z izdelovanjem digitalnega zemljevida, je to dovolj. Učenci osmega razreda pa se naučijo oziroma obnovijo izdelavo zemljevida in nato pripravijo svoj zemljevid, ki je del predstavitve (govornega nastopa).

Cilj je, da učenci v eni uri uspejo po navodilih izdelati zemljevid, se naučijo samostojno delati s programom in ustrezno shranijo svoj izdelek.

Ura je zasnovana kot del medpredmetnega povezovanja: v sedmem razredu na temo Grkov, v osmem razredu Amerike (slika 1), v devetem razredu aktualnih dogodkov (30 let padca berlinskega zidu ipd.). Vsebine, ki jih prikažemo na zemljevidu, se navezujejo na snov zgodovine, kulture, športa in drugih predmetov, obenem pa z njimi vsebinsko sledimo učnemu načrtu geografije (Sredozemlje, Amerika, Slovenija v Evropi in mednarodne povezave …). Pomembno je dobro sodelovanje med učitelji, da se obravnavane vsebine drugih predmetov geografsko umestijo v prostor in obenem na zemljevid v obliki ustreznih simbolov (sličic).

Ura se lahko izvede samostojno za poučevanje različnih geografskih vsebin.

Slika 1. Izdelovanje zemljevida pri obravnavi Amerike

3.2 Prvi koraki za izdelovanje zemljevida v Google Earth

Učenci program že uporabljajo za iskanje lokacij, poti in uličnega ogleda (street view), ne poznajo pa vseh možnosti, ki jih ponuja. Učencem najprej predstavimo stransko vrstico, ki vsebuje Iskalnik, Mesta (shranjevanje lastnih vsebin) in Sloje (izbiranje že vnesenih vsebin: meje, imena držav, ceste …). Če je stranska vrstica skrita, jo prikličemo s klikom na prvo ikono v orodni vrstici (Prikaži stransko vrstico) ali poiščemo in odkljukamo v zavihku Pogled. Nekateri učenci se hitro znajdejo in poiščejo sami, za tiste manj spretne pa je pomembno, da podajamo navodila postopno ob hkratni projekciji na tablo (delamo skupaj z učenci). Pisanje navodil ni potrebno, saj si največ zapomnijo s tem, ko delajo sami. Na zemljevid postopno vrisujemo točke (Doda oznako položaja), meje (Doda pot), pobarvamo območja držav ali druga izbrana območja (Doda mnogokotnik).

V sedmem razredu pri spoznavanju Grčije označijo lokacije, ki so povezane s Starimi Grki: Atene, Knosos, goro Olimp, Olimpijo, Delfi ipd. (slika 2). Označijo tudi morji, ki Grčijo oblivata (Egejsko in Jonsko morje). Pomembno je, da neko območje ne samo vtipkajo v iskalnik, dodajo oznako in poimenujejo, ampak si ga tudi podrobneje ogledajo, oznako pa postavijo zelo natančno npr. za Atene na Partenon, za Knosos na arheološko najdišče palače, za Olimpijo na stadion. Pri tem spoznajo, da se Olimpija (prizorišče prvih olimpijskih iger) in gora Olimp (sedež grških bogov in najvišja gora Grčije) nahajata daleč narazen. Na zemljevid vnesemo tudi današnjo mejo Grčije z ukazom Doda pot. V slojih moramo imeti vklopljen sloj državne meje. Omejimo se samo na celinsko mejo, zato začnemo z dodajanjem točk (klikanjem) na eni strani in zaključimo na drugi. Če želimo mejo popraviti ali smo naredili napako, lahko posamezne točke premikamo, dodajamo, izbrišemo, dokler meje (oziroma poti) ne shranimo.

Slika 2. Shranjevanje vnesenih vsebin v stranski vrstici Mesta

V osmem razredu pri spoznavanju Amerike poleg vrisovanja točk in mej označijo posamezna območja parkov, prerij, tornadov ipd., za kar je potrebno uporabiti funkcijo Doda mnogokotnik (slika 3). Tako kot za mejo države dodajamo točko za točko, program pa sočasno riše območje. Paziti moramo, da točk ne rišemo preko že obarvanega dela, saj s tem brišemo območje.

Slika 3. Uporaba funkcije Doda mnogokotnik za prikaz območja Yellowstonskega parka

Podobno se lotimo tudi ostalih vsebin, pri čemer smiselno povečujemo težavnost. V devetem razredu lahko že raziskujemo mikrolokacije: na primeru berlinskega zidu (Brandenburška vrata, Potsdamski trg, Checkpoint Charlie, potek avtoceste 115).

Nadaljnje vnose učenci naredijo samostojno, delo pa nadaljujejo doma ali po dogovoru v šoli. Med sabo si lahko pomagajo: spretnejši pomagajo tistim učencem, ki niso najbolj vešči dela z računalnikom.

3.3 Urejanje in shranjevanje zemljevida

Za večjo preglednost našega dela je potrebno urediti vnose, saj se v programu shranjuje delo vseh učencev. V Mestih se postavimo na Moja mesta in z desnim klikom dodamo mapo, ki jo ustrezno poimenujemo (Stari Grki, Amerika …). Vse vnose, ki se nanašajo na določeno temo, prenesemo (z levim klikom) v izbrano mapo. Če mapo ustvarimo že takoj na začetku, se vnosi avtomatično shranjujejo vanjo.

Vsako shranjeno oznako, mejo, mnogokotnik lahko poljubno urejamo. Z miško se postavimo na izbran vnos, s klikom na desni gumb se nam ponudijo možnosti, kjer izberemo spodnjo Lastnosti. Odpre se nam okno, v katerem lahko urejamo ime, velikost, barvo, prosojnost (primerno za označevanje območij/mnogokotnikov) in tudi simbol. S klikom na standardni žebljiček poleg imena se nam odpre novo okno, v katerem lahko izberemo številne druge simbole (za promet, poklice, restavracije …), lahko pa dodamo svoj simbol/sličico, če izberemo Dodaj ikono po meri. Namesto običajnega žebljička lahko za Olimp dodamo Zevsa, za Atene boginjo Aten ipd. Za enkratno uporabo je dovolj, da na spletu poiščemo ustrezno sliko in povezavo prilepimo v polje. Če pa želimo, da slike ne izginejo (shranjevanje poti), jih je bolje najprej shraniti v datoteko na računalniku in izbrati ukaz Prebrskaj ter nato poiskati shranjeno sliko.

Ko so vsi vnosi urejeni, zemljevid orientiran proti severu (na kompasu zgoraj desno kliknemo na oznako N za sever), je potrebno zemljevid opremiti tudi s potrebnimi podatki in shraniti.

Najprej pripravimo območje, ki ga želimo na zemljevidu prikazati. Poskrbimo, da bo dovolj prostora za dodajanje naslova, legende, podatkov o avtorju ter datumu izdelave. Odstranimo vse nepotrebne in moteče podatke: v Slojih izklopimo fotografije, ceste, oznake, meje, v iskalniku izbrišemo vse zadetke.

Vsak zemljevid potrebuje tudi merilo, ki spada med osnovne matematične elemente karte. Najbolj običajen zapis je številčno

merilo, lahko je tudi opisno, Google Earth pa nam ponuja grafično ali dolžinsko merilo. Gre za črto razdeljeno na več enakih delov pri čemer je dolžina posameznega dela odvisna od merila karte. [4]

V zgornji orodni vrstici izberemo ukaz Shranjevanje slike, pri čemer se nam odprejo nova okna. V prvo okno vpišemo naslov zemljevida, pri opisu dodamo ime avtorja ter kraj in leto izdelave.

Slika 4. Urejanje naslova in legende zemljevida
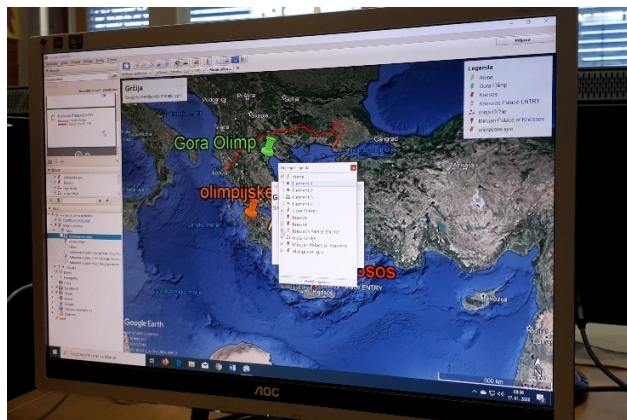
V drugem oknu urejamo legendo (slika 4): morebitne odvečne simbole izbrišemo, napačno zapisana imena (šumnike) popravimo. Obe okni lahko poljubno prestavljamo po zemljevidu. S klikom na Možnosti zemljevida urejamo elemente, ki jih želimo prikazati: poleg naslova in legende dodamo še merilo, kompas pa lahko izklopimo, saj smo zemljevid že poravnali proti severu. Če želimo, da naši vnosi pridejo bolj do izraza, pri Prilagajanju sloga izberemo zemljevid z manj nasičenimi barvami (slika 5). S klikom na Shrani sliko zemljevid poimenujemo in shranimo na ustrezno mesto v računalniku.

3.4 Navodila za delo

Učenci za izdelavo zemljevida čim bolj sledijo naslednjim navodilom.

- Zemljevid je izdelan v ustrezni velikosti in prikazuje obravnavano območje v celoti.
- Zemljevid je pravilno orientiran (sever zgoraj).
- Nepotrebni podatki so odstranjeni (izključeni).
- Zapis geografskih imen je pravilen (upoštevanje velikih začetnic in razmakov).
- Med ponujenimi zadetki v iskalniku so izbrani pravilni.
- Vrisani podatki (točke, linije …) so natančno umeščeni v prostor (zemljevid).
- Zemljevid je ustrezno opremljen: naslov, merilo, legenda, podatki o avtorju in letu izdelave.
- Izbrani simboli so ustrezni in nazorni, lahko so nadomeščeni tudi z drugimi sličicami.
- Oznake in napisi so ustrezne velikosti in barve, pomembna je preglednost in estetskost.
- Končni zemljevid je izvožen in shranjen kot slika v .jpg obliki.

Slika 5. Primer zemljevida z manj nasičenimi barvami
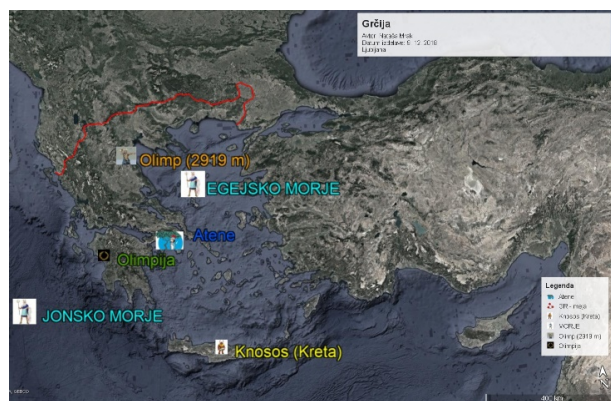
Nekaj časa in potrpežljivosti zahteva ugotavljanje prave velikosti vstavljenih oznak, napisov, odstranjevanje nepotrebnih podatkov ter končno shranjevanje zemljevida. Če želimo doseči kakovosten izdelek, je potrebno izdelati več različic in iskati izboljšave.

4 REZULTATI

S predstavljenim načinom dela so uspešno doseženi številni cilji, ki jih predvideva tudi učni načrt za geografijo: učenci uporabljajo različne načine prikazovanja geografskih informacij, se orientirajo na zemljevidu, se usposabljajo za uporabo različnih vrst zemljevidov, razvijajo poznavanje lokacij in prostorov ter poskušajo nacionalne in mednarodne dogodke postaviti v geografski okvir, pridobljeno znanje medpredmetno poglabljajo. [2] Cilje dosegamo z aktualnim izbiranjem vsebin, s sodobnimi učnimi oblikami in metodami, pri tem upoštevamo potrebe in interese učencev in posegamo po uporabi sodobnih tehnologij.

Učenci lahko svoje kompetence razvijajo le, kadar imajo priložnost biti aktivni. Učijo se samostojnega dela: uporaba programa za izdelavo zemljevidov. Učijo se sistematičnosti in organizacije dela: iskanje in shranjevanje slik, vnos vsebin na zemljevid, urejanje in izvoz zemljevida. Učijo se estetskega oblikovanja. Učijo se tudi potrpežljivosti in vztrajnosti, zlasti pri risanju večjih površin npr. držav, celin. Nekateri učenci svoje znanje uporabijo tudi pri drugih predmetih, pri raznih projektih (slika 6) ali v osebnem življenju.

Za geografijo je ključnega pomena neposredno opazovanje, ki pa ga uspešno nadomestimo z dobrimi posnetki. Analiza satelitskih posnetkov razvija opazovanje, omogoča predstavo in učenca usposablja, da prostor razume razvojno. [3] Učenci z analizo satelitskih posnetkov in izdelavo lastnih zemljevidov razvijajo orientacijo in prostorsko predstavo. Če vključimo še medpredmetno povezovanje, učenci pridobljene informacije poglobijo in jih prostorsko umestijo.

Slika 6. Predstavitev Erasmus+ držav s pomočjo Google Earth programa

5 ZAKLJUČEK

Izbrani način dela zahteva dobro učiteljevo pripravo: poznavanje možnosti za delo v programu in preizkus možnosti, preverjanje nameščenosti in delovanja programa na računalnikih. Izdelavo zemljevida je potrebno preizkusiti tudi v šolski računalniški učilnici, da se prepričamo o delovanju programa.

Učenci se programa hitro priučijo, saj je narejen za široko uporabo. Smiselno ga je uporabiti večkrat, da se znanje ne izgubi. V devetem razredu in kasneje v srednji šoli bi bilo možno izdelovanje zemljevidov nadgraditi z delom v ArcGIS programu, ki se uporablja kot osnova za delo na številnih delovnih mestih. Pomembne so tudi digitalne kompetence, ki jih učenec pridobi s takim načinom pouka, še zlasti v času, ki nas sili, da ne uporabljamo šolskih atlasov (epidemija). Navodila za izdelavo zemljevida je na podoben način možno podati tudi prek video srečanj ali video vodičev v primeru učenja na daljavo. Tako učencem kljub omejitvam gibanja omogočimo zanimivo raziskovanje Zemlje

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IKT po vertikali pri pouku matematike

Vertical ICT in mathematics lessons

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POVZETEK

V prispevku je predstavljen razvoj IKT pri pouku matematike po vertikali. Izkazalo se je, da veliko učencev ne obvlada niti osnovnega pripomočka za matematiko, kot je kalkulator. Kot učiteljica matematike in vodja aktiva matematike na Osnovni šoli Draga Kobala Maribor sem spoznala, da učenci potrebujejo osnovne veščine IKT, ki jih lahko naučimo pri matematiki. Sklicala sem učiteljice matematike po vertikali in izdelale smo načrt vpeljevanja IKT po vertikali pri pouku matematike. Vpeljale smo različne didaktične metode poučevanja s pomočjo IKT in tako začele digitalno opismenjevati učence od prvega do devetega razreda. Izkazalo se je, da so učenci sedaj dosti bolje digitalno pismeni in z zagotovostjo lahko trdimo, da bodo naši učenci odšli iz šole digitalno pismeni, saj se trudimo vsaj pri matematiki nameniti kar nekaj ur za njihov digitalni razvoj. V prihajajočih letih bomo svoje delo še nadgradile in razširile, tako da učenci ne bodo imeli le matematičnega znanja, ampak si bodo pri reševanju problemov znali pomagati tudi z informacijsko komunikacijsko tehnologijo.

KLJUČNE BESEDE

IKT, matematika, digitalne competence

ABSTRACT

The paper presents the development of ICT in the teaching of mathematics vertically. It turns out that many students do not even master a basic math tool such as a calculator. As a mathematics teacher and head of the mathematics department at the Draga Kobala Elementary School in Maribor, I realized that students need basic ICT skills that we can learn in mathematics. I organized a meeting of all math teachers from 1st to 9th grade and we made a plan to introduce ICT vertically in math lessons. We introduced various didactic methods of teaching with the help of ICT and therefore began to digitally educate students from the 1st to the 9th grade. It turned out that students are now much more digitally literate and we can say with certainty, that our students will leave school digitally literate, as we try to devote at least a few hours in mathematics to their digital development. In the coming years we will upgrade and expand our work so that students will not only have mathematical knowledge but will also be able to use information and communication technology to solve problems.

KEYWORDS

ICT, matemtics, digital competence

1 UVOD

Razvijanje različnih kompetenc: bralnih, pismenih, digitalnih in drugih se dandanes že pričakuje na vsakem predmetnem področju. V času dela na daljavo nas je marsikaj presenetilo in spoznali smo, kje smo pri matematiki dobri in kaj lahko še izboljšamo. Na aktivu matematike smo ugotovili, koliko izboljšav pri pouku samem lahko še naredimo. Na nivoju šole smo imeli izdelan načrt razvijanja digitalnih kompetenc, a ugotovili smo, da to ni dovolj. Naredili smo načrt usvajanja digitalnih kompetenc pri matematiki in jih razdelili po vzgojno-izobraževalnih obdobjih. Pregledali smo učni načrt za matematiko in iskali možnosti, kako razvoj digitalnih kompetenc smiselno vključiti v pouk matematike.

2 PREGLED STANJA

V času dela na daljavo smo spoznali, kako malo digitalnih kompetenc učenci razvijejo v času pouka. Čeprav smo že pretekla leta razvijali digitalne kompetence pri matematiki, smo ugotovili, da to ni dovolj in da moramo naše načrte razvoja digitalnih kompetenc posodobiti in razširiti. S pomočjo anket smo ugotovili, kaj je učencem delalo težave in prav na teh podatkih smo začeli pregled stanja pri matematiki. Ugotovili smo, da nekaj stvari že dobro izvajamo, a bi jih morali vsako leto ponavljati in utrjevati ter nadgrajevati. Na šoli začno učenci spoznavati BEE-BOOTke že v prvem razredu, kjer dobro pridobijo in utrdijo orientacijo v ravnini in prostoru [2]. Ugotovili smo, da imamo na šoli veliko število tablic in računalnikov, ki jih v prvem izobraževalnem obdobju ne uporabljamo, pa bi jih lahko. V drugem izobraževalnem obdobju učenci dobijo svoje digitalne identitete, za katere je pomembno, da jih neprestano uporabljajo, in da jih opozarjamo na varnost ter pomembnost identitete. Na šoli imamo ustvarjene spletne učilnice že v drugem izobraževalnem obdobju, a jih pri pouku matematike ne uporabljamo. Za vajo v računanju uporabljamo le delovne zvezke in učne liste, bi pa lahko učence začeli navajati na različne spletne strani, ki omogočajo nadgrajevanje v znanju

računanja in raziskovanje novih računskih operacij. Ugotovili smo, da učencem pri geometriji prikažemo le konkretne modele, lahko bi te predstave nadgradili s prikazi na spletu. Pričeli bi lahko uporabljati tudi programe za geometrijo, ki so prevedeni tudi v slovenščino in tako mlajši učenci ne bi imeli težav pri razumevanju. V tretjem izobraževalnem obdobju vsaka učiteljica po svojih močeh razvija digitalne kompetence, kar smo ugotovile, da bi morale poenotiti in prevetriti. V tretjem izobraževalnem obdobju začno učenci uporabljati spletne učilnice, elektronsko pošto in nekatere programe za geometrijo in računanje, kar bi morali učenci začeti uporabljati že veliko prej in tako ne bi izgubljali časa s poučevanjem osnov programov ter uporabe računalnika v sedmem razredu.

Skratka. Pri hitrem pregledu smo ugotovile, da lahko veliko še dodamo in razvijemo pri samem pouku matematike. Osredotočiti pa se moramo tako na splošne digitalne kompetence kot tudi na tiste, ki podpirajo sam pouk matematike. Seveda pa ne smemo pozabiti na matematiko samo.

3 RAZVOJ KOMPETENC PRI MATEMATIKI NA OSNOVNI ŠOLI DRAGA KOBALA MARIBOR

Po pregledu stanja na šoli smo pregledali učne načrte in izdelali tabelo razvoja digitalnih kompetenc pri pouku matematike. Odločili smo se, da moramo znanje iz usvojenih digitalnih kompetenc neprestano utrjevati, da jih učenci ponotranjijo in postanejo le-te del njihovega vsakdana. Odločili smo se, da razvoj kompetenc razdelimo po vzgojno-izobraževalnih obdobjih, znotraj le-teh pa še dodatno po razredih. Ker smo se zbrale učiteljice matematike po vertikali, smo vedele, kaj lahko od otrok na določeni stopnji razvoja pričakujemo.

Ko smo pregledale učne načrte in stanje na šoli, smo se opredelile še na to, kaj lahko pri matematiki ponudimo in kakšne kompetence želimo, da ima učenec, ko našo šolo zapusti. Raziskale smo programe, ki jih uporabljamo, pregledale, kaj bi lahko začele uporabljati že prej in s katerimi programi ter metodami bi lahko tudi nadaljevale. Nastala je tabela razvoja digitalnih kompetenc pri pouku matematike po vertikali na Osnovni šoli Draga Kobala Maribor.

3.1 Prvo vzgojno izobraževalno obdobje

V prvem vzgojno-izobraževalnem obdobju, bomo zraven prostorskih predstav, ki jih razvijamo s pomočjo BEE-BOOTov (slika 1), razvijali še uporabo tablic, s pomočjo katerih bomo učence navajali na kalkulator in osnovne računske operacije.

Veliko časa bomo namenili tudi medpredmetnim povezavam. V računalniški učilnici bomo s pomočjo slikarskih programov v sklopu matematike v povezavi z likovno umetnostjo ustvarjali s pomočjo likov, števil, simbolov,... Prav tako bomo spoznali programe za urejanje besedila, kjer bomo matematiko povezali s slovenščino in se naučili pravilnih zapisov števil, datumov, denarja, ure in drugih. Pri matematiki je potrebno veliko vaje, tako smo se odločili, da bomo nekaj ur matematike porabili tudi za preverjanje in utrjevanje znanja iz osnovnih računskih operacij. Le-teh pa ne bomo utrjevali samo na papirju, ampak bomo uporabljali IKT, s katero lahko v kratkem času delo diferenciramo in hitrost utrjevanja prilagodimo vsakemu posamezniku. Ob koncu prvega izobraževalnega obdobja bomo

učence že začeli opismenjevati tudi s programi za delo s preglednicami. Ker smo ugotovili, da učencem dela znanje poštevanke velike težave, smo zamenjali vrstni red poučevanja in bomo poštevanko spoznavali že v začetku tretjega razreda in jo utrjevali vse do konca razreda, za kar bomo uporabljali tudi interaktivne spletne vaje. Seveda bomo učence tako začeli navajati na obnašanje na spletu in jih opozarjati, kako pomembna je varnost na spletu in oblikovanje pozitivne digitalne identitete.

Slika 55: Uporaba BEE-BOOTov pri pouku matematike

3.2 Drugo vzgojno izobraževalno obdobje

V drugem vzgojno-izobraževalnem obdobju postane delo z BEE-BOOti večini učencem nezanimivo, kar nadgradimo z delom s tablicami. Počasi uvedemo koordinatni sistem, ki ga predstavimo s pomočjo programa Geogebra, ki je brezplačen in deluje tudi na tablicah. Učence navajamo, da sledijo navodilom in razlagi na ekranu, tako poleg digitalnih kompetenc razvijamo tudi bralno pismenost, saj nam računalnik oziroma tablica pokaže in napiše, kaj smo narobe naredili. V drugem vzgojno-izobraževalnem obdobju slike v slikovnih programih zamenjajo matematični programi za geometrijo. Učenci, ki so spretnejši, narišejo v programu za Geogebro Pitagorejsko drevo (slika 2), ostali pa sliko, kjer uporabijo tako večkotnike, kote, krog in dele kroga.
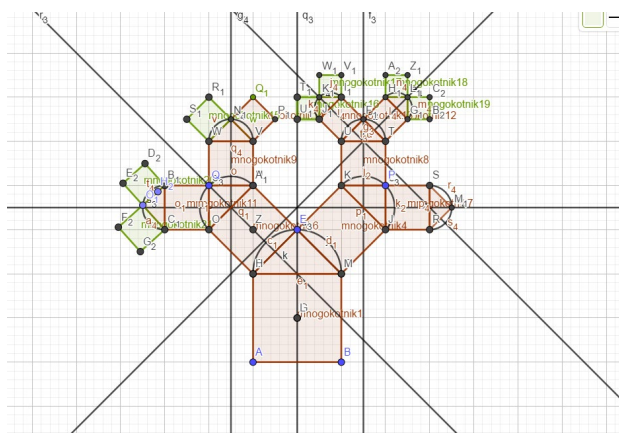
Slika 56: Primer Pitagorejskega drevesa

Na tak način učenci spoznajo osnovno delovanje programa. Pri računanju utrjujejo računske operacije in spretnosti s pomočjo spletne strani Lefo lefo [5], ki omogoča, da učenci med seboj tudi tekmujejo in si izmenjujejo dosežene rezultate. Ker

učenci dobijo svojo digitalno identiteto v začetku drugega vzgojno- izobraževalnega obdobja, le-to uporabljajo tudi pri pouku matematike tako, da učence navajamo na uporabo spletnih učilnic, kjer jih na začetku navajamo na gesla in jih opozarjamo na pomembnost gesla ter skrbno varovanje le-teh. Predstavimo jim, zakaj mora biti geslo zapleteno in poučimo jih, kaj se lahko zgodi, če geslo pride v napačne roke. Veliko uporabljamo spletno stran safe.si, ki na prikupen in poučen način prikazuje različne situacije, ki se lahko zgodijo [4].

V spletni učilnici dobivajo učenci kratka navodila, ki jim morajo slediti. Izdelali smo kvize in učence smo naučili oddajati naloge preko spletne učilnice. Zaenkrat je dovolj, če učenci oddajo le slike, Wordove dokumente ali Excelove datoteke. Proti koncu drugega izobraževalnega obdobja, jih navadimo, da pri oddajanju nalog le- te oddajo v pdf obliki. V sredini drugega izobraževalnega obdobja učence začnemo navajati tudi na delo s tabelami. Tako spoznajo Microsoftova orodja Excel in Oblak 365, do katerih imajo vsi učenci naše šole brezplačen dostop. Pokažemo jim tudi druga brezplačna orodja za delo s preglednicami, kot so OpenOffice, LibreOffice in druge. Pri matematiki jih navajamo tudi na pošiljanje spletne pošte, kar bi se naj naučili pri slovenščini v četrtem razredu, a kot velja, vaja dela mojstra. Neprestano učence opozarjamo na zapis števil, datumov, časa in drugih matematičnih znakov. Ker imajo vsi učenci naše šole od četrtega razreda naprej dostop do Oblaka 365, jih navajamo tudi na delo s tem orodjem [3]. Opozorimo jih, da ni Microsoft edini ponudnik takšnih orodij, da lahko izbirajo tudi druge. Učence smo opozorili, da bomo pri matematiki uporabljali Oblak 365, ker nam je prosto dostopen in ima šola administratorske pravice.

V preglednicah učenci spoznajo različne diagrame za prikaz podatkov, samostojno izdelajo preiskovalno nalogo, kjer naučeno znanje tudi uporabijo na dejanskem modelu. Navajamo jih na zapis decimalnega števila in ulomka.

3.3   Tretje vzgojno-izobraževalno obdobje

Učence še vedno opozarjamo na njihovo digitalno identiteto, jih navajamo na gesla in rokovanje z njimi. Vseskozi skrbimo za varnost na spletu in učence na to tudi opozarjamo [1].

V tretjem izobraževalnem obdobju učence učimo kritično oceniti najdene informacije. Znanje uporabe IKT učenci tukaj utrjujejo in poglabljajo. Tako nadaljujemo z delom in prikazi v Geogebri, kjer učenci raziskujejo različne medsebojne odnose osnovnih geometrijskih pojmov. Učence naučimo s pomočjo tehnologije izmeriti kote, označiti kote. Sami hitro ugotovijo, da lahko kote različno označimo in kako pomemben je vrstni red zapisa točk, ker jim enkrat prikaže izbočeni in drugič udrti kot. Učence zraven uporabe IKT navajamo tudi na samostojno delo in raziskovanje. Tukaj jim pokažemo tudi druga orodja za geometrijo, kot so Desmos, RiŠ, Dr. Geo in druga.

Nadaljujemo delo s preglednicami, kjer spoznamo zraven osnovnih računskih operacij in različnih zapisov števil tudi formule, kot so sum, if, sumif, count, sqrt in druge (Slika 3). Učenci znajo računati s potencami, spoznajo različne ukaze iz statistike, kot so modus, aritmetična sredina, mediana. Nadgradimo tudi znanje risanja diagramov.

Slika 57: Delo s preglednicami

Ker so učenci v tretjem izobraževalnem obdobju že zelo spretni z uporabo IKT, rešujejo že zapletene primere s podobnostjo, kot so izračunati višino šole, višino drevesa pred šolo, torej izračunati, izmeriti višino predmetov, ki so višji od učencev. Učenci samostojno povežejo znanje iz matematike z realno situacijo [2]. Hitro ugotovijo, da si lahko pomagajo z znanjem iz podobnosti. Zbrali so potrebne podatke, merili sence predmetov, katerim so znali izmeriti višino in predmetov, katerim višino so želeli izračunati. Skupaj ugotovimo, da bi lahko predmete poslikali in v računalniški učilnici izračunali njihove višine. Kar smo tudi naredili. Tako učencem pri matematiki v ta namen pokažemo tudi nekaj osnov fotografiranja in jih opozorimo na to, kaj je dobra fotografija. Naučimo se fotografijo uporabiti kot pripomoček za izračun višine šole. Naučimo se prenesti fotografije iz tablice ali telefona na računalnik, kar nam omogoča, da lahko merimo razdalje na fotografiji (slika 4) in tako ugotovimo dejanske višine objektov. Seveda pa znova utrjujemo znanje iz preglednic, saj vse izračune računamo s pomočjo računalnika.
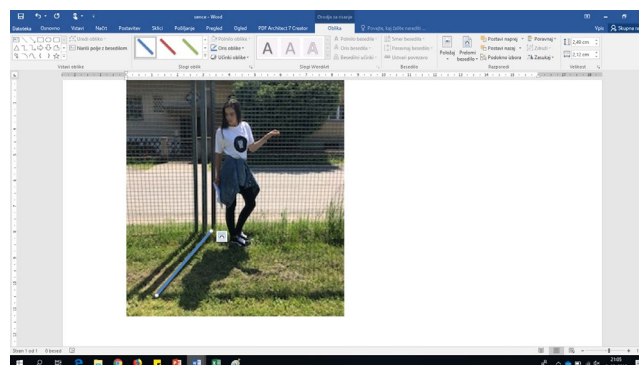
Slika 58: Merjenje v Wordu

Ne pozabimo pa tudi na uporabo računala. Pred leti smo ugotovili, da so učenci zapuščali našo šolo in niso znali uporabljati računala. Zato jih skozi vsa vzgojno-izobraževalna obdobja navajamo tudi na uporabo računala. V prvem in drugem vzgojno-izobraževalnem obdobju učence s pomočjo tablic navajamo na vrstni red računskih operacij. Ob koncu drugega izobraževalnega obdobja imajo učenci svoja računala in jih pri matematiki navajamo na uporabo le-teh, saj vsi dobro vemo, da računala računajo pravilno le, če jim pravilno vnesemo račun.

4   ZAKLJUČEK

Verjamemo, da sedaj učenci našo šolo zapuščajo polni znanja tudi uporabe IKT. Pri matematiki se bomo še naprej trudili, da bomo po celi vertikali nadgrajevali znanje uporabe IKT

predvsem matematičnih vsebin in aplikacij. S svojim delom bomo nadaljevali. Razvijali bomo IKT veščine od prvega razreda do devetega. Po posameznih triadah bomo utrjevali in nadgrajevali znanje iz IKT, saj želimo, da bodo ob koncu šolanja naši učenci digitalno pismeni. Zato je pomembno, da učencem predstavimo, kako pomembno je, da dobro obvladamo IKT, saj nam le-ta ob pravilni uporabi veliko pripomore in olajša delo. Menimo, da lahko še veliko naredimo na področju uporabe IKT, vendar le z malimi koraki nam bo uspelo.

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Aplikacije in metode dela za poučevanje angleškega jezika na daljavo

Apps and pedagogical methods for teaching English language online

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POVZETEK

V članku so predstavljeni programi in aplikacije, ki jih uporabljamo pri poučevanju angleščine na daljavo na naši osnovni šoli. V času izolacije smo uporabljali veliko različnih aplikacij, nato pa smo s pomočjo anket in pogovorov z učenci in učitelji izbrali pet najboljših digitalnih orodij, ki so se izkazali za najbolj uspešne. S tovrstnim delom nam je uspelo dvigniti motivacijo učencev za učenje tujega jezika, posledično se je dvignil tudi nivo znanja angleškega jezika.

KLJUČNE BESEDE

Aplikacije, programi, IKT, angleščina, osnovna šola

ABSTRACT

In this article are presented different computer programs and apps that we're using for online English language teaching in our primary school. During the isolation, we used many different apps. During and after the isolation we used surveys and interviews both with students and teachers and we selected top five digital tools that proved to be the most successful. With this kind of work, we succeeded in raising the levels of motivation of our pupils for learning English language. As a result, the level of English language knowledge, has also risen.

KEYWORDS

Applications, computer programs, ICT, English language, primary school

1 UVOD

V Sloveniji je angleščina za večino otrok tuj jezik, s katerim se prvič srečajo že v prvem razredu osnovne šole. Nekateri otroci se z njim srečajo že v predšolskem obdobju, večina pa v prvi triadi osnovne šole. Angleški jezik je pomemben, saj je globalni jezik, ki ga uporablja več tujih kot domačih govorcev in se uporablja pri sporazumevanju na področju znanosti, tehnologije,

trgovine, letalstva, pri meddržavnih dogovarjanjih itn. ter omogoča najširši dostop do podatkov [1].

Eden izmed pomembnejših ciljev, katerim sledimo učitelji angleškega jezika, je, da bi naši učenci postali samostojni, suvereni in učinkoviti uporabniki angleškega jezika, ki bi bili sposobni samozavestno komunicirati z ostalimi govorci angleščine in bi imeli funkcionalno znanje jezika. V osnovni šoli razvijamo te zmožnosti učencev preko poslušanja in slušnega razumevanja, govornega sporazumevanja in govornega sporočanja, branja in bralnega razumevanja, pisanja, pisnega sporazumevanja in pisnega sporočanja. Za vse te cilje je značilno, da so enako pomembni, da se med seboj prepletajo, so soodvisni drug od drugega in se pogosto razvijajo integrirano.

Z učenjem jezika učenci ne razvijajo samo svoje znanje tujega jezika, ampak razvijajo tudi sporazumevalno kulturo in razumevanje medkulturnosti, razvijajo lastno večjezičnost in jezikovno zavest. Jezike (tuje in materni jezik) primerjajo med seboj in s tem razvijajo svojo zmožnost analitičnega mišljenja. Razvijajo tudi svojo sposobnost za vseživljenjsko učenje tujih jezikov, kajti zmožnost za sporazumevanje zunaj okvira materinščine je eden izmed temeljnih izobraževalnih ciljev v osnovni šoli.

V času epidemije in pouka na daljavo smo bili vsi primorani uporabljati moderne medije oz. IKT. Če si po teoriji Edgarda Dala učenci zapomnijo 10 % tistega, kar preberejo, in 90 % tistega, kar doživijo, potem lahko delo z digitalnimi mediji pomeni nov mejnik učenja s pomočjo IKT-ja [3]. S pomočjo računalnika, tablice ali pametnega telefona lahko učenci obiščejo kraje, ki jih praktično sami ne bi mogli videti ali doživeti. Sam pouk v klasični ali virtualni učilnici je lahko kakovostnejši in bolj učinkovit ob pametni uporabi modernih tehnologij.

2 PROGRAMI IN APLIKACIJE PRIMERNI ZA UPORABO PRI POUKU ANGLEŠČINE NA DALJAVO

Čeprav so bili naši učenci vajeni dela z IKT, so se vseeno pojavile težave pri učencih in pri njihovi uporabi računalnika ter novih aplikacij. Težave so bile na več nivojih: od preslabih računalnikov do časovne omejitve časa preživetega za računalnikom (več šoloobveznih otrok in starši, ki delajo od doma), do težav zaradi aplikacij v angleškem jeziku. Z učenci smo težave reševali sproti, pogosto skupaj. Na voljo sem jim bila preko družabnih omrežij in preko telefona. Če se je pojavila

težava, katero ni znala rešiti večina učencev, sem s pomočjo aplikacije Screencastify posnela posnetek z razlago celotnega postopka in ga delila z učenci. Ta metoda pomoči se je izkazala za najbolj zanesljivo. Pogosto se je zgodilo, da smo določeno zapleteno aplikacijo enostavno nehali uporabljati in jo nadomestili s podobno, manj zapleteno.

Tukaj predstavljam pet aplikacij, ki so se nam zdele najbolj primerne za uporabo pri pouku angleščine na daljavo in ki so bile po anketi izvedeni med našimi učenci, njim najbolj uporabne, enostavne in zanimive.

2.1 Flipgrid

Flipgrid [Slika 1] je uporabna aplikacija, s katero na zabaven način spodbujamo govorno sporočanje naših učencev. Uporabljamo jo lahko na telefonu, tablici ali računalniku, pomembno je le, da imamo kamero, mikrofon in zvočnik. Učitelj pripravi učno okolje, kjer lahko učenci prispevajo svoje posnetke (npr. refleksija, diskusija, evalvacija …). Orodje ima pester nabor funkcionalnosti in je brezplačno. Učitelj naloge z učenci deli na različne načine (s QR kodo, dostop preko maila, vpis uporabnikov). Učenci se prijavijo v mrežo, pogledajo učiteljev videoposnetek z navodili in na zelo enostaven način oddajo svoj prispevek v mrežo (grid) [Slika 2]. Posnetek pogledajo, lahko ga tudi obdelajo (si dodajo dodatke, skrijejo obraz, spremenijo ozadje) in ko so zadovoljni z njim, ga objavijo. Lahko si tudi ogledajo posnetke svojih sošolcev, lahko jih video komentirajo, se odzovejo nanje z emojiji, lahko jih delijo na različnih socialnih omrežjih. Posnetke v mreži vidi le tisti, ki je bil v mrežo povabljen oz. ima kodo za dostop. Po naših izkušnjah je bila aplikacija *Flipgrid* najbolj všeč učencem druge triade. Pri učencih prve triade smo z uporabo te aplikacije naložili preveč dela že tako obremenjenim staršem, tako da smo se tega poslužili le enkrat in dobili le skromen odziv. Nekaj staršev nam je pisalo, da imajo velike težave z aplikacijo prav zaradi tega, ker je v angleščini. Pri učencih tretje triade ni bilo nikakršnih tehničnih težav ali težav zaradi tega, ker je aplikacija v angleškem jeziku. Največja težava pri njih je bila v tem, da niso želeli, da jih gleda kdo drug. Naloge v *Flipgridu* so pri njih zaživele šele, ko smo jim dovolili, da naredijo posnetek, pri katerem je nujno, da govorijo, ni pa nujno, da takrat snemajo sebe. Največji uspeh je aplikacija *Flipgrid* požela pri učencih druge triade. Aplikacijo so uspešno uporabili z manjšo pomočjo staršev, snemanje svojega video odgovora in komentarjev so vzeli zelo resno in se nanj tudi dobro pripravili. Ugotovili smo, da lahko to aplikacijo v drugi triadi tudi uspešno uporabimo za ustno ocenjevanje znanja.

Kot učiteljici mi je bilo zelo všeč, ker sem lahko vsakemu posameznemu učencu preko aplikacije podala povratno informacijo o njegovem posnetku.

Slika 1: Flipgrid logo (vir:
https://blog.flipgrid.com/news/2017/6/13/10ways *)*

Slika 2: Flipgrid (vir:
https://www.mrspriestleyict.com/blog/flipgrid#/ *)*
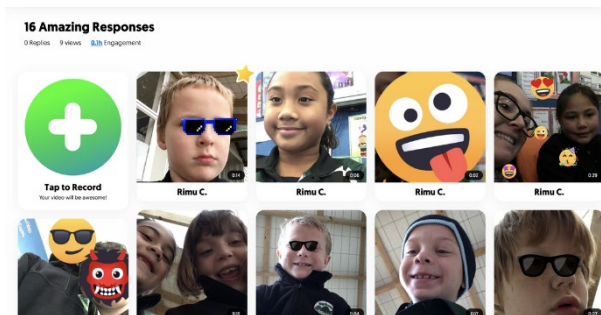
2.2 Wakelet

Naslednja aplikacija, ki krepi digitalne kompetence učencev in je primerna tako za poučevanje na daljavo kot za delo v razredu, je *Wakelet* [Slika 3]*. Wakelet* je brezplačna aplikacija za shranjevanje, organiziranje in deljenje vsebin s celega spleta. Z njo lahko shranimo katero koli vsebino s spleta, naj bo to najljubša pesem, članek, videoposnetek, blog, tweet ali celo Facebook objava. Celoten proces shranjevanja in organizacije gradiva je zelo enostaven. Uporabljali smo ga z učenci tretje triade. Tudi ta aplikacija se lahko uporablja na različnih napravah (tablica, računalnik pametni telefon).

Pri pouku na daljavo smo *Wakelet* uporabljali na različne načine:

- za samostojno delo, ko so učenci pripravljali določen izdelek: npr. plakat ali predstavitev teme za govorni nastop. Učenci so *Wakelet* uporabljali predvsem v začetnem delu, kjer so s pomočjo spleta iskali informacije, povezane z dano temo. V začetni fazi so običajno svojo zbirko delili tudi z nami, svojimi učitelji, tako da smo lahko videli, kako nastaja izdelek, kakšno gradivo zbirajo učenci in jih po potrebi usmerjali in jim pomagali pri izboru pravega (in verodostojnega) gradiva. V tem delu so se učenci veliko naučili tudi o varnosti na internetu ter o spletni etiki.
- pri skupinskem, sodelovalnem delu, kjer je skupina učencev morala izdelati nek skupni izdelek oz. predstavitev, ampak dela niso smeli opraviti skupaj zaradi prepovedi druženja. To je bil učencem najljubši del dela s to aplikacijo, kajti ugotovili so, kako hitro lahko zberejo gradivo, če pri tem sodelujejo in se dopolnjujejo. Všeč jim je bilo tudi, ker je *Wakelet* nadomestil več orodij in aplikacij, ki so jih morali uporabljati včasih, da so opravili enako delo.
- za navodila učitelja ali pri predstavitvi določene teme. Sama sem uporabila to aplikacijo, kadar sem učencem predstavila novo orodje. Svoja navodila sem pripravila z aplikacijo *Wakelet,* v katero sem poleg samih navodil vključila tudi slikovno in video gradivo o tem orodju, ki sem ga našla na spletu. Pogosto sem *Wakelet* uporabila kot uvodno motivacijo v novo temo. Tako sem učencem predstavila temo, npr. *nutrition* (prehrana) [Slika 4] in preko *Wakelet*-a sem jim predstavila prehransko piramido, animiran filmček iz *You Tuba* o zdravi prehrani, za konec sem jim dodala še povezavo do spletne strani z vprašalnikom, ki so ga

rešili o svoji prehrani in ki nam je potem služil kot iztočnica za nadaljnjo obravnavo snovi.

Slika 3: Wakelet logo (vir:

Vidim, da je ta aplikacija naredila dober vtis, kajti kar nekaj učencev mi je po zaključenem delu pouka na daljavo povedalo, kako pogosto jo uporabljajo tudi pri stvareh, ki niso povezane s šolo, kot na primer seznam filmov, ki si jih morajo ogledati, seznam dobrih računalniških iger, ki jih morajo odigrati, zbiranje informacij o nadaljevanju šolanja v srednji šoli itd. Všeč jim je, ker imajo s to aplikacijo vse željene informacije na enem mestu. Najbolj jim je všeč, ker s to aplikacijo na stotine internetnih povezav spremeniš v eno samo.
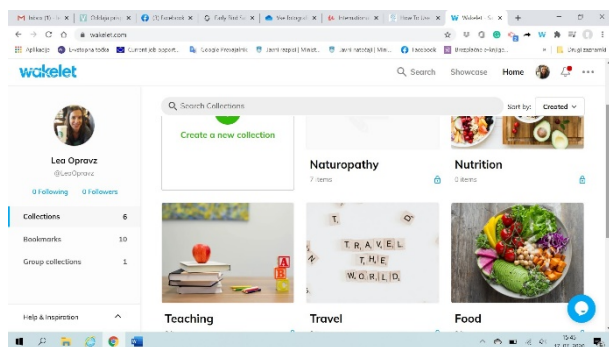
Slika 4: Wakelet zbirke (osebni arhiv)

2.3 Screencastify in Loom

Obe aplikaciji sta si zelo podobni in sta bili v času dela na daljavo za nas nepogrešljivi. Uporabljali smo ju za snemanje zaslona, zraven pa lahko snemata tudi zvok in video preko spletne kamere. Res je, da smo navodila in razlage pogosto podajali učencem v tekstovni obliki, pogosto pa smo se vsi znašli v situaciji, kjer smo učencem morali enostavno stvari razložiti verbalno, ob beli tabli in z vso mimiko telesa, ki jo uporabljamo pri pouku.

Screencastify in Loom [Slika 5] sta brezplačni aplikaciji, pri katerih se mora učitelj registrirati, učenec pa le klikne na povezavo in že uživa v učiteljevem posnetku. Obe aplikaciji zajemata zaslon, istočasno snemata video, uporabnik pa po želji vklopi tudi snemanje samega sebe. Pri svojih urah sem ga pogosto uporabljala na tri načine:

- razlaga nove snovi. Po anketi, ki sem jo izvedla med svojimi učenci po končanem poučevanju na daljavo, je bilo veliko učencem zelo všeč, ko sem poslala razlago snovi v obliki videa in kot zapis v wordovem dokumentu. Moramo vedeti, da so naši učenci različni učni tipi, tako da enim bolj odgovarja poslušanje, drugim pa branje nove učne snovi.
- podajanje navodil za delo. Pogosto se je zgodilo, da je bilo enostavno preveč navodil, da bi jih zapisala, zato sem se pogosto odločila in navodila posnela. To se je

izkazalo za zelo primerno pri učencih prve triade, ki še niso pretirano dobri bralci. Veliko staršev mi je bilo zelo hvaležnih, kajti na ta način sem jaz otrokom razložila, kaj morajo narediti, na kaj morajo biti pozorni in kako naj rešijo katero nalogo in jih na ta način razbremenila.
- prikaz zapletenih postopkov uporabe novih aplikacij ali kakšnega drugega postopka kot npr: kako oddati nalogo v googlovi učilnici, ali: kako posneti posnetek v aplikaciji Flipgrid.

Čeprav sta si obe aplikaciji zelo podobni in sta zelo enostavni za uporabo, je med njima še vedno nekaj razlik. Tu bom zapisala le nekaj razlik, ki so mene prepričale v pogostejšo uporabo aplikacije Loom:

- Dolžina videoposnetkov: Screencastify dovoli brezplačno snemanje le 5 minutne videoposnetke (v času korone so ta čas sprostili na neomejeno dolge videoposnetke), aplikacija Loom ima omejitev 25 minut, kar je več kot dovolj za uporabo poučevanja na daljavo v osnovni šoli.
- Shranjevanje videoposnetkov: Screencastify shranjuje posnetke na Google drive in posledica tega je, da se količina brezplačnega prostora na google računu zelo hitro napolni, Loom pa shranjuje posnetke na svojo spletno stran in učitelj deli z učenci povezavo na njihovo stran, če seveda ne objavi svojega posnetka na You Tubu.
- Posnetek spletne kamere računalnika lahko pri Screencastify le premikamo po zaslonu, pri aplikaciji Loom ga lahko spreminjamo med samim snemanjem. Lahko ga povečamo na celoten zaslon, poljubno pomanjšamo ali celo odstranimo, odvisno kaj v določenem trenutku potrebujemo.
- Boljša zaščita objavljenih posnetkov. Pri obeh aplikacijah deliš posnetek preko povezave, ampak aplikacija Loom omogoči, da ta posnetek še dodatno zaščitimo z geslom.
- Komentiranje posnetkov in štetje ogledov. Če videoposnetka, narejenega s Screencastify, ne objaviš na You Tubu, ga gledalci ne morejo komentirati in/ali se na njega odzvati z emoji. Pri posnetkih aplikacije Loom lahko posnetke komentiramo in se nanje odzivamo z emojiji.
- Če želite uporabljati napredne funkcije obeh aplikacij in snemati neomejeno število posnetkov, je potrebno za Screencastify plačati 29 $ na leto, pri aplikaciji Loom je profesionalna verzija doživljenjsko brezplačna za učitelje in študente.
- Moramo omeniti še eno razliko med tema dvema aplikacijama, ki je bolj v prid aplikaciji Screencastify. Uporaba oz. snemanje posnetkov s Screencastify lahko poteka tudi v primeru, ko smo brez internetne povezave. Za snemanje z aplikacijo Loom pa vedno potrebujemo internetno povezavo.

2.4 Nearpod

Nearpod [Slika 6] je aplikacija oz. spletna platforma, ki zaradi svojih mnogih možnosti uporabe spominja na neke vrste enostavno spletno učilnico. Tudi ta aplikacija je za učitelja in učence brezplačna, potrebna je le registracija. Uporablja se lahko na različnih napravah in je primerna za okolje Windows, Ios in Android.

Slika 6: Nearpod logo (vir: https://nearpod.com/)

Aplikacija je namenjena predstavitvi nove snovi ter prav tako spremljanju in preverjanju znanja učencev. Učitelj lahko pri pripravi svoje ure uporabi že ustvarjene učne ure, ki jih vidi v knjižnici, le te lahko predela in spremeni, tako da ustrezajo njemu in njegovim učencem, lahko pa seveda sestavi tudi svoje lastne učne ure. Že sestavljene ure so kvalitetne in razdeljene po predmetih, edina težava je lahko le to, da so vse v angleškem jeziku. Za nas, angliste, to seveda ni težava.

Učitelj lahko sestavi učno uro v aplikaciji *Nearpod*, če pa ima že sestavljeno predstavitev v Powerpointu, PDF-ju, Google slides ali Sway-u, jo lahko naloži v *Nearpod* in jo spremeni v interaktivno *Nearpod* učno uro[Slika 7] . Sama izdelava učne ure v *Nearpodu* je enostavna. Podobno je delu v Power Pointu, le da lahko tu razen gradiva, ki ga predstavljamo učencem (besedilo, fotografije, avdio in videoposnetki ter povezave do gradiva na spletu) dodajamo tudi različne aktivnosti, v katerih bodo sodelovali naši učenci. V svojo predstavitev lahko vključimo tudi različne kvize, ankete, aktivnosti, kjer lahko učenci odgovorijo z risanjem (odlična aktivnost za preverjanje besedišča), lahko naložimo delovni list, ki ga že imamo sestavljenega in učenci preko *Nearpoda* pišejo nanj in ga rešijo, kakor bi v živo reševali delovni list v šoli. Lahko tudi

odgovarjajo na dana vprašanja, rešujejo naloge kjer morajo dopolniti povedi ter naloge iskanja parov, ki je tudi zelo primerna pri poučevanju tujega jezika. Učencem zanimiva aktivnost je tudi opazovanje in učenje z gledanjem 3D predmetov. Učenci se lahko z učiteljem preko te aplikacije odpravijo na virtualni izlet v skoraj 100 različnih krajev po svetu, kjer si ogledajo njihove zgodovinske, kulturne in turistične znamenitosti.

Ko učitelj pripravi učno uro, ima dve možnosti, kako jo deli z učenci:

- ob pritisku na gumb LIVE deli uro v živo s svojimi učenci in lahko v realnem času spremlja delo in napredek vsakega učenca posebej. Tak način smo večkrat uporabili pri delu z *Nearpod-om* v razredu.
- ob pritisku na gumb STUDENT PACED LESSON vsak učenec predela pripravljeno učno uro, ko si sam to želi oz. ko ima čas in s svojim tempom. Tudi pri tem načinu učitelj dobi v realnem času povratne informacije o delu vsakega učenca posebej. Ob poteku časovnega okvirja, namenjenega določeni učni uri, dobi učitelj poročilo o napredku in dosežkih celega razreda in vsakega individualnega učenca. Ta način smo najpogosteje uporabljali v času učenja na daljavo.

Aplikacija *Nearpod* je bila najbolj zanimiva mojim učencem druge triade. Aplikacijo so poznali že iz časa pred poukom na daljavo, tako da nam ni bilo potrebno vložiti veliko časa in truda v to, da bi učence naučili uporabo novega orodja. Učenci so na zelo zabaven način spoznavali novo snov in utrjevali besedišče, mi učitelji pa smo v vsakem trenutku natančno vedeli kakšno je znanje naših učencev, s katero snovjo imajo še težave in kaj bo potrebno še utrditi.

Z aplikacijo *Nearpod* je bilo tudi enostavno diferencirati ure in dodati še nekaj dodatnih, bolj zahtevnih nalog za tiste učence, ki zmorejo več.

Nearpod je bila ena izmed najbolj uporabnih aplikacij pri našem delu na daljavo, saj smo z njo z lahkoto sestavili celo šolsko uro z različnimi dejavnostmi in aktivnostmi. Zaradi omogočenega snemanja avdio posnetkov sem na ta način lahko na začetku ure učence pozdravila in jim dala krajša navodila o uri, ki smo jo izvedli ta dan, nato pa so s svojim tempom predelali učno snov in preverili svoje znanje. Na koncu so tako učenci kot jaz dobili povratno informacijo o pravkar izvedenem delu.
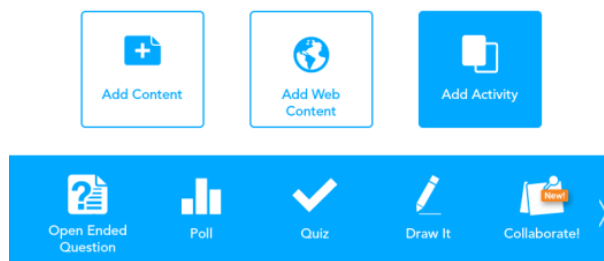
Slika 7: Ustvarjanje predstavitve (vir: https://mrspearsall.com/category/ed-tech/nearpod/)

2.5 EdPuzzle

Aplikacija *EdPuzzle* [Slika 8] služi kot orodje, s katerim lahko video posnetek iz You Tuba ali podobnih spletnih strani opremimo s komentarji in vprašanji, na katere učenci

odgovarjajo, in tako pripravimo interaktivni video. Odgovori učencev se zabeležijo in so lahko učitelju v pomoč pri spremljanju napredka in razumevanja. Okolje je primerno za preverjanje razumevanja snovi ali za podajanje teoretičnih vsebin.

Slika 8: EdPuzzle logo (vir:
https://edtechawesomeness.com/2017/08/15/cool-tools-edpuzzle/

Običajno smo ga uporabljali tako, da smo pred gledanjem videoposnetka za učence posneli kratka avdio navodila, v katerih smo jim razložili, kakšen je cilj gledanja tega posnetka ter jim dali pomembnejša navodila za delo. Med samim gledanjem smo jim dodali odseke, ko se je posnetek ustavil (po kakšnem pomembnejšem odseku posnetka) in je sledilo nekaj vprašanj v povezavi s pogledano vsebino oz. preverjanje razumevanja. Vprašanja so lahko izbirnega ali odprtega tipa. Dokler učenec ne odgovori na vsa vprašanja, ne more nadaljevati z ogledom posnetka. Vedno so dobili tudi nekaj vprašanj odprtega tipa ob koncu gledanja posnetka. Takoj ko učenec konča z nalogo, dobi delno povratno informacijo, končno informacijo pa dobi, ko učitelj preveri vse učenčeve odgovore [Slika 9]. Učitelj ima pri urejanju videoposnetka možnost rezanja, tako da lahko dele, ki za učence niso pomembni, enostavno izreže iz videoposnetka.
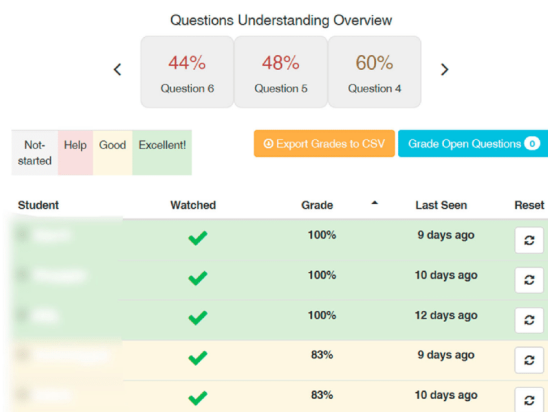
Slika 9: Poročilo za učitelja o tem, kako uspešni so bili učenci pri določeni nalogi (vir:
https://www.researchgate.net/figure/Sample-image-showing-the-reports-page-generated-by-Edpuzzle-for-answers-given-to_fig4_324562565

Učitelj lahko aplikacijo *EdPuzzle* integrira v svojo Google učilnico, lahko pa le objavi povezavo do te aktivnosti. Določimo lahko tudi, od kdaj do kdaj je naloga na voljo učencem za reševanje. Prednost te aplikacije je tudi povratna informacija učitelju o uspešnosti učencev pri reševanju naloge. Učitelj ima možnost pogledati posamezen posnetek, kako uspešno ga je rešil celoten razred, ima pa tudi možnost povratne informacije o posameznem učencu (ali je v celoti pogledal videoposnetek, katere naloge je rešil in kako uspešno).

Pri brezplačni verziji aplikacije je posameznemu učitelju na voljo 30 videoposnetkov. Če nam to ni dovolj, je na voljo plačljiva verzija, kjer je število posnetkov neomejeno.

3 ZAKLJUČEK

Čas poučevanja na daljavo zaradi korona virusa pa nas je vse prisilil, da smo v zelo kratkem času usvojili nove metode poučevanja, komuniciranja z učenci ter preverjanja znanja. Sama sem se naučila uporabljati vsa tista orodja za katera sem vedela, da obstajajo, a so se mi zdela prezahtevna za uporabo. Seveda ni bilo vse enostavno in zabavno. V poučevanje na daljavo je moral vsak učitelj vložiti ogromno svojega časa in vsakodnevno iskati nove možnosti podajanja snovi, preverjanja znanja in še posebej motiviranja učencev, ki si pogosto gledali na čas pouka na daljavo kot na čas počitnic.

Tudi učencem ni bilo enostavno, kajti nekateri v treh mesecih pouka na daljavo nikakor niso uspeli preklopiti na tovrsten način dela. Vendar iz svojih izkušenj lahko trdim, da je tudi učencem tak način dela prinesel neko dodano vrednost. Vsakodnevno sem bila v stiku z večino svojih učencev in pri učencih višjih razredov sem opazila, da so postali bolj samostojni, bolj organizirani in bolj samozavestni, saj so ugotovili, da z »majhno« pomočjo nas učiteljev zmorejo premikati tudi ogromne skale.

Pa zaključimo z izjavo Alberta Einsteina: »Edini vir znanja so izkušnje« [2]. Sedaj smo vsi bogatejši za izkušnjo z pouka na daljavo. Videli smo, kaj zmoremo in česa smo sposobni s pomočjo modernih medijev. Moderni mediji, tehnologije in izobraževalne aplikacije imajo to moč, da skozi zanimive vsebine pri učencih (ob pravilni uporabi) povečajo motiviranost, raven sodelovanja pri pouku, spodbujajo njihovo predstavo in razvijajo kreativnost. Ker je pri uporabi take tehnologije vključenih več čutil, je tudi raven pomnjenja učne snovi veliko večja kot pri klasičnemu pouku.

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Razvijanje veščin 21. stoletja pri medpredmetni povezavi fizike z matematiko, informatiko in športno vzgojo

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POVZETEK

Vsak napredek skozi zgodovino je povezan s pridobivanjem novih znanj, ki pa s časom naraščajo. Posledično za uspeh posameznika in družbe več ni dovolj samo to, da nekdo pozna veliko vsebin na določenem strokovnem področju, ampak hkrati postaja vse pomembnejše tudi razvijanje t. i. veščin 21. stoletja. To so: kritično mišljenje, ustvarjalnost, komunikacija, sodelovanje, opazovanje itn. V članku na primeru medpredmetne povezave ponazarjam, kako lahko v šoli zgoraj omenjene veščine medpredmetno razvijamo, saj so te osnova za uspešno karierno pot prihajajočih generacij. Nova znanja in tehnološki razvoj ustvarjajo tudi nove poklice. Dijake moramo torej izobraziti, da bodo lahko opravljali poklice, ki jih še sploh ni. Za njihovo uspešno kariero zato ne bo dovolj zgolj dobro poznavanje vsebin, saj postaja enako pomembno kot vsebinsko znanje še obvladovanje prej omenjenih veščin. Slednje jim bodo omogočile, da bodo dovolj fleksibilni in se bodo zmogli učinkovito prilagoditi novim zahtevam v družbi in gospodarstvu. Osnovni namen te medpredmetne povezave je razvijanje veščin 21. stoletja za boljšo učno in prihodnjo karierno mladih.

KLJUČNE BESEDE

Veščine 21. stoletja, medpredmetne povezave, IKT

ABSTRACT

Any progress through history is associated with the acquisition of new knowledge that increases with time. Consequently, for the success of not only the individual, but the society as well, it is not enough for someone to know a lot of content in a certain professional field. The development of the so-called 21st century skills is becoming increasingly important at the same time. Critical thinking, creativity, communication, collaboration, observation and similar skills fall into this category. In this article, I will use the example of interdisciplinary connection to illustrate how we can develop the above-mentioned skills in school, as they are the basis for a successful career path of future generations. New knowledge and technological development also create new professions or jobs. This means that we have to educate students so they can pursue professions that for now do not even exist. As a result, good knowledge of a particular content will not be enough for their successful career, as mastering the previously mentioned skills is becoming just as important as the knowledge of the content. The latter will enable that they will be flexible enough and that they will effectively be able to adapt new demands in the society and the economy. The basic purpose of this cross-curricular link is to develop 21st century skills for better learning and future career success of young people.

KEYWORDS

21st century skills, cross-curricular connections, ICT

1 UVOD

Različne ravni tehnološkega razvoja zahtevajo različno usposobljeno osebje s širokim spektrom veščin. Iz dneva v dan naprednejša in visoko razvita tehnologija bo v bližnji prehodnosti zahtevala veliko višji delež kadra s t. i. veščinami 21. stoletja oz. prečnimi veščinami [1]. Z optimizacijo, avtomatizacijo in robotiko bo nadomeščenih veliko poklicev. Človek bo potreben večinoma tam, kjer bo boljši od robotov. To bo na področjih, kjer bodo potrebne kompetence 21. stoletja, kot so: reševanje kompleksnih problemov, čustvena inteligenca, sodelovanje, komunikacija, ustvarjalnost, kritično razmišljanje, podjetnost in domišljija [1]. V podporo razvijanju omenjenih veščin sem izvedel laboratorijsko vajo merjenja moči pri hoji/teku po stopnicah, ki bo dijakom pomagala pri lažjem spoprijemanju z novodobnimi izzivi.

2 INTEGRACIJA POUKA FIZIKE V DRUGE UČNE PREDMETE

Šolski sistem ima šibko točko, saj s svojim vzgojno-izobraževalnim procesom ne zmore slediti zahtevam sodobnega časa, kjer se vedno znova srečujemo z novimi tehnološkimi znanji in dognanji. Slednja zahtevajo sprotne prilagoditve in vedno nove veščine. Razvijanje veščin 21. stoletja zahteva sistematičen pristop in veliko časa. Pri pouku fizike lahko po eni

strani na veliko načinov razvijamo takšne veščine, toda po drugi strani smo zelo omejeni s časom, saj je snovi veliko, hkrati pa imamo na voljo v gimnaziji samo dve učni uri fizike tedensko. To je premalo, da bi lahko dijake ustrezno pripravili na njihove prihodnje izzive. Dijakov ne moremo izobraziti za nove poklice, ker jih še ne poznamo. Zelo učinkovito pa jim lahko pomagamo pri razvoju veščin, ki bodo pri novih poklicih v prihodnosti nepogrešljive, saj lahko te relativno dobro predvidimo.

S svojimi dijaki sem izvedel laboratorijsko vajo merjenja moči tako, da smo porabili samo eno učno uro fizike. Za uspešno izvedbo laboratorijske vaje in hkratno razvijanje veščin smo potrebovali še dodatnih pet šolskih ur. Teh nismo porabili pri pouku fizike, saj bi nam s tem zmanjkalo časa za obravnavo preostale snovi. Rešitev sem videl v vzpostavitvi več medpredmetnih povezav. Vajo smo tako izvedli pri eni učni uri fizike, eni učni uri matematike, dveh učnih urah informatike in dveh učnih urah športne vzgoje. Na ta način sem pridobil 5 učnih ur za razvijanje veščin 21. stoletja pri dijakih in obravnavo fizikalnih vsebin.

Fizika je temeljna naravoslovna znanost, ki posega na več znanstvenih področij. Pri informatiki se ukvarjajo s sodobno tehnologijo, ki se uporablja tudi pri fiziki. Zakaj potem ne bi vsaj enega dela fizike obravnavali pri informatiki? Prav tako fizika obravnava kinematiko in dinamiko, zakaj potemtakem ne bi vsaj del pouka fizike obravnavali pri pouku športne vzgoje? In ni ure fizike, ko se ne bi ukvarjali tudi z matematiko, ki je osnovno orodje za opis naravnih pojavov. Zakaj potem ne bi kakšne ure fizike izvedli pri matematiki? Pogovoril sem se z nosilci omenjenih učnih predmetov, ki so moje argumente in predloge z veseljem sprejeli.

Dodaten izziv pri izvedbi tako zastavljenega učnega procesa je fiksen urnik dijakov. To je pomenilo, da mi ne bo treba biti prisoten pri vseh teh urah, temveč sta na urah bila prisotna profesor predmeta in laborantka za fiziko. Z laborantko sva pred začetkom pouka natančno šla skozi vsa navodila in potek laboratorijske vaje. Podobno strokovno srečanje sem opravil še s profesoricami za matematiko, športno vzgojo in informatiko.

2.1 Določanje ciljev in potrebnih znanj za doseg ciljev pri učni uri fizike

Pri učni uri fizike smo z dijaki zastavili cilje, ki jih želimo doseči na naslednjih učnih urah. Prav tako smo preverili in utrdili vso potrebno teoretično znanje, ki ga bodo dijaki za dosego ciljev potrebovali.

Temeljni cilj, ki smo si ga zastavili, sta bila določiti moč pri hoji po stopnicah in izračunati količino čokolade, ki bi nadomestila energijske izgube. Za njun doseg smo s pomočjo slike 1 in vizualizacije problema načrtovali tri možne poti doseganja krovnih ciljev in oblikovali več podciljev. To so bili:

- izmeriti čase vzponov do vrha stopnic;
- izračunati višino stopnišča s pomočjo višine ene stopnice in števila vseh stopnic;
- izračunati višino stopnišča z uporabo znanja prostega pada;
- izračunati višino stopnišča z uporabo znanja kotnih funkcij;
- določiti kot α (slika 1) s pomočjo viziranja in
- izračunati porabljeno energijo za vzpon do vrha stopnišča.

Teoretično znanje, ki smo ga ponovili in utrdili, je zajemalo naslednje vsebine: prosti pad, delo, energije, izreki o energijah in moč.

V sklopu učne ure smo z dijaki vnaprej načrtovali tudi:

- da bodo hodili in tekli po stopnicah pri medpredmetni povezavi s športno vzgojo;
- da bodo za dosego cilja potrebovali dodatno matematično znanje kotnih funkcij, ki ga bodo osvojili v sklopu medpredmetne povezave z matematiko;
- da bo pri delu vsak uporabljal svoj mobilni telefon, ki mu bo služil kot štoparica, merilec naklona in orodje za vnašanje meritev;
- da bodo meritve vnašali s pomočjo mobilnega telefona v svojo osebno Excelovo preglednico;
- da bodo za dosego ciljev potrebovali osnovna znanja iz Excela;
- da se bodo morali vpisati v Microsoftov račun Office 365, kjer bo vsak našel svojo povezavo do Excelove datoteke z vsemi tabelami za vnos meritev in da
- se bodo v Office 365 vpisali pri pouku informatike, kjer bodo osvojili tudi potrebna znanja iz Excela in
- da si morajo na pametni telefon naložiti aplikacijo za merjenje naklona (Bubble level Galaxy) [2].
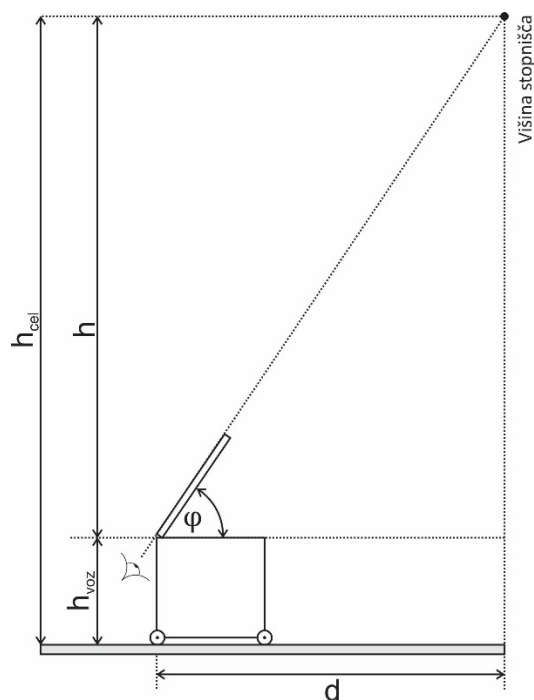
Slika 1: Določanje višine stopnišča s pomočjo viziranja in kotnih funkcij.

2.2 Preverjanje in utrjevanje kotnih funkcij v skupinskem delu pri pouku matematike

Profesorica matematike je v prvi polovici učne ure razložila snov iz vsebin kotnih funkcij (definicije, uporaba in računanje s kotnimi funkcijami), v drugi polovici učne ure pa so dijaki delali

v skupinah pod vodstvom laborantke za fiziko in profesorice matematike.

Vsaka skupina dijakov je dobila metrsko desko, ki so jo morali prisloniti na zid pod poljubnim kotom. S pomočjo telefonov so izmerili kot α med desko in vodoravnico, nato pa vodoravno k_2 in navpično k_1 razdaljo deske (slika 2).
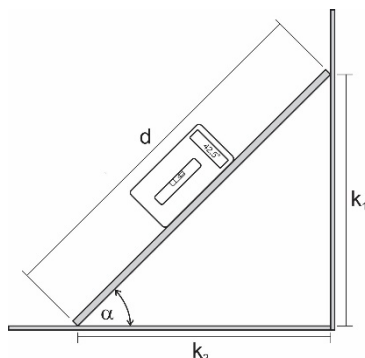
Slika 2: Merjenje naklona deske, navpične in vodoravne komponente.

V drugem delu skupinskega dela so dijaki ti dve razdalji izračunali še s pomočjo kota in dolžine deske, ter ju primerjali z izmerjenima. Ko so vsi dobili približno enake vrednosti, smo lahko trdili, da smo eksperimentalno preverili veljavnost in uporabnost kotnih funkcij. Na ta način so dijaki pridobili potrebna znanja iz vsebin kotnih funkcij.

Pri tej učni uri so dijaki preverjali kotne funkcije z namenom spodbujanja sodelovalnega timskega dela, kritičnega mišljenja, načrtovanja in razvijanja komunikacije.

2.3 Izvajanje meritev za določanje moči pri uri športne vzgoje

Pri tej učni uri sta sodelovali laborantka za fiziko in profesorica športne vzgoje. Glavni cilj je bil, da dijaki izvedejo vse potrebne eksperimentalne meritve in jih vnesejo s pomočjo uporabe pametnega telefona v osebno Excelovo datoteko (slika 3). Morali so se povezati v Eduroam omrežje in dostopati do Excelove datoteke, ki je bila shranjena v oblaku OneDrive. Vsak je imel dodeljeno pravico, da lahko ureja in vstavlja meritve v svojo lastno datoteko.

Dijaki so bili pri delu razdeljeni v skupine, pri čemer so se urili v veščinah sodelovalnega timskega dela. Prva skupina štirih dijakov je morala s pomočjo viziranja določiti višino zunanjih požarnih šolskih stopnic. To so naredili tako, da so na voziček dali ravno metrsko palico in jo nagnili pod takšnim kotom, da so videli vrh stopnišča, v skladu s sliko 1. Sledila je meritev naklona palice s pomočjo telefona in nato še meritev vodoravne razdalje do stopnišča in višine vozička. S pomočjo teh podatkov so lahko z uporabo kotnih funkcij določili višino stopnišča (slika 1).

Druga skupina dijakov je med vzpenjanjem po stopnicah imela naslednje naloge:

- s pametnih telefonom izmeriti čas hoje (hitre hoje in teka) do vrha stopnišča;
- prešteti število stopnic do vrha;
- izmeriti višino ene stopnice na več mestih z namenom kasnejšega izračuna višine stopnišča;

- izmeriti čas prostega padanja kamenčka od vrha stopnišča do tal za poznejši izračun višine stopnišča.

Vnaprej so bili opomnjeni, da naj meritve izvajajo na tak način, da bodo čas čim bolj optimalno izkoristili. Vse meritve so v ustrezno tabelo na svojih telefonih morali vnašati sproti (slika 3). Po vseh opravljenih meritvah so dijaki zamenjali vloge in naredili še preostale meritve.

Pri teh dveh urah so dijaki razvijali veščine opazovanja, sodelovanja, komunikacije, ustvarjalnosti in kritičnega razmišljanja.

Slika 3: Excelova datoteka z navodili in vnesenimi meritvami oz. izračuni.

2.4 Izpolnjevanje Excelove datoteke pri pouku informatike

Zaključne aktivnosti so dijaki izvajali pri dveh urah informatike, kjer smo bili navzoči profesor fizike, profesorica informatike in laborantka za fiziko. Dijaki so delali samostojno vsak s svojim računalnikom v učilnici za informatiko, saj so imeli vsa navodila že v svojih tabelah v obliki pripomb (slika 3 in 4). V celicah niso bila samo navodila, ampak tudi namigi, kako se kakšnega problema lotiti (slika 4). Preden so delo začeli, so morali odgovoriti na motivacijsko vprašanje; koliko čokolade bi lahko zaužili, da bi nadomestili energijske izgube, potem ko so se štirikrat povzpeli do vrha požarnega stopnišča.

Slika 4: Opomba in napotek pretvorbe iz Wattov v konjsko moč.

Vse zahtevano je vsem dijakom, v dveh urah informatike in s pomočjo profesorjev in laborantke, uspelo narediti. Z dijaki smo

po opravljanih aktivnostih opravili tudi evalvacijo dejavnosti, v sklopu katere smo poiskali težave in napake pri delu, na nerešene probleme poiskali rešitve in določili domače delo. Za domačo nalogo so morali izračunati, kolikšna bi bila približno absolutna napaka zaužite čokolade zaradi napak pri računanju višine stopnišča.

Pri teh dveh učnih urah so dijaki razvijali kritično mišljenje, reševanje problemsko zastavljenih nalog in računalniško pismenost.

3   ZAKLJUČEK

Na hitro spreminjajočem se trgu dela težko predvidimo vse poklice prihodnosti. Ne glede na to pa lahko že v današnjem času, ko so vse informacije hitro dostopne, ocenimo, da v poklicih prihodnosti ne bo več ključno dobro pomnjenje velikega števila podatkov. Na prihodnjem trgu dela pričakujemo, da bodo uspešnejši kadri tisti, ki se bodo hitro prilagajali novim razmeram dela in bo podkrepljen s t.i. veščinami 21. stoletja oz. prečnimi veščinami. Te veščine so prilagodljivost, iznajdljivost, zmožnost delovanja v spremenjenih razmerah, prevzemanje odgovornosti in pobude, sodelovalno timsko delo, komunikacijske sposobnosti in uporaba digitalnih orodij [1]. Z namenom načrtnega razvijanja in krepitve opisanih veščin sem fizikalno učno snov predelal v sklopu šestih učnih ur, od katerih sem pet učnih ur izvedel v medpredmetnih povezavah z matematiko, informatiko in športno vzgojo. Prednost tako izvedenega dela je v krepitvi sodelovalnega timskega dela, prestavitev pouka iz učilnic, urjenja dijakov v sodelovalnem timskem delu in uporabi sodobnih digitalnih orodij za učne namene. Dodatno obremenitev tako izvedenega pouka predstavlja veliko usklajevanja z nosilci drugih predmetov in neprilagodljivost urnika.

Ne glede na manjše ovire, ki so del spremenjenega načina dela, menim, da so dijaki v tako organiziranem pouku veliko bolj proaktivni, samoiniciativni, kritično misleči in tudi sooblikovalci učnega procesa, kot so to lahko pri klasičnem frontalnem poučevanju.

VIRI

[1]   Transversal Skills Framework. ATS2020. (2020). Dostopno na: http://ats2020.eu/transversal-skills-framework.

[2]   Mobilna aplikacija za merjenje naklona. Bubble level Galaxy. Dostopno na: https://play.google.com/store/apps/details?id=pl.nenter.app.bubblelevel&hl=en_US

Učenje na daljavo v Arnesovih spletnih učilnicah

Distance learning in Arnes online classrooms

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POVZETEK

V prispevku je predstavljeno delo na daljavo v času epidemije SARS-CoV-2, ki je potekalo preko Arnesovih spletnih učilnic. Na dveh osnovnih šolah se je izvajalo učenje na daljavo z uporabo Arnesovih spletnih učilnic za učence od 1. do 9. razreda pri predmetih tuji jezik v prvem vzgojno-izobraževalnem obdobju, knjižnično-informacijska znanja in matematika od 6. do 9. razreda. V času dela na daljavo so uporabniki podrobneje spoznavali Arnesovo spletno učno okolje in raziskali prednosti in slabosti uporabe spletnih učilnic.

KLJUČNE BESEDE

Učenje na daljavo, Arnesove spletne učilnice, spletno učenje, osnovna šola

ABSTRACT

The paper presents distance learning during the SARS-CoV-2 epidemic, which took place in Arnes' online classrooms. At two primary schools, distance learning was carried out using Arnes online classrooms for students from 1st to 9th grade in foreign language in the first educational period, library and information skills and mathematics from 6th to 9th grade. During the distance learning, users got to know Arnes' online learning environment in more detail and explored the advantages and disadvantages of using online classrooms.

KEYWORDS

Distance learning, Arnes online classrooms, online learning, primary school

1 UČENJE NA DALJAVO

V šolskem letu 2019/20 so se slovenske osnovne šole v drugi polovici šolskega leta zaprle in svoje vzgojno-izobraževalne dejavnosti izvajale na daljavo. Marca 2020 so se šolski strokovni delavci soočali z novo realnostjo, z učenjem na daljavo, z učenjem v spletnem okolju, kjer sta didaktika in metodika dela popolnoma drugačni v primerjavi s klasični poukom. Prenos

komunikacije, procesa učenja in poučevanja v spletno okolje oz. v okolje, kjer sta učitelj in učenec fizično ločena, je odprl številna vprašanja in ponudil možnosti za izboljšanje vzgojno-izobraževalnega procesa.

Učenje na daljavo ima svoje začetke v angleško govorečih državah. Konec 19. stoletja se je zaradi geografske izolacije nekaterih območij in velikih razdalj v Združenih državah Amerike, Kanade in Avstralije razvilo učenje na daljavo [1]. Encyclopedia Britannica *distance learning* ali učenje na daljavo razlaga kot obliko izobraževanja, v kateri sta učitelj in učenec prostorsko ločena, komunikacijo med njima pa omogoča različna tehnologija [1]. Skozi zgodovino so se modeli učenja na daljavo izpopolnjevali, spreminjali glede na ciljno učečo skupino in se posodabljali v skladu s tehnološkim napredkom.

12. marca 2020 je bila v Republiki Sloveniji razglašena epidemija, virus SARS-CoV-2 je povzročil zaprtje vzgojno-izobraževalnih zavodov ter drugih ustanov. Učenje in poučevanje sta se preselila v domače okolje, učitelj in učenec sta postala fizično ločena, šole so na podlagi navodil in priporočil oblikovale skupne načine komunikacije, spletne učilnice in protokole pri delu na daljavo.

Zavod Republike Slovenije za šolstvo je izdal strokovna navodila za ravnateljice in ravnatelje osnovnih šol za izvajanje izobraževanja na daljavo v izrednih razmerah, v katerem avtorji priporočajo, da v času izobraževanja na daljavo [2]:

- šola vzpostavi komunikacijo s starši oz. učenci po različnih kanalih.

- se pri izbiri komunikacije šola, aktiv, oddelčni učiteljski zbor poenotijo in naj pri izbiri načina komunikacije upoštevajo možnosti in zmožnosti staršev in otrok.

- je pomembna tako povratna informacija učitelju o zadovoljstvu učencev in staršev s strani učencev in staršev kot tudi povratna informacija učencu na njegovo delo in napredovanje.

- naj učitelji upoštevajo, da vsak učenec nima dostopa do svoje naprave oz. da nimajo vsi tiskalnikov.

Sodobni učitelj se je tako znašel pred popolnoma novim izzivom. Učenje na daljavo je zahtevno in od učitelja zahteva, ne samo obvladovanje pedagoškega dela, ampak tudi poznavanje IKT opreme, ustrezno stopnjo računalniške pismenosti, prilagajanje novim razmeram ter hitro odzivnost v spletnem okolju.

Da bi izvedli učenje na daljavo, prenesli dejavnosti v spletno okolje, uskladili učni proces in zmožnosti učencev, sva se učiteljici na Osnovni šoli Vide Pregarc v Ljubljani in Osnovni

šoli Antona Martina Slomška na Vrhniki odločili za uporabo Arnesovih spletnih učilnic.

2 ARNESOVE SPLETNE UČILNICE

Arnes ponuja storitev, ki temelji na spletnem sistemu Moodle – Arnes Učilnice. Ker na Arnesu skrbijo za tehnično vzdrževanje spletnih učilnic, so Arnesove Učilnice zagotovo najboljša izbira za spletno okolje, v katerem se izvaja učenje na daljavo.

Nekatere šole so se odločile za uporabo Arnesovih spletnih učilnic. Obveščanje staršev in učencev je praviloma potekalo preko šolskih spletnih strani, na kateri so šole objavljale tudi dostop do spletnih učilnic. S klikom na povezavo so učenci ali starši vstopili v Arnesove spletne učilnice, ki so bile urejene po razredih ali predmetih. S klikom na določeno Arnes spletno učilnico so se odprli predmeti oz. področja, pod katerimi so učitelji objavljali navodila, povezave, slikovno gradivo, video posnetke, fotografije, odpirali razprave v obliki forumov, pripravili prostor za oddajanje nalog učencev, izdelali kvize, pripravili interaktivne vsebine (H5P), izvedli videokonference Jitsi.

Arnesove spletne učilnice so enostavne za uporabo, zato so na OŠ Vide Pregarc zajeli kar celotno vertikalo, to je učence od prvega do devetega razreda. V nižjih razredih, kjer učenci še ne berejo samostojno, so pri uporabi spletnih učilnic pomagali starši.

Za prijavo v Arnes Učilnice so učenci potrebovali AAI račun, ki ga je naredil računalnikar na šoli. Šola je izdelala kratka navodila za prijavo v Arnes Učilnice. Večjih težav s prijavami ni bilo.

2.1 Tuji jezik v prvem vzgojno-izobraževalnem obdobju

Za učence prvih treh razredov so bile oblikovane tri spletne učilnice. Glede na razred je učiteljica objavljala navodila za delo na daljavo. V prvem razredu so navodila prebrali starši, v drugem in tretjem razredu pa učenci sami. Navodila so bila objavljena enkrat tedensko, saj ima predmet angleščina na razredni stopnji dve uri na teden. Arnesove Učilnice so omogočile, da je uporabnik prebral navodila in opravil določeno dejavnost, pri tem je lahko:

- s klikom na povezavo na YouTube ponovil angleško pesem,

- s klikom na priponko odprl slikovno gradivo in na podlagi le-tega pripravil govorni nastop po vzorcu,

- s pregledom pripetega slikovnega gradiva po navodilih izdelal pravljični zemljevid,

- ob ogledu naloženega videoposnetka ponovil ritmično izreko, s katero je ponovil dneve v tednu,

- s klikom na povezavo na spletno stran poslušal zvočno pravljico v angleščini in nato poročal s sliko ali besedo o sestavinah pravljične jedi,

- s klikom na povezavo na interaktivni učni list, ki je sam seštaval točke in dajal številčno povratno informacijo,

- s klikom na priponko v PowerPoint formatu opravil preverjanje znanja,

- s klikom na povezavo rešil kviz in preveril svoje znanje besedišča iz različnih sklopov.

Po opravljenih nalogah so učenci glede na vrsto naloge oddali svoj izdelek, zapis, ilustracijo ali posnetek na način, ki je bil opredeljen v navodilih. Večina je svoje izdelke pošiljala na elektronski naslov učitelja, nekatere naloge ali rezultati pa so se beležili z reševanjem interaktivnih učnih listov.

Spletna učilnica se je posodabljala dvakrat tedensko, včasih tudi vsak dan, odvisno od načina dela. Zaradi preglednosti so se označevali tedni učenja na daljavo. Sčasoma je besedila bilo vse več, zato so se objavile samo tekoče vsebine (za obdobje dveh tednov), ostalo pa se je pripelo v Wordov dokument Arhiv. S klikom na priponko so imeli uporabniki pregled nad celotnim delom.

Za mlajše učence se je izkazalo, da je delo v spletni učilnici lažje, če so navodila kratka in ne zahtevajo veliko klikanja do cilja oziroma, če je poleg povezave slikovno gradivo ali če povezava sama ponuja video posnetek (slika 1), ne da bi uporabniki posebej odpirali strani ali lepili povezave.

Slika 1. Primer video povezave s slikovno oporo.

2.2 Knjižnično-informacijska znanja

Učenci so v času učenja na daljavo imeli možnost opravljati bralno značko in eko bralno značko. V veliko pomoč jim je bila spletna učilnica Knjižnica, v kateri je bila objavljena povezava do spletne knjižice Koronavirus, pod njo pa navodila za opravljanje bralnih dejavnosti (slika 2). Ker so bile knjižnice zaprte, učenci niso imeli dostopa do besedil, zato so se v spletnih knjižnicah objavljala besedila, ki so prosto dostopna na spletu. Povezave do ljudskih in avtorskih pravljic so učencem pomagale, da so opravljali bralno značko. Od vseh ponujenih besedil so učenci največkrat izbrali slovensko leposlovje na Wikiviru, ki so v spletni učilnici bili objavljeni v obliki povezav, te so bile urejene po priimkih avtorjev za lažjo orientacijo. Učenci so nato glede na svoje zmožnosti in starostno stopnjo odgovorili na vprašanja in jih objavili v zbirniku v Padletu ali pa so zapiske poslali učitelju na e-mail in jih je nato učitelj objavil v Padlet zbirniku. Če pa so bralci skupinsko prebrali besedilo, se je odprl klepet, kjer so udeleženci delili svoje bralne vtise.

Poleg klasične bralne značke se je na podoben način izvajala tudi eko bralna značka. Učencem je spletna učilnica nudila povezave na članke z ekološko vsebino, povezave do besedil v angleškem in nemškem jeziku, do slovarjev, zvočnih knjig, strokovnih revij, gledaliških in lutkovnih predstav pa tudi priročnikov za ustvarjanje.

Slika 2. Navodila za opravljanje bralne značke.

Spletna učilnica se je posodabljala vsak dan. Učenci so tako sproti dobili povratno informacijo o svojem delu, preverili so lahko komentarje v zbirniku, z rdečo barvo so bile označene novosti. Knjižničar je moral enkrat tedensko preverjati povezave, saj se je dogajalo, da nekatere povezave niso bile ves čas dostopne.

Rezultat opravljenih bralnih značk je bil kljub učenju na daljavo visok. Veliko število bralcev je šolskemu knjižničarju sporočalo, da imajo čas in dostop do besedil in da bodo verjetno tudi med počitnicami brali besedila, ki so na voljo v spletnih učilnicah.

2.3 Matematika

Učenci so se matematiko učili v spletni učilnici Matematika, ki je bila razdeljena po razredih (slika 3).
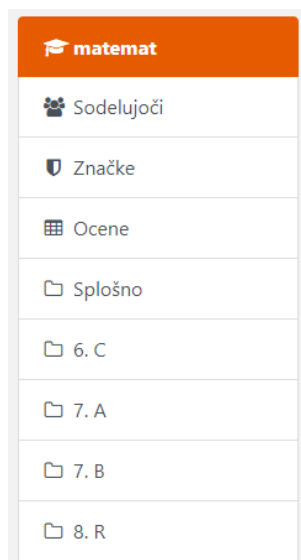
Slika 3. Razdelitev spletne učilnice za matematiko.

Na vrhu spletne učilnice so bila Obvestila (slika 4), ki so zajela redno obveščanje o novicah, ki se tičejo vseh učencev in navodila (npr. kako najhitreje dostopam do spletne učilnice).
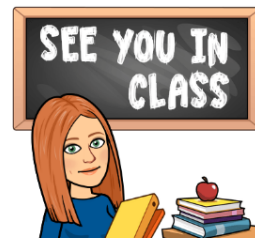
Slika 4. Zadnje obvestilo v spletni učilnici.

Sledili so posamezni razredi, znotraj razredov pa je bila delitev narejena po tednih (slika 5). Ker je sčasoma spletna učilnica postala nepregledna zaradi prevelikega števila objav, smo neaktualne tedne skrili za udeležence.

Slika 5. Razdelitev poglavja 6. c.

Vsako poglavje je imelo tudi forum, kjer so učenci postavljali vprašanja (slika 6). Odgovarjali pa so tako sošolci kot učiteljica. Forum je služil kot pomoč pri težavah, na katere so naleteli učenci, lahko pa tudi zgolj za debato med njimi.

V spletni učilnici smo objavljali vsak dan sproti, za vsako uro na urniku posebej. Vedno smo najprej pričeli z nagovorom učencem, nato smo dodali navodila za delo za učno uro, sledila so dodatna navodila (priprava na tekmovanja, reševanje NPZ-jev, izdelava plakata Matematika v vsakdanjem življenju …). Navodila so bila sestavljena iz besedila, povezav do uporabnih spletnih strani, povezav do videokonferenc, povezav do anket, povezav do preverjanja znanja in rešitev le-teh, motivacijskih slik, napotitve za premagovanje ovir, povezav do videoposnetkov. Učence smo tudi sproti opozorili, v kolikor kdo naloge ni pravočasno oddal, naj to uredi.

Slika 6. Primer foruma razreda.

Arnes Učilnica znotraj storitve nudi Videokonferenco Jitsi, na željo učencev pa smo uporabili Zoom (slika 7).

Slika 7. Povabilo na videosrečanje Zoom.

Učenci so povratne informacije za delo dobili:

- svoje izdelke so poslali na učiteljičin mail in ta jim je odgovorila.

- učenci so rešiti ankete narejene v Google Docs in so takoj dobili povratno informacijo.

- učenci so izdelali kolaž slik svojega dela in slike prilepili v Padlet, kjer so sošolci in učiteljica komentirali delo posameznika.

- učenci so rešiti spletni kviz Kahoot in so takoj dobili povratno informacijo.

- učenci so zahtevano nalogo oddali v spletni učilnici in učiteljica je podala povratno informacijo.

- učenci so sodelovali v videokonferenci.

Zelo uporabno za učiteljico matematike je bilo tudi poglavje Sodelujoči (slika 8), saj je učiteljica redno spremljala, kdaj je bil posamezni učenec nazadnje aktiven v učilnici ter tako sproti opozarjala učence na morebiten prevelik primanjkljaj v sprotnem delu.

Slika 8. Spremljanje zadnjega dostopa do predmeta.

3   DISKUSIJA

31. maja 2020 se je učenje na daljavo uradno zaključilo. Vsi osnovnošolci so se s 1. junijem 2020 lahko vrnili v šolske klopi. Za učence osnovnih šol je učenje na daljavo potekalo več kot dva meseca. V času učenja na daljavo s(m)o učitelji v spletnih učilnicah ves čas skrbeli za povratne informacije na različnih ravneh: kakšno je počutje učencev, kako doživljajo učenje na daljavo, kako se spopadajo s spletnim učnim okoljem, ali imajo tehnično podporo, kako se znajdejo pri uporabi spletnih učilnic, ali lahko sledijo navodilom.

Starši in učenci so sporočali, da so Arnesove Učilnice preproste za uporabo, da se znajo orientirati v spletnih učilnicah, da so povezave vidne in razumljive, da so jim navodila za uporabo v pomoč. Poudarili so, da je spletna učilnica odlično izhodišče za uporabo dodatnih aplikacij kot so Zoom, Kahoot in Padlet. Z vsakodnevno komunikacijo spletna učilnica deluje živo, saj se kar naprej posodablja in spreminja.

Za učitelje je vsekakor prednost, da z uporabo Arnesovih Učilnic lahko s prilagoditvami vnašajo v učenje na daljavo elemente formativnega spremljanja, ki poudarja aktivnost učenca in trajnejše znanje. Če pod elemente formativnega spremljanja štejemo [3]: namene učenja in kriterije uspešnosti, dokaze, povratno informacijo, vprašanja v podporo učenju in samovrednotenje/vrstniško vrednotenje; potem z Arnesovimi Učilnicami lahko zajamemo vse. V spletnih učilnicah lahko predstavimo namene učenja, kriterije uspešnosti, izdelke v spletnih učilnicah lahko uporabimo kot dokaze, lahko omogočimo komunikacijo, ki omogoča vrednotenje. Vse našteto je pomembno tudi za učitelja, saj tako lahko tudi preverja in ocenjuje ter v spletnem okolju vzpostavlja podobne učne strukture kot v razredu.

Arnesove Učilnice so se izkazale za zelo učinkovito spletno okolje v času dela na daljavo. Razen nekaj začetnih težav z dostopanjem do strežnikov, kar so na Arnesu hitro uredili, težav z dostopanjem do spletnih učilnic ni bilo. Delo znotraj učilnic je bilo enostavno, ne učitelji ne učenci niso imeli večjih težav. Komunikacija je bila dvostranska in učinkovita, povratna informacija pa takojšnja.

Omejitve in priporočila so postale del vsakdanjega življenja. Učenje na daljavo ni več samo pojem, ki se izvaja nekje daleč na drugi celini, ampak je postalo del slovenskega šolskega sistema, zato je potrebno pripraviti bodoče učitelje na delo na daljavo, vpeljati v študijske programe tudi sistematično razvijanje računalniške pismenosti, strokovno izpopolniti učitelje, ki niso vešči dela z IKT, ter podpreti učitelje, da raziskujejo nova spletna orodja.

4   ZAKLJUČEK

V času učenja na daljavo smo na dveh osnovnih šolah uporabljali Arnesove Učilnice, ki so omogočale delo na daljavo pri različnih

predmetih od 1. do 9. razreda. Ugotovili smo, da z uporabo Arnesovih učilnic lahko izvajamo učenje na daljavo v skladu s priporočili Zavoda Republike Slovenije za šolstvo, saj je Arnesovo spletno okolje preprosto za uporabo s strani uporabnikov, na drugi strani pa omogoča zbiranje dokazov in povratnih informacij ter omogoča vnos elementov formativnega spremljanja v digitalno okolje.

V primeru, da se bo učenje na daljavo ponovilo v novem šolskem letu, pa velja razmisliti o dostopu v spletne učilnice z gesli, saj se z objavami učnih gradiv, ki jih izdelujejo učitelji, odpirajo tudi vprašanja o avtorskih pravicah, navajanju virov in intelektualni lastnini strokovnih delavcev. Kot primer dobre prakse velja izpostaviti spletno učilnico Matematika, kamor so učenci dostopali z AAI prijavo, s čimer smo poskrbeli tudi za njihovo spletno varnost.

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Poučevanje tujega jezika na daljavo in nova normalnost

New normal: foreign language and distance teaching

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POVZETEK

Digitalizacija učenja ponuja mnogotero možnosti za usvajanje tujega jezika, hkrati pa pomeni, da učitelj v novem okolju prevzema vloge, ki do pojava digitalizacije niso obstajale. Nova »normalnost« nas je čez noč prisilila, da smo klasično poučevanje zamenjali samo s poučevanjem na daljavo. Zaprt prostor učilnice je zamenjal neskončni prostor digitalnega sveta. Brez fizične prisotnosti je učitelj čez noč moral osvežiti ali nagraditvi svoje IKT spretnosti in jih uporabiti za optimalno učenje na daljavo. Moral je tudi upoštevati številne zunanje faktorje, ki bi lahko vplivali na uspešnost učenja dijakov, a hkrati imel edinstveno možnost, da upošteva načelo avtonomnosti pri učenju, ki dela učno izkušnjo najbolj optimalno.

KLJUČNE BESEDE

Avtonomnost, tuji jezik, digitalizacija, vloga učitelja, poučevanje na daljavo, učenje na daljavo

ABSTRACT

Digitalisation of teaching offers an abundance of opportunities to foster language acquisition, thus giving a teacher a set of new roles that did not exist prior to the emergence of digitalisation. The new »normal« urged us to become more involved in distance teaching than ever before. Learning in an enclosed classroom has become substituted with the infinite learning space of the digital world. With no face to face communication, a teacher has overnight become someone who has to employ the advantages of »the digital« classroom in order to teach their students effectively, thus obtaining new skills in IKT technology that pertains to distance teaching, but also considering outside factors that might influence their or their students' learning process. The distance learning has also given teachers the opportunity to consider the factor of autonomy in each and every student's style of learning, thus making their learning experience optimal.

KEYWORDS

Autonomy, foreign language, digitalisation, distance learning, distance teaching, teacher's role

1 UVOD

Generaciji t. i. *screenagerjev*, rojenim v svet digitalnega za učenje več ne zadostuje le beseda, ampak za učenje potrebujejo digitalne podpore. Usvajanje znanja je z digitalizacijo postalo časovno ter prostorsko odprto. Z digitalizacijo učenja je le-to preseglo ozko definicijo pomnjenja in zdaj vključuje raziskovalno, sodelovalno delo, pomeni tudi iskanj preverjenih in merodajnih informacij na medmrežju, pri čemer je učeči se subjekt avtonomen uporabnik, aktiven v učnem procesu. Nova »normalnost« je kljub izzivom ter preprekam in dilemam o nenadomestljivosti klasičnega pouka v šoli, pomenila priložnost, da učitelj, kot usmerjevalec učnega procesa dijaku omogoči, da je pri usvajanju jezika samostojen, avtonomen ter časovno neobremenjen, tj. da se uči (oz. pri tujem jeziku potaplja v jezikovno kopel), ko to tudi sam želi.

V pričujočem prispevku se osredotočam na izkušnje poučevanju angleščine kot prvega tujega jezika na daljavo v srednji šoli in gimnaziji. Spoznanja, ki ji navajam, so moje lastne ali pa so to povratne informacije dijakov, hkrati pa ugotavljam, kje so še možnosti za izboljšavo učenja na daljavo.

2 VLOGA UČITELJA PRI POUČEVANJU NA DALJAVO

Preteklo šolsko leto je bilo v luči nove »normalnosti« na področju izobraževanja unikum, poln izzivov, novih (spo)znanj ter lekcij za prihodnost. Nova »normalnost« je od učitelja zahtevala, da se je IKT opismenil. Funkcija učitelja pri poučevanju na daljavo pa se ni zmanjšala, ampak le *dinamizirana*. Le-ta v informacijski dobi ni le prenos znanja, ampak tudi poznavanje specifik ciljne publike, saj poučuje populacijo, ki ima, [4] (a) visoko razvite spretnosti pri uporabi modernih tehnologij, ki pa jih je, kot njihovo močno področje, potrebno naprej dodatno razvijati. Prav tako (b) delo v digitalnem okolju [dijake] dodatno motivira, (c) uporaba spleta pa neodtujljiv medij pri poučevanju, saj poglablja in razširja znanja, ki jih [dijak] nezavedno ponotranji med tem ko se uči v svetu, ki mu je blizu.

Nova »normalnost« je čez noč povzročila situacijo, ko več ni šlo za kombinacijo klasičnega poučevanja in poučevanja v digitalnem okolju, katerega se večina učiteljev poslužuje, ampak dokončen (in vsaj začasen) premik k slednjemu. Odsotnost dijakov izza štirih sten učilnic in matičnih šol in manko neposrednega stika s profesorji je pomenil, da smo se morali vsi,

tako dijaki kot učitelji (pa tudi starši), čez noč privaditi na novo razmere – situacijo poučevanja in učenja na daljavo, kjer se je, tako na eni kot drugi strani, izkazala za nemoten potek izobraževalnega procesa nujnost poznavanja IKT tehnologije. Da pa bi ohranili pouk kvaliteten, je bilo tudi ključno, da se učitelji zavedamo, kdo je naša ciljna publika. Kvaliteten pouk bo tisti, [1] ki »*nas aktivno vključuje* in povezuje z drugimi sodelujočimi, [pri čemer pride] do izmenjave izkušenj in zanimivih idej«. V tem času je [2] pomemben učiteljev »prilagojen pedagoški stil« oz »posluh« kot tehnologija sama. Učitelj je [2] »animator kolektivne inteligence« učečih se subjektov, hkrati pa je opazovalec in vodja ter podpornik individualnega učnega procesa, ki ga omogoča splet. Vloga učitelja pri učenju na daljavo se torej le redefinira.

3 PARADIGMA UČENJA NA DALJAVO – TEORIJA

Iz paradigme učenja na daljavo [3] je viden premik v odnosih med deležniki v virtualnem okolju. Vloga učitelja in učenca je dinamizirana. Učitelj, ki fizično ni prisoten v prostoru, vodi, organizira in usmerja proces učenje, nudi pomoč in daje povratne informacije v zvezi s predmetnim področjem, samostojno pa delo opravi dijak sam. Gre za poseben odnos interakcije, ki mogoča izkušenjsko učenje v dijaku domačem okolju, učne vsebine pa so prek moderne tehnologije in spletnih platform bolj privlačne in tako dijaka notranje motivirajo ter stimulirajo (nezavedno) učenje. Vloga učitelja je vloga organizatorja in usmerjevalca, pomočnika in vira povratne informacije (ali dodatne razlage), dijak pa se uči samostojno. Njegova vloga se spreminja, saj postaja samostojni uporabnik in ne le učenec. sveta okrog sebe.

Tabela 1: Paradigma učenja na daljavo – vloge učitelja, učenca in tehnologije

Kdo, kaj	*Kako mora biti v virtualnem okolju*
Učitelj	Vodi učenca kot organizator pouka, je e-kompetenten
Učenec	Je v interakciji z vsebinami in drugimi sodelujočimi, postaja avtonomen, notranje motiviran in kritičen uporabnik, ki si tudi sam določa kdaj in koliko dela
Prostor	Digitalni prostor za usvajanje znanj, izmenjavo idej in informacij
Izkušnje	Proces izmenjave izkušenj med člani skupine, ki ga v učni proces vključuje učitelj
Učenje	Prijetna izkušnja (osebna, intelektualna rast), nezavedno ponotranjenje podatkov
Učne vsebine	Fleksibilne, večplastne, življenjske in odprte glede na potrebe in želje učencev
Moderna tehnologija, učna okolja	Virtualno okolje, splet, e-učilnice, ZOOM, aplikacije, e-komunikacija (portal e-asistent), *google docs*
Raba novih komunikacijskih tehnologij	Učitelj in učenec se poslužujeta IKT, kar omogoča izmenjavo znanj in izkušenj. Potreben je skupni nivo e-kompetenc.

Učitelj kot »animator« pri poučevanju na daljavo naredi učenje tujega jezika karseda raznoliko, odprto in dinamično in le-to izhaja iz raznolikega (a ne prevelikega) števila virov in pristopov. Na ta način učenec najde vir ali pristop, ki mu najbolj odgovarja in med vsemi možnostmi tudi izbira in si učenje kroji po lastni meri, je avtonomen , učenje pa si personalizira – na ta način pa bo tudi bolj motiviran in uspešen, pri tem pa ne čuti časovnih pritiskov klasične šolske ure. Ti aspekti in dejstva optimalnejšega učenja so mi pri načrtovanja dela na daljavo pomagali, da sem oblikoval pouk »po meri dijaka«.

4 PRIMERI DOBRIH PRAKS POUČEVANJA NA DALJAVO PRI TUJEM JEZIKU

Pri poučevanju na daljavo sem naletel na veliko izzivov, vprašanj, našel pa tudi veliko rešitev in dobrih praks, podlaga katerih je poznavanje IKT tehnologije, a morda pomembneje, posluh do dijakov oz. razumevanje, kdo so in kako se učijo. V tem poglavju navajam in osvetlim pomembnejša spoznanja v času poučevanja na daljavo.

4.1 Komunikacija

Z dijaki smo komunicirali preko enega skupnega okna »komunikacija« (na portalu e-asistent), kjer so tedensko prejemali navodila za delo. Ob pričetku dela na daljavo, sem dijake vseh oddelkov obvestil, kako sem zastavil delo in na kakšen način bo potekalo naše sodelovanje. Vseskozi je bilo moje in njihovo delo tudi evalvirano.

4.2 Načrtovanje in izvedba (primer tedenskega sklopa)

Načrtovanje pedagoškega procesa se je izkazalo za ključno tudi pri delu na daljavo. Pri planu dela za posamezni teden sem upošteval najprej količino dela in zadolžitev, ki jih dijaki opravijo samostojno glede zahtevnost učne snovi in dejstvo, da delajo skoraj samostojno in na daljavo, predvidel pa sem tudi, kako si je delo možno razdeliti na manjše zaključene celote, saj upoštevam dejstvo, da se vsi enako hitro ne učijo.

Dijaki so bili v skupnem oknu »komunikacije« na portalu e-asistent v ponedeljek zjutraj (plan dela, gradiva, posnetki, povezave itd. so bili pripravljeni teden prej) obveščeni o snovi, ki jo bo potrebno (ob različnih podporah) predelati. Pravočasna obveščenost dijakov, se mi je zdela ključna, saj le-ta omogoča, da dijaki že v začetku tedna vidijo, koliko zadolžitev jih čaka in lahko tudi *sami* načrtujejo ter organizirajo delo v novem tednu. Obvestilo o zadolžitvah je bilo z alinejami razdeljeno na manjše enote. Namen takega obvestila je bil dvojen. Dijaki, ki so učno uspešnejši, so lahko snov celotnega tedna predelali v enem zamahu, tisti pa, ki potrebujejo več časa, so lahko delo opravili v skladu s časovnico dela na urniku (tj. v treh manjših sklopih, v obsegu treh šolskih ur) do konca tedna. Ta oblika dela spodbuja pri dijakih avtonomnost dela (dijak si sam določa, kdaj bo opravil zadolžitve), in dijaku daje večjo fleksibilnost pri učenju (zaradi manjšega števila ZOOM video konferenc, ki so jih zamenjale vnaprej posnete zvočne ali video razlage zahtevnejše snovi), da si sam časovno razporeja delo.

4.3 Povratna informacija

Povratna informacija je ključnega pomena.

Najprej to velja, ko gre za ugotavljanje in evalvacijo ali dijaki razumejo snov. Nabor dijakov iz vsakega razreda (tedensko preverjanje nalog več kot 200 dijakov, od tega 60 maturantov, je nemogoče) je moral do konca tedna oddati naloge iztekajočega tedna (ali preteklih tednov). Pri tem upoštevam možnost izbirnosti. Dijaki so bili obveščeni, katere naloge morajo nujno oddati (npr. poprava testa) in katere lahko oddajo izbirno (povzetek vsebine videa, interpretacija znanega citat, članek, povezan z obravnavano temo, po lastni izbiri itd.), istočasno pa imajo možnost, da svoje odgovore preverijo v sporočilu z rešitvami. Izbor nalog, ki so jih oddali, so fotografirali in istovetnost, da gre za njihovo delo, podprli z dijaško izkaznico ter gradivo poslali po elektronski pošti.

Drug primer izbirnosti in samostojnega odločanja v kontekstu povratne informacije je bila video konferenca ob petkih. Vsak petek (oz. zadnjo uro po urniku v tekočem tednu) so dijaki lahko prišli na skupno ZOOM video srečanje (povezava je bila tedensko v oknu »komunikacija«), kjer so za snov iztekajočega tedna lahko prosili za pojasnila, dodatno razlago ali le preverbo, da je snov razumejo. Načelo izbirnosti daje dijakom možnost, da si sami, avtonomno, določajo, kako bodo preverili svoje znanje, nanj pa nalaga tudi odgovornost za lastno učenje.

Povratna informacija je lahko tudi podatek o tem, ali je način posredovanja snovi, tj. ali so metode in pristopi k poučevanju ustrezni (le-ta je seveda neodutljivo povezana z zgornjo).V začetku obdobja nove »normalnosti«, je med učitelji potekala živahna virtualna diskusija o načinih podajanja snovi na daljavo, izmenjava informacij o primernih metodah poučevanja in platformah, ki so hkrati tudi učinkovite (in ne nazadnje varne) za delo z dijaki na daljavo. Zagotovo ima vsak predmet svoje specifike, ki zahtevajo svojevrsten način dela. Do ugotovitev, kaj je optimum pri poučevanju tujega jezika, pa pridem lahko že s preprosto (anonimno) anketo. Dijaki so v oknu »komunikacija« odgovorili na nekaj vprašanj, ki so me vodile do izboljšav. Nekateri so tudi podali svoje predloge preko neposrednih sporočil ali video konference.

4.4 Izbor spletnih platform in metod dela pri poučevanju tujega jezika na daljavo

Znano je, da se ljudje najbolj optimalno učimo, ko smo sproščeni, ko delovno okolje ni stresno in smo notranje motivirani. Ena izmed nalog učitelja pri učenju na daljavi je bila, da vsaj do neke mere zadostimo tem faktorjem, saj je v novi situaciji umanjkala fizična bližina in nadzor profesorja.

Ena izmed ugotovitev povratnih informacij dijakov je bila, da je prevelika raznolikost virov, povezav, *novih* platform, aplikacij in načinov dela, lahko tudi kontraproduktivna (vsi dijaki prav tako niso enako spretni z moderno tehnologijo oz. se v množici podatkov in tudi načinov, kako do teh podatkov izgubljajo). Odločil sem se, da za video konference uporabljam enako platformo kot večina ostalih profesorjev, da izkoristimo že znane vire informacij in gradiv (e-učilnice, učbenik in delovni zvezek), ter komuniciram z dijaki preko portala e-asistent (okno »komunikacija«).

Vnaprej posnete video in zvočne ure so se izkazale za dober način razlage snovi. Ker so si dijaki istega razreda pri tujem jeziku v svojem znanju zelo različni, je bilo moje osnovno vodilo upoštevanje le-ga. Pri snovi, ki zaradi kompleksnosti zahteva dodatno razlago (npr. pogojniki, razpravljalni esej ali uradno

pismo za maturo), sem vnaprej posnel zvočne učne ure, s pomočjo katerih sem dijake skozi že znane vire (učbenik in delovnik zvezek) ter gradiva iz že znane e-učilnice vodil in usmerjal pri usvajanju nove snovi. Za ta pristop sem se odločil iz več razlogov. Glavni sta časovna fleksibilnost in upoštevanje notranje diferenciacije. Za razlago eseja, na primer, bi v razredu pri klasičnem pouku porabil 3 šolske ure, saj v heterogeni skupini ni mogoče prehitevati snovjo. Te tri ure bi v primeru izbora ZOOM video konference (in klasičnega poteka razlage) potekale ob točno določenih terminih po urniku in časovno nikakor niso optimalne. Učno uspešnejši dijaki, bi ob slednjem za napredovanje skozi snov porabili več časa. Snov bi bila slišana le enkrat, kar pa bi za učno šibkejše lahko bilo problematično. V primeru pa, da so zvočne (ali video) ure posnete vnaprej, pa dosežem ciljno publiko v celoti. Kako? Dijaki, ki za učenje ne potrebujejo veliko podpore, se bodo zaradi možnosti odprtega učenja ob poslušanju zvočne podlage ter nabora nalog hitro seznanili z zakonitostmi pisanja eseja in bodo ob samostojni analizi že napisanih esejev hitro prišli do sinteze – samostojne tvorbe te literarne vrste. Učno šibkejši dijaki pa lahko med samo razlago posnetek ustavijo, oz. posamezne dele ali celoten posnetek poslušajo večkrat.

4.5 Ocenjevanje znanja

Poseben izziv je predstavljajo ustno in pisno ocenjevanje znanja na daljavo. Optimalno rešitev, ki bi nadomestila (objektivno) ocenjevanje v razredu je bilo skoraj nemogoče najti, hkrati pa je bilo potrebno najti možnost, ki bi zagotovila objektivnost ocenjevanja in merodajnost rezultatov.

Za pisno ocenjevanje na daljavo sem uporabil švedsko platformo exam.net, ki že v brezplačni različici ponuja dovolj funkcij za pisanje testa, za upravljanje le-tega pa niso potrebna poglobljena IKT znanja (npr. test v pdf obliki se enostavno naloži v sistem, dijaki ga odprejo, in v prazno *word* datoteko vpisujejo odgovore). Za razliko od drugih platform exam.net omogoča odprtje celozaslonskega načina, kar prepreči možnost odpiranja drugih spletnih strani, datotek itd., saj se v tem primeru izpit zapre in ga mora učitelj vnovič odpreti. Hkrati je možno platformo kombinirati s videokonferenco ZOOM (, ki je bila sicer osnova tudi ustnega ocenjevanja), kar učitelju daje možnost dodatnega nadzora nad dijakom, ki pa so tudi zaradi časovnih omejitev bili primorani biti na pisanje fokusirani in niso imeli (veliko) možnosti uporabe nedovoljenih pripomočkov.

4.6 Delo z maturanti

Brez dvoma nam je bila pri poučevanju na daljavo prioriteta delo z dijaki zaključnih letnikov in maturanti.

V tem času sem s pomočjo že zgoraj opisanimi primeri načrtovanja tedenskega obsega dela, zvočnimi posnetki razlag kompleksnejših vsebin (stalna sporočanjska oblika časopisnega članka), domačih nalog pisanja (preko *google docs* platforme so dijaki pošiljali svoje seje, pisma, reportaže itd., kjer so preko iste platforme dobili individualno povratno informacijo), internetnimi povezavami do maturitetnih nalog vseh vrst iz preteklih let ter z video konferencami (utrjevanje knjižnih predlog za maturo, urjenjenje govornih spretnosti za ustni del mature, povratna informacija o svojem pisnem izdelku) dosegel veliko večino dijakov, ki so, morda tudi zavedajoč se, da je matura pred vrati, opravili večino zadolžitev.

5 ZAKLJUČEK

Nova »normalnost« preteklega šolskega leta je pomenila sunkovit preobrat tudi na področju poučevanja, ki je (vsaj začasno) temeljil samo na digitalnih podlagah. Učinkovitost pouka (tujega jezika) na daljavo je zahtevala tudi dodaten *posluh* do učečega se subjekta, ne le strokovno znanje učitelja na svojem predmetnem področju. Uporaba različnih pristopov (avdio posnetki, videi, video konference, ankete, kvizi), ažurnost povratnih informacij učitelja ter raznolikost virov za utrjevanje in usvajanje snovi je učenca notranje motivirala in istočasno postavila v fokus učnega procesa. Dijaki so pri avtonomnem in pri (časovno) bolj fleksibilnem učenju bili notranje motivirani za delo. Ker pa velja, da učenje recipročen proces, kjer sodelujeta učitelj in dijak, je bila povratna informacija in evalvacija tudi pri tej obliki dela ključna, saj je omogočila optimizacijo učnega procesa na daljavo.

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Učenje besedišča z aplikacijo Quizlet

Vocabulary learning with Quizlet

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POVZETEK

Učenje besedišča pri tujem jeziku je izredno pomembno, saj je za sporazumevanje potreben bogat besedni zaklad. Ker pa lahko učenje besedišča postane kar hitro dolgočasno, v pouk pogosto integriram IKT, ki popestri sam pouk in učence motivira za delo. V prispevku je predstavljena aplikacija Quizlet, ki jo pri poučevanju tujega jezika pogosto uporabljam za samostojno in sodelovalno učenje besedišča. Aplikacija združuje besedišče, razlago oziroma sliko, izgovorjavo in črkovanje ter omogoča zabavno in na učenca osredinjeno učenje. Učenci z aplikacijo Quizlet ciljno besedišče hitro usvojijo, saj jih elektronske učne kartice, raznolike vaje in igre motivirajo za delo in učenje.

KLJUČNE BESEDE

Učenje besedišča, tuji jezik, Quizlet

ABSTRACT

Learning vocabulary in a foreign language is extremely important, as communication requires a rich vocabulary. However, because learning vocabulary can quickly become boring, I often integrate ICT into the lessons, which enriches the lessons themselves and motivates students to work. The paper presents the Quizlet application, which I often use when teaching a foreign language for independent and collaborative vocabulary learning. The application combines vocabulary, explanation or image, pronunciation and spelling, and enables fun and student-centered learning. With the Quizlet app, students quickly learn the target vocabulary, as electronic learning cards, various exercises and games motivate them to work and learn.

KEYWORDS

Vocabulary learning, foreign language, Quizlet

1 UVOD

Poučevanje in učenje s pomočjo informacijsko-komunikacijske tehnologije (IKT) je v zadnjih 15 letih prineslo v slovenski prostor velike spremembe, tako pri načrtovanju in izvajanju učnega procesa, kot pri obliki učnih gradiv, ki se uporabljajo pri tujem jeziku [2]. Za pouk tujega jezika ima učitelj na voljo veliko pripravljenih elektronskih in interaktivnih gradiv ter spletnih aplikacij, s katerimi lahko izdela tudi lastna učna e-gradiva [1]. Pri uvajanju digitalnih orodij v pouk pa je pomembno, da učitelj izbere oblike dela, ki se osredotočajo na učenca, ter da z vsebinami in ustreznimi aplikacijami omogoča učencem aktivno in učinkovito delovanje v digitalnih okoljih.

2 UČENJE BESEDIŠČA PRI TUJEM JEZIKU

Besedišče kot osnovno komunikacijsko sredstvo za sporazumevanje je pomembno za razvoj sporazumevalne oziroma leksikalne zmožnosti, tako v maternem kot v tujem jeziku. Bogat besedni zaklad je namreč nujno potreben za uspešno obvladovanje različnih jezikovnih situacij. Učenje besedišča pri tujem jeziku pa lahko kar hitro postane monotono, saj je za usvojitev le-tega potrebno veliko ponavljanja in raznolikih predstavitev posameznih besed. Za učinkovito učenje in usvajanje besedišča pri poučevanju nemščine v pouk integriram tudi IKT, saj le-ta popestri sam pouk in učence motivira za delo.

Uporaba IKT lahko pomaga učencem pri razvijanju bralnih in slušnih zmožnosti ter pisnega izražanja, bogatenju besedišča in slovničnega znanja.

Kot ugotavlja Retelj, morajo e-učna gradiva in programska oprema za učenje besedišča omogočati, da učenci hitro opazijo ciljno besedišče, nuditi morajo razlago ciljnega besedišča ter vsebovati raznolike vaje in naloge, preko katerih učenci spoznavajo razne vidike poznavanja besed. Učenci morajo preko nalog spoznavati svoje napake pri rabi besedišča in imeti možnost, da jih popravljajo [2]. Aplikacija, ki sledi tem načelom za učinkovito učenje besedišča in jo pogosto uporabljam pri pouku nemščine kot tujega jezika je Quizlet. Aplikacijo uporabljam predvsem za učenje in utrjevanje besedišča in slovničnih struktur in sicer kot uvodno motivacijo, ob koncu učne enote kot ponovitev in utrjevanje besedišča ali za samostojno učenje.

3 QUIZLET

Quizlet je aplikacija za izdelavo digitalnih učnih kartic za samostojno učenje in ponavljanje, ki omogoča na učenca osredinjeno učenje. Omogoča preprosto izdelavo kartic z besedno ali slikovno iztočnico v različnih jezikih in izgovorjavo v ciljnih jezikih.

Po brezplačni registraciji na spletni strani http://www.quizlet.com/ nam je na voljo ogromna zbirka ustvarjenih kartic. V letu 2019 je bilo ustvarjenih že preko 300 milijonov zbirk kartic v različnih jezikih. Med temi zbirkami lahko poiščemo ustrezno in jo prenesemo ter prilagodimo lastnim potrebam. Ustvarimo pa lahko seveda lastne zbirke kartic. Dodamo pojme, besede, razlage in slike. Ko izberemo ciljni jezik, nam aplikacija sama ponudi predloge opisov, prevodov in nabor fotografij, kar omogoča hitro ustvarjanje kartic (slika 1).
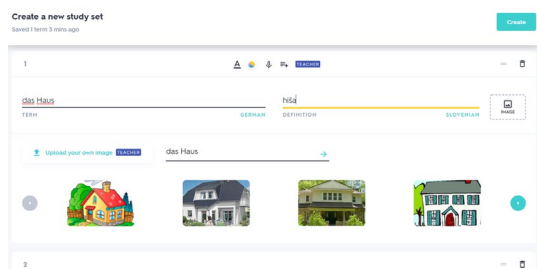
Slika 1: Ustvarjanje posamezne kartice v Quizletu (Vir: lasten, zajem zaslonske slike)

V primeru, da imamo pojme in razlage že zbrane, lahko le-te uvozimo tudi iz Wordove ali Excelove predloge.

Poleg ustvarjanja posameznih pojmov in kartic ponuja aplikacija možnost, da ustvarimo diagram. Izberemo in naložimo ustrezno sliko, na njej označimo točke in vpišemo pojme in definicije (slika 2). Zbirka kartic se samodejno ustvari in je pripravljena za nadaljnje učenje.
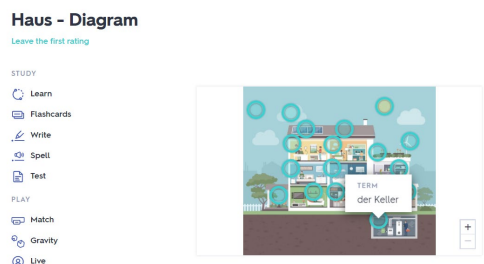
Slika 2: Primer zbirke kartic z diagramom (Vir: lasten, zajem zaslonske slike)

Za bolj pregledno organizacijo omogoča aplikacija, da si ustvarimo mape ali razrede, v katere nalagamo posamezne zbirke kartic (slika 3).
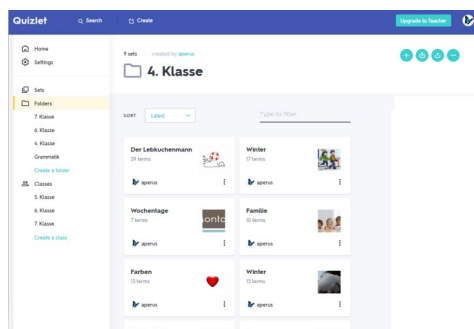
Slika 3: Primer prikaza organizacije zbirk za posamezen razred (Vir: lasten, zajem zaslonske slike)

Ko je posamezna zbirka kartic narejena, se lahko učenci s pomočjo različnih nalog in iger samostojno učijo.

Učencem posredujemo povezavo do mape ali razreda, v katerem imamo zbirke kartic oziroma jim delimo le posamezno zbirko kartic. To lahko uredimo preko elektronske pošte oziroma povezavo pretvorimo v QR kodo, do katere enostavno dostopajo. Zbirko kartic pa lahko delimo tudi v Googlovi učilnici (slika 4).
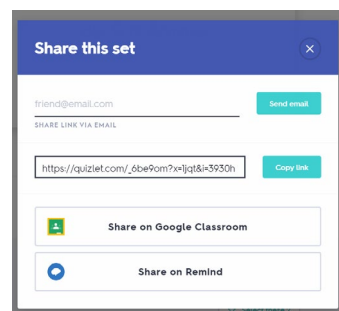
Slika 4: Deljenje zbirke kartic z učenci (Vir: lasten, zajem zaslonske slike)

Ko učenci dostopajo do zbirke, lahko kartice uporabljajo na različne načine: z obračanjem kartic za učenje, z raznimi vajami pisanja in slušnega zaznavanja, s testom in z igrami za preverjanje in utrjevanje (slika 5).
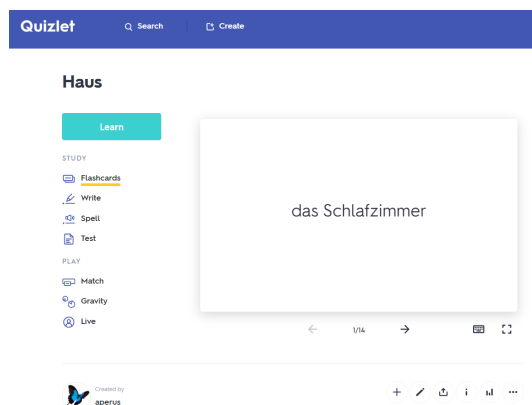
Slika 5: Prikaz možnosti za učenje

Zavihek *learn* je namenjen učenju besedišča po skupinah sedmih besed iz celotne zbirke kartic in preverja razumevanje in zapis teh besed. Učenec ob učenju dobi takojšnjo povratno informacijo o pravilnem razumevanju in zapisu.

Pod zavihkom *flashcards* so zbrane vse besedne kartice, ki jih je pripravil učitelj. S klikom na posamezno kartico se učencu prikaže definicija pojma (slika ali opis) in izgovorjava v tujem jeziku. Žal aplikacija izgovorjave v slovenskem jeziku še ne podpira. S plačljivo nadgradnjo pa lahko tudi glasovno posnamemo branje.

Zavihek *write* je namenjen utrjevanju zapisa. Učenec ob prikazu slike ali opisa zapiše pojem in dobi takojšnjo povratno informacijo, ali je zapis pravilen ali ne in kje je napravil napako.

Zavihek *spell* omogoča utrjevanje zapisa slišanih besed, ki so podprte s sliko in definicijo. Učenec dobi povratno informacijo o pravilnem zapisu in v primeru napačnega zapisa se mu pojem črkuje.

Zavihek *test* preverja učenčevo znanje besednih kartic z raznolikimi vajami in nalogami: zapis besedišča, naloge izbirnega tipa, naloge povezovanja, naloge pravilno / napačno. Učenec dobi takojšno povratno informacijo, kaj je rešil pravilno in kaj ne ter katera rešitev je pravilna. Test si lahko tudi natisne oziroma ga pošlje učitelju.

Quizlet ponuja tudi tri zabavne igre. Pri igri *match* učenci povezujejo pojem z razlago oziroma slikovno iztočnico. Pri tem lahko tekmujejo, kdo hitreje najde pare (slika 6).

Slika 6: Igra match (Vir: lasten, zajem zaslonske slike)

Pri igri *gravity* učenci tekmujejo v pravilnem zapisu pojmov (slika 7).
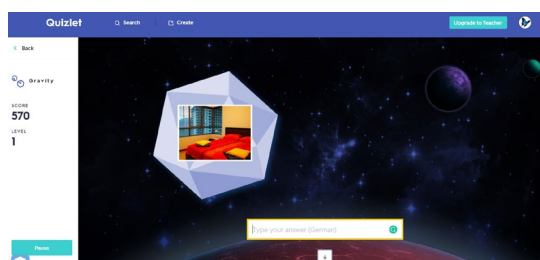
Slika 7: Igra gravity (Vir: lasten: zajem zaslonske slike)

Igra *Live* omogoča sodelovalno učenje, saj so učenci naključno razdeljeni v skupine. Igralci sodelujejo v skupinah, da pravilno dodelijo pojme ustreznim definicijam, saj ima vsak učenec le del odgovorov (slika 8). Učitelj spremlja napredek skupin na računalniku.

Quizlet Live pa lahko uporabimo tudi v načinu Single Player, kjer vsak igra proti vsem.

Osnovne funkcije aplikacije Quizlet so dostopne brezplačno, lahko pa si račun nadgradimo na račun učitelja, ki je plačljiv, a omogoča več prilagoditev in vpogled v delo posameznih učencev.

Na voljo pa je tudi mobilna različica aplikacije, kar učencem olajša samostojno učenje doma. Učenci si prenesejo aplikacijo na telefon, se prijavijo in enostavno dostopajo do dodeljenih zbirk.

Slika 8: Igra Quizlet Live. Foto: A. Peruš

4   ZAKLJUČEK

Quizlet je enostavna in zanimiva aplikacija, ki omogoča različne dejavnosti za lažje in zanimivejše učenje besed, struktur in pojmov. Pri tujem jeziku ga uporabljam za učenje besedišča od 4. razreda naprej. Uporabljam ga za učenje besedišča in širjenje besednega zaklada. Primeren je za učenje tujega jezika, saj združuje besedišče, razlago, izgovorjavo in črkovanje. Uporabimo pa ga lahko tudi pri drugih predmetih za učenje določenih pojmov. Starejši učenci si lahko sami sestavljajo zbirke kartic in s tem pridobivajo kompetenco učenja učenja. Učenci so za učenje z aplikacijo Quizlet zelo motivirani in besedišče na zabaven način zelo hitro usvojijo. S slušno in vizualno podprtimi učnimi karticami in nalogami je postalo učenje besedišča zabavno in bolj učinkovito.

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Exploring and promoting digital analysis skills: Testing optimal conditions of X-ray irradiation
(A STEM collaboration example)

Raziskovanje in promocija digitalnih veščin: Testiranje optimalnih pogojev rentgenskega obsevanja
(primer sodelovanja STEM)

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ABSTRACT

In this paper, we describe establishing of a digital environment for analytics in physics experiments. ICT skills are essential in establishing the potential for automated or digital analysis in the observation of physics experiments. We have proven that this claim is valid in the case of X-ray detection on a imaging phantom. We photographed an irradiated imaging phantom under different initial conditions and tried to compare results with each other in terms of different output parameters as optimal voltage used and signal to noise ratio. With the help of independently created automated Pyton software for the RGB analysis of the images and using analytical tools as Root and Logger Pro programmes, we showed the interdependence between the variables in the X-ray imaging.

KEYWORDS

Digital technologies, digital skills, data analysis, STEM, X-ray detection, imaging, observation

POVZETEK

V tem prispevku opisujemo vzpostavitev digitalnega okolja za analitiko v fizikalnih eksperimentih. IKT spretnosti so bistvenega pomena pri ugotavljanju možnosti avtomatizirane ali digitalne analize pri opazovanju fizikalnih eksperimentov. Dokazali smo, da ta trditev velja v primeru rentgenskega zaznavanja na slikovnem fantomu. Fotografirali smo obsevan fantom za slikanje v različnih začetnih pogojih in poskušali med seboj primerjati rezultate glede na različne izhodne parametre kot sta optimalna uporabljena napetost in razmerje signal / šum. S pomočjo neodvisno ustvarjene avtomatizirane programske opreme Pyton za RGB analizo slik in z uporabo analitičnih orodij kot sta programa Root in Logger Pro smo pokazali soodvisnost med spremenljivkami v rentgenskem slikanju.

KLJUČNE BESEDE

Digitalna technologija, digitalne veščine, analiza podatkov, STEM, rentgensko zaznavanje, slikanje, opazovanje

1 INTRODUCTION

In today's world, knowing digital approaches is increasingly crucial. On the other hand, the relationship between the various branches of science - chemistry, physics, computer science - even in the education system itself is still in its infancy. Interdisciplinarity and cross-curricular integration depend on individual initiatives. Particularly noteworthy is the link between information technology and science education to motivate young people to STEM content. In this context, digital skills are crucial for establishing closer links between science and education. We presented one of the options in our paper.

In this paper, we describe an experiment done in collaboration between the International Baccalaureate at the Gimnazija Bežigrad and the Faculty of Physics and Mathematics of the University of Ljubljana. The aim of this experiment was twofold: firstly, to explore how changing the voltage affects different image quality properties in X-ray Imaging phantom detection; secondly, to explore how and to explore digital tools necessary to execute the experiment as a regular study and collaboration tool. The experiment and its data analysis allows for an exploration of digital tools in STEM experiments and can represent a good basis for further collaboration between the institutions.

The goal of this research was to prove the correlation between the voltage applied to the X-ray apparatus and the image quality of the recorded picture. We were also exploring the impact of the distance between the fluorescent screen and the phantom irradiated by the x-ray apparatus on the intensity of the light measured.

The experiment conducted is based on the theory of X-rays. The rays are produced by an apparatus, where a certain voltage is applied to a X-ray tube that accelerates the electrons towards the molybdenum's anode. The x-ray beams are the result of the interaction of electrons with matter. They are shielded by a collimator so that can only exit the sources at a certain spatial angle.

The detection of X-rays was achieved by taking a picture of a fluorescent screen, which emitted fluorescent green light when hit by x-rays, with a camera. The acquisitions had to be taken in complete darkness with a long exposure time to enable enough light to accumulate on the sensor.

After the data was converted to numerical form, a double error function was fitted on the 2D response image. The parameters, which I received as an output, were then used in the analysis.

2 METHODS

The experiment was performed at the University of Ljubljana, Faculty of Mathematics and Physics. I used the experimental equipment for the X-ray exercise of the subject Laboratory experiments V [6].

The detection of the x-ray particles was double-phased. The apparatus used to produce x-rays was "Didaktiksysteme 554811". The first part of the experiment was acquiring data in the form of captured photos, whereas the processes and techniques employed further on my research are analytical and systematical.

2.1 X-ray particles detection

2.1.1 X-ray Aparatus - Didaktiksysteme 554811

The machine I used to produce X-ray beams for my research is LD's Didaktiksysteme "X-ray Aparatus" 554811 [8] (outlay can be seen in Fig.1). The maximum operating conditions of the high voltage tube that accelerates particles into the molybdenum's anode is U=37kV. For safety measures the apparatus used in the experiment had maximum voltage of 35kV. The maximum current produced by the instrument is 1.0 mA.
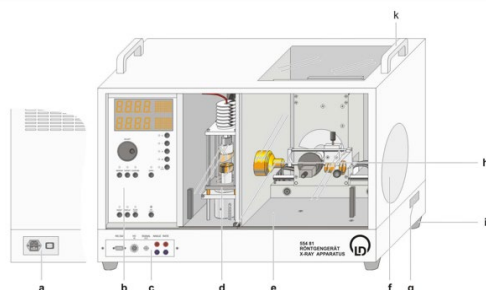
Figure 3. X-ray Apparatus overview

2.1.2 X-ray fluorescent screen

Firstly, a fluorescent screen [7] was used (see Fig.2). The screen is a lead glass pane that is coated with a fluorescent layer. The lead glass forms a tight radiation seal, however, the photons produced by the removal of electrons in the atoms of the coating can still travel through the screen. This phenomenon is used to detect the X-rays colliding with the screen.
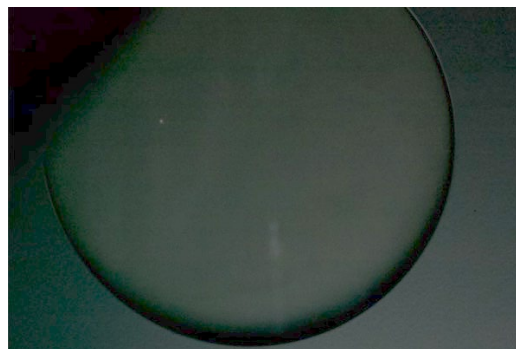
Figure 4. The fluorescent screen

2.1.3 Imaging phantom

Imaging phantom, or simply phantom, is a specially designed object that is scanned or imaged in the field of medical imaging to evaluate, analyze, and tune the performance of various imaging devices [3].

A phantom used to evaluate an imaging device should respond in a similar manner to how human tissues and organs would act in that specific imaging modality. For instance, phantoms made for 2D radiography may hold various quantities of X-ray contrast agents with similar X-ray absorbing properties to normal tissue to tune the contrast of the imaging device or modulate the patients exposure to radiation. In the most simple case, the two different observed tissues can be simulated simply with two different materials, for example metal coated plastic and air.

The phantom used in this experiment was a plastic board covered with a layer of metal, that had holes of different radii drilled in. The sizes of the holes were:

- 2.0 mm,
- 1.6 mm,
- 1.4 mm,
- 1 mm,
- 0.8 mm,
- 0.5 mm,
- 0.3 mm.

Each obstacle was repeated 7 times to allow for some statistical data to be collected on a particular obstacle (hole) size.

2.1.4 Photographic capture of photons

The second part of the detection was done by a digital camera. The photographic part of the experiment was covered by two layers of black PET foil, because the emitted photons from the x-ray detection screen would not be detected accurately when mixed up with the sunlight. The camera used in this experiment is Nikon D40 The exposure time was determined by a series of trials, and set to 6 seconds to achieve the optimum of the number of photons captured.

The setup can be seen from Fig. 3 and a sample outcome of a photograph taken of a phantom is shown in Fig. 4 and 5.

Figure 5. The experimental setup- camera

2.2 Analysis

It has soon become clear that without digital tools the observation of the processes taking place in the imaging phantom and the setup as a whole would be impossible on the level of accuracy requested to draw reliable conclusions. Thus the second aim of the study was to use existing and to develop missing digital tools to enable RGB analysis of the images taken.

2.2.1 Python script- image color processing &

The photos taken by the camera were then transferred to a computer, where further analysis was carried out. The captures were analyzed using a Python script that determines a specific RGB light composure of a certain pixel on a straight line, whose direction and extremes are provided by the user. The result of the image color processing is a graph of light intensity in the correlation with coordinate of the pixel explored. The base code was found on the internet [1] and was then changed so that it suited my experiment's needs.

2.2.2 Root script- intensity analysis and image splitting

ROOT [2] was in this experiment used in two parts of analysis. Firstly, the picture of the phantom had to be split up in several smaller pictures, which were only showing one hole in the phantom at a time. This step was required to enable easier management with the original data. Other processes in the analysis were then run on large amount of very similarly structured photos, which enabled the code to be less complicated.
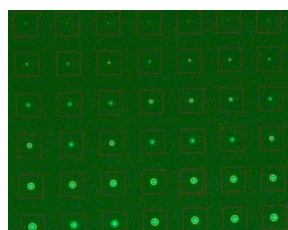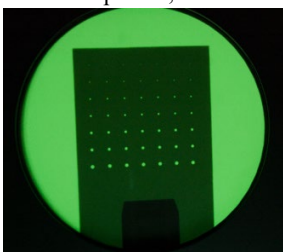
Figure 6. Irradiated phantom   Figure 7. Image splitting

Secondly, the color analysis done in ROOT analysis framework is similar to the one in Python. However, in this case the options for the analysis are much wider. A light composition analysis investigation can be done over the x-, y- axis and over the whole picture. To achieve the highest accuracy of the

outputting values the analysis over the whole picture was done. The program tried to fit an error function [4] on the 2D response. Borders of such a signal is usually treated as a Gaussian function [5], so when a number of signals are treated together as one signal, convolution of the point response with the image shape makes the borders take form of an error function. The fitting of an error function was in my case used all around the given circular 2D signal (Fig.6).
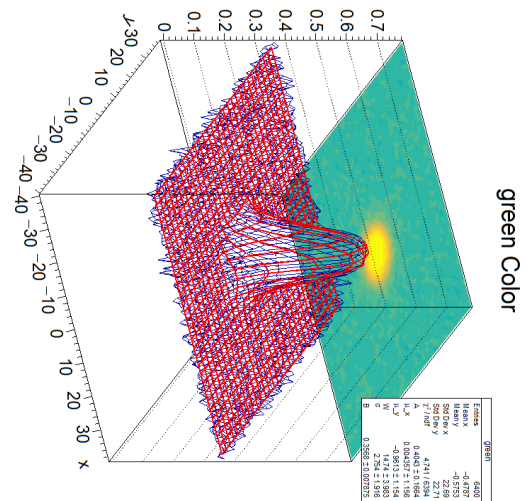
Figure 8. 2D histogram of a captured photo

The outputs that determined the double error function were:

- A, the height of the signal,
- W, the width of the signal,
- B, the height of the background,
- ∂, the width on the half of the height of the graph od derivative of the error function

2.2.3 LoggerPro analysis

The data acquired from the analysis by the code in Python and ROOT can be transferred to LoggerPro by importing the data as a text file with different columns. After the data is appropriately represented, we can identify the average height of the signal and the average width of the border by using cursor coordinates displayed by LoggerPro. The data gathered was then presented in the table to show the correlation. Graphs were drawn to explore different dependences.

3 RESULTS

The images captured using the phantom with   holes and the above described setup (Fig.3), were analyzed using the described digital tools.

Our goal was to determine the sharpness of the holes' images. The results acquired from the exploration were firstly in the form of pictures (see example in Fig.7). After the analysis using the developed Python programming tools the results had a numerical form, since they represented an average width of the signal and the average height. Both obtained values are an important test of the sharpness of the picture border and the quality of the photo.

Figure 9. Example of analyzed material   **(left)**
Figure 10. Python color intensity test   **(right)**

After the ROOT script was run on a set of little pictures, as presented above, the code tried to find the best fit for the mentioned double error function. The parameters that root used to find the best correlation, were then exported to a .txt file, where they could be used for further analysis.

On the pictures captured with the lower input voltage the smallest holes of the size of 0.5mm were really hard to see and the analysis of light intensity on those was not returning consistent results. That is why I decided to perform the research only on the remaining 6 different sizes of gaps (0.8mm, 1mm, 1.4mm, 1.6mm and 2mm).

The voltages used in this experiment are displayed in the table below:

Table 3. Accelerating voltages used on the X-ray apparatus

Trial no.	1	2	3	4	5	6
Voltage [kV]	35	32	29	26	23	20

The aim of this experiment was to explore how changing the voltage affects different image quality properties.

3.1 Signal to background's dependence on the voltage

Signal to backgrounds ratio is often a good criterion showing the quality of the picture taken. It represents the contrast between the background light intensity and the details in the front. Since two outputs from the root code were parameters A and B, respectively the intensity of the signal and the intensity of the background, a dependence of the ratio of the two was explored.

After the process of averaging the data of different shots taken by Python, the numbers were transferred to LoggerPro. The graph drawn by the program is shown below.
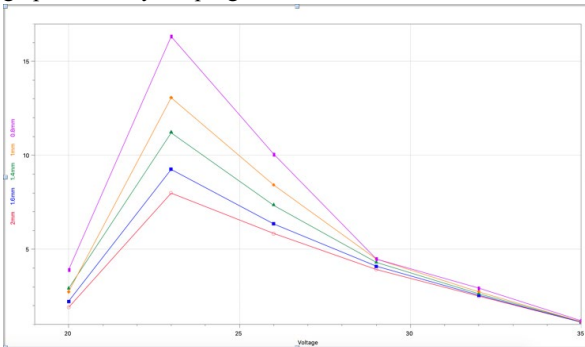
Graph 1. Correlation of light contrast with voltage

We can clearly see that there is a constant increase in signal/background's ratio, when the voltage is around 23kV. The picture that was analyzed had the best contrast among the other. If we compare the pictures at the bottom, we can clearly see that the graph drew us to a reasonable conclusion. The picture on the left was the one, where the x-ray particles were accelerated by a 23kV of voltage, whereas the right picture was captured with the irradiation of x-ray accelerated by 35kV voltage. The contrast on the left one is much greater than on the capture with higher input energy.
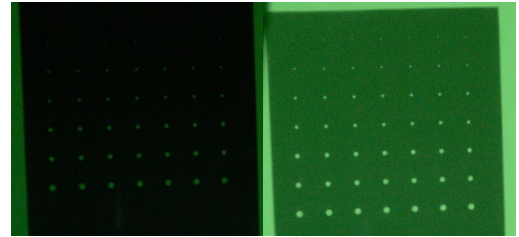
Figure 11. Captured photo of high contrast   **(left)**
Figure 12. Captured photo of low contrast   **(right)**

3.2 Resolution dependence on the voltage

σ is a parameter of the error function that essentially tells us how steep the border between the peak of the signal and background of the measurement is. It represents the width of a derivative function of the error function. The width of the derivative is a statistical value that tells us how well the border of the picture was captured, the quality of the image can be described.
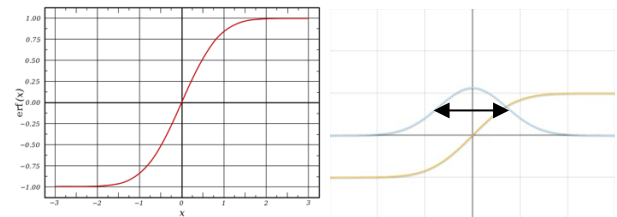
Figure 13. Error function   **(left)**
Figure 14. Average width of the derivative function of the error function   **(right)**

The data that was processed with the mentioned codes resulted in the graph, where the *sigma*-value does not increase or decrease with the variation of voltage. There was no found correlation since the changes in the values with different voltages are probably a result of a statistical error. The data gathered and averaged is collected in the table and the graph below.

Table 4. σ's average values for different gap diameters and voltages

Diameter of the hole [mm] / Voltage [kV]	2	1.6	1.4	1	0.8	0.5
35	3.07	3.43	3.47	3.38	3.63	3.72
32	3.03	3.45	3.46	3.46	3.60	6.04
29	3.00	3.44	3.47	3.41	3.11	3.54

26	3.21	3.66	3.70	3.49	3.68	2.97
23	2.92	3.33	3.48	3.17	3.28	3.55
20	3.93	4.39	4.46	8.93	10.17	4.01

Graph 2. σ 's correlation with voltage

We can clearly see that the differences between the values are not the consequence of the variation of voltage.

4 DISCUSSION

There are several things I would like to address regarding the accuracy of this experiment. To point out, the experiment was performed manually so there were numerous procedures I had to go through and where mistakes were made. Errors in final data are most probably results of such oversights.

Firstly, the layer that covered the camera and prevented the light from disturbing the sensor was on some spots torn apart, so the impact of the light cannot be fully negligible.

Further on, the camera had to be focused on the fluorescent screen before its cover was taken off under the mentioned black layer. This could also be a reason for inaccurate pictures captured.

Moreover, the X-rays with the accelerating voltage below 23kV often did not have enough energy to collide with the atoms in the fluorescent layer enough so that a sufficient amount of light would be emitted. That is why measurements at the voltage of 20kV are prone to high relative errors, and the trials with the voltage of 18kV had to be discarded altogether.

The last thing that I feel could easily be improved if I had more time and resources, are the analysis codes. The ROOT and Python analysis scripts I ran on captured photos often did not give very accurate output, because the starting parameters were not set correctly. Even though I worked on improving the code to the point, where the efficiency and reliability was relatively high, there were still some cases where the code using the described models did not converge with the initial parameters provided. Especially the part of the experiment, where the Root script was finding optimum double error function to fit on the given data, was problematic, since a small difference in the way function was structured had major impact on the output parameters.

To conclude, the experiment could of course be performed more efficiently, professionally, accurately, the errors could be minimized. However, I believe that with given time, resources and my non-existing previous experience with such machinery,

the experiment was performed optimally, and the results are quite relevant as they show how and to what degree digital skills are important in analysis of data obtained in physics experiments.

5 CONCLUSION

My initial thesis for the first part was that neither the pictures captured while phantom is irradiated by the highest nor the lowest voltage will have the highest contrast value, the signal to background ratio. I can say that my expectations for the results were that one of the pictures with lover voltage input will be the candidate for the highest ratio of contrast. After the exploration, I can with great certainty say that both my theses were correct, and my research only supported them.

My initial thesis for the second part was, that the values gathered for the σ- parameter would imply optimal conditions based on the fact that the mentioned value would depend on the voltage that was varied. However, the numbers for σ I got do not point to such conclusions. In the experimental environment I was working in there was no correlation between σ and U found. My second thesis therefore was incorrect and the evidence I got, proves that picture quality of the signal-background border does not vary with the inputted voltage.

In conclusion, my first thesis was correct, while my second one was incorrect. The results I got are supported by a large amount of data, which leads me to believe that the conclusions I have drawn are relevant as well.

Ultimately, the results could not have been obtained without using digital skills. STEM collaboration between high school and experts with highly developed digital skills is of utmost importance in order to firstly promote digital skills at a relatively early age of students, and secondly, to enable the students to learn them and use them in real-experimental setups, measurements and analysis.

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Uporaba IKT pri pouku športne vzgoje v času dela na daljavo

Use of ICT in physical education classes during distance work

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POVZETEK

Uporaba informacijsko-komunikacijske tehnologije v procesu izobraževanja na Gimnaziji Bežigrad poteka že vrsto let. Številni učitelji pri svojem pouku že dolgo uporabljajo različna IKT-orodja, s katerimi si lajšajo delo ter izboljšujejo kakovost pouka. V zadnjem času je v porastu zlasti uporaba spletnih učilnic Moodle. Sama sem se spletnimi učilnicami seznanila že pred leti, intenzivno pa sem jih začela uporabljati v zadnjem šolskem letu, ko nas je delo na daljavo prisililo v iskanje čim bolj učinkovitih sredstev za sodelovanje in povezavo z dijaki. Pri svojem delu stremim pretežno k praktičnem pouku in gibanju, zato se mi je v preteklosti zdela uporaba spletnih učilnic ter drugih IKT orodij veliko bolj smiselna pri ostalih predmetih kot pri športni vzgoji. Uvedba pouka na daljavo v preteklem šolskem letu pa je pred vse nas postavila nove izzive, še zlasti za učitelje športne vzgoje, ki tovrstne oblike dela uporabljamo v manjši meri kot učitelji ostalih predmetov. Po nekaj mesecih intenzivne uporabe so se tako spletne učilnice kot tudi različne videokonferenčne platforme (Zoom, Skype, Teams) pri izvedbi pouka izkazale za nepogrešljive, tako z vidika teoretičnega kot praktičnega dela. Pogovor z dijaki, njihova aktivna prisotnost in sodelovanje v spletnih učilnicah ter na videokonferencah so pokazali, da so le-te lahko v veliko pomoč pri izvedbi pouka.

KLJUČNE BESEDE

Spletna učilnica, športna vzgoja, pouk na daljavo, srednja šola, IKT

ABSTRACT

The use of information and communication technology in the process of education at the Gimnazija Bežigrad has been going on for many years. Many teachers have long used various ICT tools in their lessons to facilitate their work and improve the quality of lessons. Recently, the use of Moodle online classrooms has been on the rise. I became acquainted with online classrooms years ago but I started using them intensively in the last school year, when working remotely forced us to find the most effective means to cooperate and connect with students. In my work I strive mainly for practical lessons and movement, so in the past I thought the use of online classrooms and other ICT tools makes much more sense in other subjects than in Physical education. The introduction of distance learning in the past school year has posed new challenges for all of us, especially for Physical education teachers, who use such forms to a lesser extent than teachers of other subjects do. After a few months of intensive use, both online classrooms and various video conferencing platforms (Zoom, Skype) proved to be indispensable in the implementation of lessons, both in terms of theoretical and practical work. Conversation with students, their active presence and participation in online classrooms and video conferences showed that they could be of great help in conducting lessons.

KEYWORDS

Online classroom, physical education, distance learning, high school, ICT

1 UVOD

Informacijsko-komunikacijska tehnologija je v zadnjem času postala nepogrešljiv del izobraževalnega procesa. Delavci v vzgoji in izobraževanju ves čas stremimo k izboljšanju kakovosti izobraževanja, zato iščemo nove poti in izzive, ki bi nas pripeljali k temu. Opremljenost šol z informacijsko-komunikacijsko tehnologijo je vedno boljša, povečuje se usposobljenost učiteljev za uporabo tovrstne tehnologije, vedno večja pa je tudi ponudba ustreznih izobraževalnih gradiv v te namene. Spletne učilnice in videokonferenčne platforme so le del tovrstne tehnologije, ki pripomorejo k večji učinkovitosti izobraževanja in s pomočjo katerih lahko izboljšamo pouk, saj omogočajo sodelovanje dijakov in učiteljev tudi izven šolskega prostora. Zadnji meseci preteklega šolskega leta so pred učitelje osnovnih in srednjih šol postavili poseben izziv, in sicer kako ostati v stiku z učenci od doma, kako jim nuditi čim bolj kakovosten pouk na daljavo ter kako spremljati njihovo delo in napredek. Zlasti spletne učilnice so pri tem odigrale pomembno vlogo.

2 SPLETNE UČILNICE, VIDEOKONFERENČNE PLATFORME TER DRUGA ORODJA PRI UČENJU NA DALJAVO

2.1 Učenje na daljavo

O učenju na daljavo govorimo, ko učitelj in učenec nista hkrati prisotna na istem mestu. Ločeni so lahko v času in prostoru, sodelovanje pa se vzpostavlja z uporabo IKT. Pri izobraževanju na daljavo se učenec uči samostojnega učenja, prilagojeno je učenčevim prostorskim in časovnim omejitvam ter sposobnostim, gradiva se lahko sprotno popravljajo in dopolnjujejo, dostopni so tekoči podatki … Učenje na daljavo pa ima tudi nekaj slabosti, kot so manjši nadzor nad učencem – potrebna je precejšnja samodisciplina, dolgotrajno sedenje pred zaslonom, pomanjkanje socialnih stikov z drugimi učenci, usposobljenost sodelujočih za uporabo tehnologije, vprašljivo pa je tudi preverjanje znanja [1].

Če se je v preteklosti izobraževanje na daljavo uporabljalo predvsem kot dopolnilna oblika dela klasičnemu učenju, smo se ga bili v preteklem šolskem letu prisiljeni poslužiti vsi učitelji. Epidemija korona virusa in s tem posledično zaprtje šol sta nas prisilila v to, za marsikoga novo obliko dela. Kljub številnim dilemam, ki so se pojavljale na začetku, menim, da se je v dani situaciji izobraževanje na daljavo izkazalo za kar učinkovito obliko dela.

2.2 Spletna učilnica Moodle

Spletna učilnica je namenjena sodelovanju učiteljev in učencev izven klasičnega pouka, izven učilnice. V tem virtualnem okolju se srečujejo učenci in učitelji s pripravljenimi učnimi vsebinami. Učencem so v spletni učilnici na voljo različna orodja za izobraževanje, kot npr. povezave na spletne strani, datoteke z različnimi vsebinami, ki se lahko prenašajo v obe smeri (od učitelja k učencu ter obratno), forumi, ki omogočajo komunikacijo pa tudi različni kvizi, ki jih učenci lahko rešujejo. Naloge, ki jih učenci oddajajo, lahko učitelj v spletni učilnici tudi oceni, učenci pa si jih lahko kadarkoli tudi ogledajo [2].

2.3 Videokonferenčne platforme in druga orodja

Videokonferenčne platforme, kot sta Zoom in Skype, omogočajo, da se lahko večje število ljudi, ki so vsak na svoji lokaciji, sreča v živo, ob istem času [3]. Sama sem za namene srečanja z dijaki v živo, pogovor z njimi, razlago snovi ter ocenjevanje večinoma uporabljala Zoom. Ker pred tem nisem imela potrebnih izkušenj in znanja o uporabi videokonferenčnih platform, se mi je Zoom zdel najlažji za uporabo, brez težav pa so ga osvojili tudi dijaki.

Pri svojem delu na daljavo sem pogosto uporabljala tudi spletno aplikacijo Kahoot. Gre za preprosto in učinkovito motivacijsko orodje za mlade, ki popestri učni proces [4]. Uporabljala sem ga predvsem za popestritev učnega procesa na daljavo ter za ponavljanje in utrjevanje predelane snovi, uporabila pa sem ga tudi za ocenjevanje.

3 UPORABA SPLETNE UČILNICE MOODLE IN OSTALIH IKT-ORODIJ PRI ŠPORTNI VZGOJI

S spletno učilnico Moodle sem se srečala že pred leti, ko sem se na šoli udeležila izobraževanja o njeni uporabi. Dolgo časa sem menila, da spletne učilnice za svoj predmet ne potrebujem, saj sem pri športni vzgoji vedno dajala prednost praktičnem delu. Pred nekaj leti pa sem začela poučevati tudi v oddelku mednarodne šole, kjer se sistem poučevanja in ocenjevanja precej razlikuje od tistega, na katerega sem bila navajena v gimnaziji. V programu mednarodne šole se dijaki srečujejo z veliko več teoretičnimi vsebinami, precej pa je tudi oddajanja različnih teoretičnih nalog, poročil in načrtov. Ker je bilo teh vsebin in nalog veliko, sem se odločila, da počasi tudi sama začnem uporabljati spletno učilnico.

3.1 Uporaba spletne učilnice pri delu na daljavo

Na začetku sem spletno učilnico uporabljala predvsem v namene nalaganja pisnih navodil ter oddajo nalog. S tem sem si precej olajšala stvari, saj so imele dijakinje teoretične vsebine in navodila vedno na voljo, zato sem si prihranila čas s ponovno razlago. Kasneje pa sem ugotovila, da mi spletna učilnica ponuja veliko novih možnosti za podajo učne snovi. Kar se je izkazalo uporabno zlasti pri učenju na daljavo v preteklem šolskem letu. Zaradi tuje govorečih dijakov je besedilo spletne učilnice v angleškem jeziku.

Mojo spletno učilnico je sestavljalo sedem poglavij. Poglavja so se navezovala na posamezna obdobja oziroma tematske sklope, ki smo jih predelali pri športni vzgoji. Prvo poglavje se je nanašalo na tematski sklop fitnes (Slika 1). Dijakinje so morale v obdobju, ko smo imeli na programu fitnes, pripraviti osebni vadbeni program. Navodila za izdelavo programa so bila v spletni učilnici, tako da so jim bila vedno dostopna. Svoj program so morale oddati v nabiralnik prvega poglavja, kjer so si kasneje lahko tudi ogledale svojo pridobljeno oceno. Po enem mesecu dela v fitnesu so morale dijakinje napisati evalvacijo na svoj plan vadbe in njegovo učinkovitost ter tudi evalvacijo oddati v poseben nabiralnik prvega poglavja. Prav tako so morale oddati primer ogrevanja, ki so ga pripravile po navodilih.
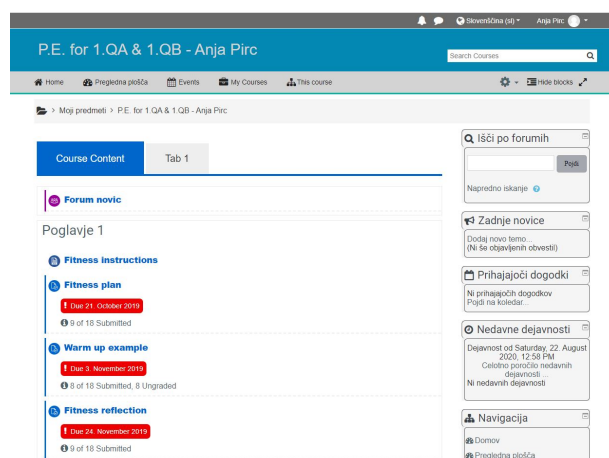

Slika 1. Tematski sklop fitnes

Drugo poglavje se je nanašalo na tematski sklop odbojka. Dijakinje so od teoretičnih vsebin v tem sklopu morale poznati sodniške znake pri odbojki. To poglavje je vsebovalo povezavo do spletne strani, ki prikazuje omenjene sodniške znake (Slika 2).

Pri plesu in ritmični gimnastiki so morale dijakinje sestaviti lastno plesno ali ritmično gimnastično sestavo. V ta namen sem jim pripravila navodila, ki so jih imele vedno na voljo v spletni učilnici pod poglavjem tri. Svoj načrt za sestavo so morale oddati v poseben nabiralnik, prav tako pa tudi evalvacijo prikazane sestave na koncu tega tematskega sklopa (Slika 2).
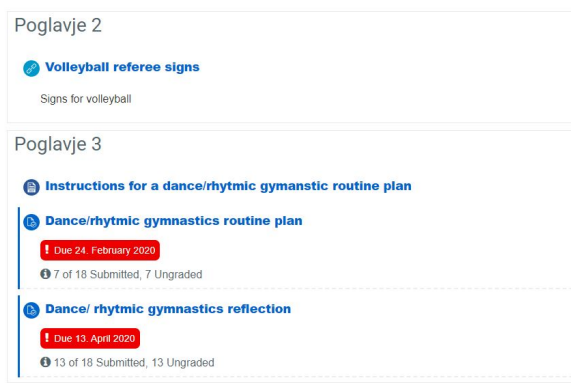
Slika 2. Tematska sklopa odbojka in ples z ritmično gimnastiko

Na začetku šolskega leta sem nameravala v svoji spletni učilnici zapolniti samo prva tri poglavja, saj za druge tematske sklope nisem imela v načrtu ocenjevanja in preverjanja pisnih teoretičnih vsebin. Zaradi zaprtja šol in posledično dela na daljavo pa sem svojo spletno učilnico razširila. Z dijakinjami sem v tem času komunicirala pretežno preko spletne učilnice ter občasno Zooma. Četrto poglavje je tako vsebovalo navodila za delo. Dijakinje so vsak teden v spletno učilnico prejele navodila za delo, ki so se večinoma nanašale na osnovno telesno pripravo, kar so lahko izvajale doma. Posamezna navodila so bila označena z datumom, dijakinje pa si jih lahko odprle s klikom (Slika 3).

Slika 3. Poglavje z navodili za delo med učenjem na daljavo

Poglavje 5 je bilo namenjeno teoretičnim vsebinam, ki bi jih z dijakinjami morala predelati med praktičnim delom v šoli. Namesto tega so v spletno učilnico prejemale dokumente s teoretičnimi vsebinami, kjer so bila opisana pravila posameznih športnih panog, tehnični in taktični opis športa ter povezave do spletnih strani, kjer so si dijakinje lahko ogledale pravilno izvedbo posameznih tehničnih in taktičnih elementov nekega športa (Slika 4).

Slika 4. Poglavje z nekaterimi teoretičnimi vsebinami

Za dokazilo o opravljeni vadbi so morale dijakinje vsak konec tedna napisati krajše poročilo o svojem delu za športno vzgojo ter aktivnostih, ki so jih opravile doma. Poročila so morale oddati v poseben nabiralnik v poglavju 6 (Slika 5). Tudi tukaj se je spletna učilnica Moodle izkazala za zelo uporabno, saj sem lahko sproti preverjala, kdo je poročilo oddal in kdaj. Postavila sem roke za oddajo posameznih poročil, dijakinje pa so vseeno imele možnost poročila oddati tudi naknadno. Na ta način sem lahko spremljala njihovo sprotno delo, hkrati pa jim omogočila, da so zaradi obilice drugega dela poročila oddale tudi kakšen dan kasneje.
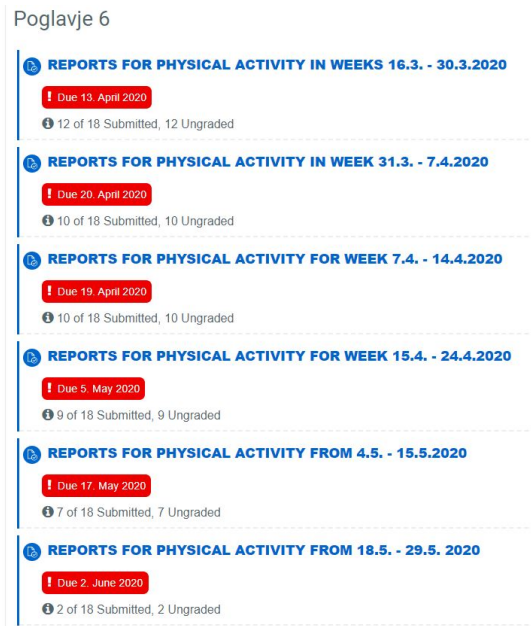
Slika 5. Nabiralnik za oddajo poročil o aktivnostih

Zadnje poglavje v spletni učilnici je bilo namenjeno medpredmetni povezavi. S kolegom, ki v tem razredu poučuje zgodovino, ter kolegom, ki poučuje športno vzgojo dijake, smo februarja pričeli z medpredmetno povezavo na temo antičnih olimpijskih iger. Ker nam je izvedbo celotne povezave v šoli

onemogočila karantena, smo se jo odločili nadaljevati na daljavo. To je bila precej zahtevna naloga, saj je bilo potrebno hkrati zbrati veliko več dijakov in spremeniti celoten potek ter zaključek medpredmetnega povezovanja. Veliko smo z dijaki sodelovali preko Zooma, zopet pa se je za nepogrešljivo pokazala spletna učilnica, kamor so dijaki prejeli teoretične vsebine, ki smo jih predelali že v šol in so bile temelj za zaključno ocenjevanje ter navodila za ocenjevanje. V nabiralnik tega poglavja so morali oddajati tudi svoja poročila o delu v povezavi z medpredmetno povezavo (Slika 6). Samo ocenjevanje smo izpeljali v več delih (da smo lahko pokrili vse štiri kriterije, ki se jih pri medpredmetnem povezovanju na mednarodni šoli ocenjuje). Uporabili smo tudi spletno aplikacijo Kaoot, kjer so dijaki reševali kviz.

Slika 6. Poglavje za medpredmetno povezavo

3.2 Uporaba ostalih IKT orodij pri delu na daljavo

Za srečevanje z dijaki sem v času dela na daljavo večinoma uporabljala videokonferenčno platformo Zoom. Občasno sem se poslužila tudi Skypa, vendar se je izkazalo, da je dijakom Zoom bližje, bolj enostavna pa se mi je zdela tudi njegova uporaba. Z dijaki sem se preko Zooma načeloma srečevala enkrat tedensko, nekajkrat pa sem poskusila izvesti tudi uro športne vzgoje. Šlo je večinoma za prikaz različnih vaj v sklopu osnovne motorične priprave. To je bil malo večji izziv, saj je bilo potrebno precej iznajdljivosti, kako postaviti računalnik, da me bodo dijaki videli med vsemi izvedbami, hkrati pa sem tudi jaz morala videti njih, da sem jih lahko popravljala. Tukaj so nastajale težave, saj se nam je večkrat zgodilo, da so dijaki zaradi slabe internetne povezave izgubili sliko, ali pa sem jo izgubila jaz. Pojavljale pa so se tudi težave z zvokom. Po nekaj poskusih smo ugotovili, da Zoom ni najprimernejša oblika za vodenje vadbe v živo, zato smo to opustili.

Za zelo uporabno stvar pri učenju na daljavo pa se je izkazala spletna aplikacija Kahoot. Po nekaj tednih dela sem želela popestriti učni proces ter preveriti znanje dijakov. Zanimalo me je, kako lahko pouk na daljavo naredim zanimivejši ter koliko so se dijaki v tem času sploh naučili. Na predlog sodelavca sem poskusila s Kahootom. Takoj sem bila zadovoljna z njim, saj se je izkazal za zelo lahko učljivega in tudi dijaki so ga hitro osvojili. Kahoot ponuja številne možnosti za izvedbo različnih kvizov, s katerimi lahko preverjamo znanje dijakov in ga po potrebi tudi ocenimo. Sama sem v te namene sestavila kar precej kvizov, s katerimi sem preverjala znanje dijakov o posameznih športnih panogah ter splošni motorični pripravi. Dijaki so kvize reševali z

veseljem, saj so jim popestrili pouk, med sabo pa so tudi tekmovali (Slika 7).

Kvize sem sestavila na različne načine. Običajno je šlo za klasično obliko kviza s štirimi možnimi odgovori (Slika 8). Z dijaki sem se povezala preko Zooma, na mobilnih telefonih pa so reševali kviz. Vsako vprašanje je bilo časovno omejeno. Med seboj so tekmovali v poznavanju teoretičnih vsebin športa, na koncu pa smo dobili zmagovalca. To obliko kviza sem uporabila tudi pri ocenjevanju teoretičnih vsebin, saj se na koncu izpiše celotna statistika. Vpogled imamo število pravilno rešenih vprašanj, za vsakega dijaka pa odstotek pravilnih rešitev.

Kadar pa nisem želela, da dijaki med seboj tekmujejo ali se z njimi nisem povezala preko Zooma, sem kviz sestavila v obliki izziva. Kviz sem časovno omejila, kar pomeni, da so dijaki imeli na voljo nekaj dni, da so začeli z reševanjem. Po določenem datumu se je kviz zaprl in reševanje ni bilo več mogoče. Na ta način sem dijakom omogočila, da so vprašanja rešili, kadar so želeli. Tudi ta oblika se je izkazala za pozitivno, saj so si dijaki lahko sami zbrali tisti čas za reševanje, ki jim je najbolj ustrezal. Ta oblika kviza pa je vsekakor primernejša tudi za tiste dijake, ki ne želijo tekmovati, saj jih to postavlja v stresno situacijo.
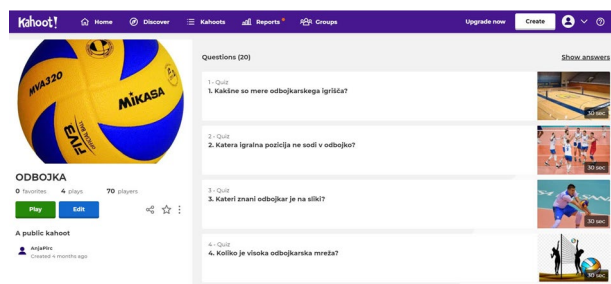
Slika 7. Primer Kahoot kviza z nekaj vprašanji o odbojki

Slika 8. Primer vprašanja z možnimi odgovori pri Kahoot kvizu

4 ZAKLJUČEK

Informacijsko-komunikacijska tehnologija vstopa v vsa področja našega življenja. Vedno bolj je prisotna tudi v izobraževalnem procesu, s tehnologijo pa živijo tudi sodobni otroci in mladostniki. Učencem moramo ponuditi nove in sodobne oblike poučevanja, ki jih bolj motivirajo in pritegnejo k učenju, hkrati pa tudi učitelju olajšajo delo. Kljub težavam, ki smo jih imeli zaradi učenja na daljavo, sem se iz te izkušnje veliko naučila. Spoznala sem kar nekaj novih orodij za pomoč pri poučevanju in popestritvi dela. Naučila sem se uporabljati Zoom, sestavljati kvize v Kahoot aplikaciji ter nadgradila svoje znanje o uporabi spletnih učilnic. Vse se je izkazalo za zelo uporabno in dobrodošlo kot pomoč pri učenju. Pouk v učilnici

oziroma v mojem primeru v je še vedno tisti, ki je za doseganje vzgojnih, procesnih in izobraževalnih ciljev najpomembnejši in je z vidika poučevanja, učenja in socialnih stikov tudi najprimernejši. Vendar pa nam je IKT pri vsem tem lahko v veliko pomoč. Tako z vidika motivacije kot dopolnitve k poučevanju ter olajšanju dela. Tudi sama bom IKT v večji meri vključevala v svoje delo.

VIRI

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Digitalni umetniki ali pouk na daljavo

Digital artists or distance learning

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POVZETEK

Za usvajanje znanja pri učencih iščem različne načine poučevanja, ki jih motivirajo. Pouk na daljavo je zaradi svetovne zdravstvene situacije pomenil nov izziv, postavljanje novih ciljev, tudi nemoč, strah, predvsem pa plavanje v neznano. V danem trenutku so bili zastavljeni novi cilji, kjer se nauči učenca, da se organizira, je samostojen in odgovoren, obvlada digitalno tehniko za vstop v spletne učilnice, e-pošto, zna dati povratno informacijo in se pri tem uči posredovano snov.

Pri pouku v šoli z izbiro metod dela nisem omejena, pri pouku na daljavo sem; tako sem največkrat uporabila možgansko nevihto, metodo razlage za kasnejše individualno delo učencev, predstavitve lastnih izkušenj in pridobivanje rezultatov. Ključ uspeha je bil v lastni organiziranosti, sistematičnosti in v preoblikovanju informacij v nekaj uporabnega. V času pouka na daljavo sem se izpopolnjevala, izmenjavala izkušnje s sodelavkami v aktivu in na šoli, iskala informacije pri učiteljicah na drugih šolah. Problem je nastal pri učencih, ki nimajo pričakovanj, so nesamostojni in nimajo podpore staršev zaradi službene obremenjenosti ali nesocialnega okolja.

Ključ uspeha je bil v personalizaciji, saj učenci z jasnimi cilji niso bili omejeni v času, s sošolci in so odgovorno in samostojno naredili vse načrtovane naloge, neodvisno iskali še povezave z že znano snovjo in bili kreativni. Delo z vsakim posebej je omogočalo osebnostni razvoj z učenčevimi pričakovanji, talenti in potrebami. Z dodatnim izobraževanjem in z izmenjavo izkušenj bom zagotovo v prihodnje lahko izboljšala poučevanje na daljavo, ki bo opravljeno še bolj po meri učenca.

KLJUČNE BESEDE

Pouk na daljavo, učenec, učenje, spletne učilnice, komunikacija

ABSTRACT

To acquire knowledge in students, I look for different ways of teaching that motivate them. Due to the global health situation, distance learning meant a new challenge, setting new goals, including helplessness, fear, and above all, swimming in the unknown. At the given moment, new goals were set, to teach the student to organize, to be independent and responsible, to master the digital technique of entering online classrooms, the e-mail, to know how to give feedback and in doing so to learn the provided teaching material.

During school lessons I am not limited by the choice of working methods, in distance learning I am; so I mostly used brainstorming, the method of explanation for later individual student work, presenting one's own experiences, and getting results. The key to success was in one's own organization, systematicity, and in transforming information into something useful. During distance learning, I improved my skills, exchanged experiences with my colleagues in the working group and other colleagues at school, and sought information from teachers at other schools. The problem arose with students who have no expectations, are not independent and do not have parental support due to workload or antisocial environment.

The key to success was in personalization, as students with clear goals were not limited in time, with classmates and they did all the planned tasks responsibly and independently, independently searched for connections with already known material and were creative. Working with each one individually enabled personal development with the student's expectations, talents, and needs. With additional teacher training and with the exchange of experiences, I will certainly be able to improve distance teaching in the future, which will be done even more tailored to the student.

KEYWORDS

Distance learning, learner, learning, online classrooms, communication

1 UVOD

Za nami je izjemno in nenavadno šolsko leto 2019/20, ki je zahtevalo nov način dela, drugačen pristop do učencev, kreativnost in veliko delovne discipline. Čas od 16. 3. do 22. 5. (pouk od doma) oz. do 29. 5. 2020 (pouk od doma in v šoli) je pokazal, koliko so učenci samostojni, vešči dela z računalnikom in kako pomembno je delo učitelja pri izobraževanju. V veliko pomoč je učencem bilo zagotovo poznavanje spletnih učilnic, ki jih uporabljam že od leta 2012. Namenjene so bile dodatnemu delu z učenci, kjer so našli naloge za sodelovanje na Cankarjevem tekmovanju, poglabljali znanje za nacionalno preverjanje znanja v 6. in 9. razredu.

Postavljeni smo bili pred nov izziv, kjer smo se lahko zanesli na svoje znanje, izkušnje in naša šola tudi na vodstvo. V aktivu za slovenščino smo prevetrili učni načrt, sprejeli smernice vodstva šole, kjer je manj pomenilo več. Učencem smo namenili delo, ki bo sprejemljivo razmeram, njihovim sposobnostim in računalniški opremi. Z učenci smo se pred zaprtjem šol pogovorili o načinu dela jim vlili moči in upanje, da zmoremo. Povedali smo jim, da je pouk na daljavo njihova pravica in odgovornost in to niso počitnice. Učenci so preverili dostop do svoje elektronske pošte, osvežili prvo stran zapisa v zvezku (moj e-naslov, možnost dostopa do spletnih učilnic, do e-DZ Založbe Rokus Klet in spletne strani Devetletka).

2 DELO NA DALJAVO

2.1 Spletne učilnice

Poučujem od 6. do 9. razreda slovenščino, učenci so vešči računalnika bolj kot njihovi mlajši vrstniki, tako je bil začetek nekoliko lažji. Vsak nov začetek šolskega leta izkoristim uro ali dve za delo v računalniški učilnici, kjer učenci vstopajo v spletno učilnico, rešujejo naloge in jih preverjamo preko e-pošte. Pri delu jim pomagam, pomagajo si tudi sami med seboj. Način dela tako ponovijo, ga nadgradimo tudi kasneje s kakšno domačo nalogo. Domače naloge so izjema, saj so današnji učenci zelo zaposleni s popoldanskimi aktivnostmi in se nalogam raje izogneм, ker smo sicer vsi v neprijetnem položaj; učenec, ker je nima in učitelji, saj nimamo sredstev za dosego cilja opravljanja domačih nalog.

Šola ima spletne učilnice razporejene po razredih za 1. in 2. vzgojno izobraževalno obdobje ter po predmetih za 3.vzgojno izobraževalno obdobje, sedaj so dodali še za oddelek podaljšanega bivanja, knjižnico, interesno dejavnost in dneve dejavnosti.

Učenci so dobili v času pouka na daljavo tedenske naloge po dnevih s prijaznim povabilom, ki je pomenilo zunanjo motivacijo.

Povabilo: »Le pogumno, le za mano ….« je zapisala slovenska pisateljica Anja Štefan. Tako vas v tem tednu nagovarjam, ko vam vlivam veliko moči, poguma in želje po novem znanju. Vse, kar je potrebno narediti v tem tednu, vas čaka v priponki. Ostanite zdravi, vzemite si čas za sprostitev in pokličite tiste, ki jih imate radi [Praprotnik Žaucer, privatna komunikacija] .

Ali: Pozdravljeni šestošolci, z vami je lepo delati, trudite se in me vedno znova presenetite s svojimi odličnimi razmišljanji in odgovornim delom. Hvala.

Vsak drobec znanja, ki ga učenec pridobi sam – vsak problem, ki ga sam reši – postane mnogo bolj njegov, kot bi bil sicer.(H. Spencer). S to mislijo vas vabim k raziskovanju življenja slovenskega književnika, Toneta Pavčka. Dela se lotite z vso skrbnostjo in samostojno, saj je to preverjanje pred ocenjevanjem, ki sledi naslednji teden. Sledite navodilom in se ponovno potrudite [Praprotnik Žaucer, privatna komunikacija].

Nato je sledila priponka s tedensko zadolžitvijo, zapisana po dnevih. Potrudila sem se z navodili, ki so bila enoznačna, zapisana z različno velikostjo pisave, potemnjena, podčrtana in predvsem pregledna.

Naloge pri književnosti (dramsko besedilo, proza) so bile razdeljene na pogovor/razmišljanje/povezovanje pred branjem, po branju so raziskovali besedilo. Tu so iskali motive za

ravnanje književne osebe, znali poiskati o čem predvsem govori besedilo, raziskovali slog pisanja, prepoznali zvrst in poustvarjali z nadaljevanjem zgodbe, spreminjanjem celotne zgodbe ali zapisali tvorbno nalogo. Pri poeziji so iskali pesniška sredstva, rimo, zgradbo pesmi in se preizkusili v kovanju rim. O avtorju so zapisali najosnovnejše podatke: književno obdobje, pomen, poklic, dela in kakšno zanimivost iz življenja. Izdelali so literarno izkaznico ali plakat. Naloge so bile razdeljene na obvezne za zadostitev temeljnih standardov znanja in tiste za učence, ki jim je slovenščina močno področje. Razlika se je pokazala v zahtevnosti razmišljanja globine besedila, jezikovnem znanju in njegovi rabi. Učenci s primanjkljaji so usvojili le minimalne standarde.
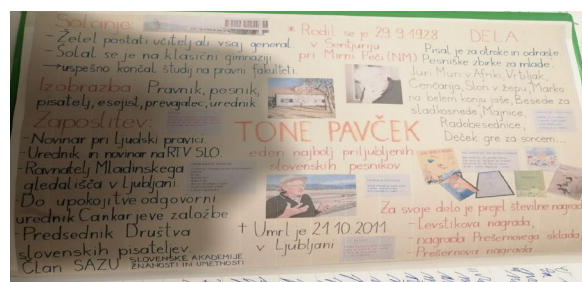
Slika 1: Izdelek učenca.

Snov pri jeziku je bila najprej namenjena reševanju nalog razumevanja neznanega besedila, nato so sledile naloge spoznavanja nove snovi in naloge ponavljanja in utrjevanja. Vse je bilo pripravljeno v delovnem zvezku z različnim naborom nalog po taksonomski stopnji. Na koncu vsakega sklopa je sledila naloga formativne spremljave pouka, kjer so učenci odgovorili na vprašanja, kaj so se naučili, kaj dobro znajo, česa še ne znajo, kako bodo odpravili vrzeli v svojem znanju.

Za dodatno delo sem poiskala interaktivne naloge na spletu, kjer so šestošolci utrjevali znanje samostalnika, pridevnika, glagola, številnika, osebnega zaimka in prislova; sedmošolci so utrjevali stavčne člene. Osmošolci so reševali naloge podredno zložene povedi (odvisniki) in devetošolci naloge utrjevanj priredno zložene povedi (priredja). Takšnih nalog so vajeni, saj jih pogosto vključim v proces učenja, ko so utrujeni, za dvig motivacije in za tekmovalno spodbudo.

Učencem z dodatno strokovno pomočjo in tujcem sem pošiljala naloge preko e-pošte prirejeno njihovim sposobnostim. V to skupino sem vključila tudi nekatere učence Rome. Pokazala se je potreba po takšnem vzpostavljanju stika, saj se v spletnih učilnicah niso znašli. Bil je tudi primer romske deklice, ki sem ji pošiljala prirejene naloge na e-naslov prijateljice in sta potem skupaj opravili nalogo. Šola ji je omogočila izposojo tablice, a je ni bila vešča ne ona in ne njeni domači. Sledila sem prvinam vsebinskega in procesnega znanja, ki se nato ocenjujejo pri pouku slovenščine in jih konkretiziram z raznimi načini in oblikami ocenjevanja, z besedili, vprašanji, nalogami, primeri jezikovne rabe …[1].

2.2 Odzivi učencev

Ključ uspeha je, da znamo poiskati v množici podatkov tiste temeljne informacije, jih sistematizirati in pripraviti za nadaljnjo rabo in nadgradnjo. Znati moramo reševati probleme in

sodelovati med seboj. Prav odzivi učencev na delo so povratna informacija o uspehu, ki je lahko tudi proaktiven, pripravljen na poraz, a biti morajo dovolj vztrajni, da se poberejo. Vse to je posledica kapitala in dela sodobne današnje družbe. Delo na daljavo je zahtevalo odkrivanje novega, neraziskanega področja.

Prvi teden so bili odzivi učencev le za pokušino. Osmo in devetošolci so se odzivali zelo redko ali nikoli. Vsak poizkus vzpostavitve stika se je končal brez uspeha. Šesto in sedmošolci so delo sprejeli kot prijetno igro v tekmovalnem smislu, kdo bo naredil takoj in vse. Podobno je bilo še v 2. tednu. Verjela sem, da potrebujejo čas za prilagoditev, za urejanje IKT. Dnevno sem beležila njihov odziv in jih konec 1. tedna opozorila na neodzivnost, v 2. tednu sem poslala podatke o neodzivnosti razredničarkam in staršem. Odzivi razredničark so bili v pričakovanju, v pomoč in spodbudo, da se ti učenci priključijo. V 3. tednu je bila priključena večina otrok, sodelovanje je bilo korektno, čutili so, da je pouk na daljavo njihova dolžnost in pravica. Pri delu so bili uspešni, naloge so reševali po navodilih. Prav branje navodil pri nekaterih učencih povzroča težave, saj navodila berejo le približno ali celo ne, kar se odraža pri preverjanju znanja in preizkusu znanja, ko delajo individualno.

Nekoliko večji problem so predstavljali romski otroci, ki doma nimajo računalnika, starši ne znajo pomagati in ne obvladajo slovenskega jezika. Vsak poizkus dobiti stik z njimi se je končal brez odziva; na e-pošto niso odgovarjali, tudi ne na eAsistenta, telefon je zvoni v prazno, številka je bila nedosegljiva, …

Povratne informacije so ostali učenci pošiljali po e-pošti preko računalnika in telefona, preko e-Asistenta, s pomočjo spletne učilnice, nekaterim so to delo opravili starši, ker sami niso znali. Pri manjšem številu učencev sem pogrešala sporočilo ob oddaji nalog, peščica je bila tako nevešča, da so sporočilo zapisali kar v zadevo. Ko bomo v novem šolskem letu lahko vstopili v računalniško učilnico, bomo temeljito ponovili oblikovanje besedilne naloge – sporočilo na e-pošti, kar je sicer v učnem načrtu v 8. in 9. razredu. Tako se bomo izognili nepravilnostim, kot je primer učenca, ki je zapisal celotno sporočilo pravopisno pomanjkljivo v zadevo in ga zaključil z Lp, kot to zapišejo vrstniki med seboj v telefonskem sporočilu.

Vsak odziv učenca sem zabeležila za svojo lastno evidenco, kjer je bilo razvidno, kdaj je poslal povratno informacijo, kaj je dobro rešil, kaj slabše, dodala sem še oznako za stik z razredničarko in starši. V skupni rabi sem zabeležila še odzivnost učenca za potrebe šole. Uradno je delo na daljavo trajalo dnevno od 7. do 15. ure, a sem bila učencem na voljo 24 ur, tudi med prazniki in v soboto ter nedeljo. Učenci, tudi starši, so pozabili na čas in so pošiljali povratne informacije, vprašanja za delo, tudi samo lepe misli ob različnih urah, ne oziraje se na delovni čas učitelja.

Čas pouka na daljavo se je začel prevešati čez polovico, ko smo učenci in učitelji začutili pomanjkanje osebnega stika, zelo smo pogrešali drug drugega. Zavedala sem se v tem trenutku, da skupaj z njimi sodim v razred, da je očesni stik tisti, ki učenca umesti v prostor, ga umiri in pripravi za delo. Poslana povratna informacija o učenčevem delu skupaj z njegovo fotografijo je to potrdila.

2.3 Odzivi staršev

Zavedali so se svoje vloge in predvsem odgovornosti. Bili so v pomoč svojim otrokom, z znanjem in v čustveno podporo.

Otrokom so bili v pomoč pri organizaciji dela, jim pomagali na vsakem koraku po svojih najboljših močeh. Pri tistih, ki so si znali sami organizirati razporeditev dnevnih dejavnosti, so svoje delo že pred časom opravili. Učenci so namreč različni: samostojni, delno samostojni, popolnoma nesamostojni. V kolikor je še negativna kombinacija s starši je lahko neodzivnost za delo na daljavo nična. Presenetljivo pogumna sporočila so upali zapisati nekateri starši; vse v dobri meri, da zaščitijo svojega otroka, čeprav je doma sedel in preganjal dolgčas. Zapisali so, da otrok ni dobil nobene informacije o pouku na daljavo, čeprav smo učitelji vsak za svoj predmet podali natančne informacije, dodatne informacije so dobili od razrednikov, tudi mediji so pomagali pri osveščenosti in učenci so poznali spletno učilnico. Starši so bili dokaj zmedeni, hoteli so me prepričati, da njihov otrok pošilja rezultate dela, šli so celo tako daleč, da so me postavili v zmoto, da njihovega otroka ne učim, ker so pomešali slovenščino z angleščino. Sporočilo je vsebovalo številne klicaje.

K sreči so prevladali zdrav razum, skrb za otrokovo prihodnost in prilagoditev trenutnim razmeram ter celo opravičilo. Drugi del staršev je znal dodatno motivirati svoje otroke, jih vključiti v proces učenja, ko so prešli v monotonost in obup zaradi nastale situacije. Vsaka spodbuda, vsak realen stik z učenci in starši, izmenjava izkušenj z drugimi učitelji nas je vse dvigovala pred neznanim in nas prepričala, da zmoremo. Večina dela ostaja na ramenih staršev, ki morajo poleg tega v mnogih primerih opravljati še svojo službo. Od njih se pričakuje, da ob npr. doseženi V. stopnji izobrazbe nudijo svojemu otroku pomoč na nivoju strokovnjaka s specialnimi znanji s VII. ali višjo stopnjo izobrazbe[2].

Mnogi starši so nam bili hvaležni za skrb, trud in primernost izbranih nalog, ki so jih glede na svoje sposobnosti in zastavljeni učni načrt morali opraviti. Tu se je potrdilo, da učenec sodi v šolo, da je učitelj strokovno usposobljen za delo z njimi. Prav bi bilo, da v prihodnje starši ne bi vdirali na področje, ki je strokovno in zanj odgovarjata učitelj in ravnatelj. Radi pomagamo učencem, smo pripravljeni na dodatne ure, tudi neplačane, če so zagotovilo za izboljšanje znanja in pridobitev višje ocene, ker učenec ni razumel snovi, je bil bolan ali odsoten iz katerega drugega opravičljivega vzroka. Vsak otrok je za starše nekaj neprecenljivega, tega se zavedamo in prihajamo naproti, še toliko z večjo ljubeznijo, če so nameni pošteni in iskreni.

2.4 Odzivi vodstva šole

V uvodu sem zapisala, da smo imeli učitelji veliko podporo v vodstvu šole, sicer smo se celoten kolektiv izjemno dobro povezali, kot vedno, se spodbujali, ponujali rešitve in si vlivali moči. Izjemno podporo sta nam nudili tudi učiteljici vešči računalnika. Sporočila o primerih dobre prakse smo si izmenjevali, bili navdušeni nad kolegom, ki je sodeloval v Izodromu, brali članke v Večeru o dobrem delu na šoli, poslušali intervju na RTV Maribor, ki je bil opravljen z našo kolegico, čestitali kolegici za napredovanje, čestitali zlatemu priznanju na državnem Cankarjevem tekmovanju (tu sem bila mentorica), čestitali nagrajencem na območnem tekmovanju Zaščite in reševanja Maribor (tu sva bili s kolegico mentorici), čestitali raziskovalcem Mladi za napredek Maribora, brali okrožnice Ministrstva za izobraževanje, znanost in šport, sledili navodilom ravnatelja, … Vsak konec tedna smo mu poslali poročilo o opravljenem delu, ki je obsegalo:

- pripravo na pouk,
- pripravo gradiv za učence po oddelkih,
- vodenje dokumentacije,
- drugo pedagoško delo potrebno za nemoten potek dela na daljavo,
- sodelovanje s starši, učenci in učitelji.

Na željo ravnatelja smo dodali še kakšno sporočilo učencev in staršev ter enkraten dnevniški zapis dela učitelja. Njegovo spremljanje našega dela je bilo spodbudno, prijazno, deloval je umirjeno, svetovalno in z veliko mero optimizma in zaupanja v svoj kolektiv. Pomembno je, da ob šolanju na daljavo ne mislimo le na izvedbo predmetnika in učnega načrta, ampak tudi na odnose[3].

3 OCENJEVANJE

3.1 Ocenjevanje znanja

Pridobivanje ocen je bila najbolj težka in občutljiva naloga. 2. ocenjevalno obdobje se je šele prav začelo, bil je čas pridobivanja nove snovi. Načrtovane pisne naloge ni bilo moč izvesti, ustno spraševanje se mi ni zdelo primerno, saj je obstajala velika možnost nedovoljenih pripomočkov, zagotovo pa neizvedljivo zaradi pomanjkanja tehničnega znanja in tehnike. Takšnega dela so bolj vešči srednješolci in študentje.

V aktivu smo se dogovorili za enoten pristop pridobivanja ocen, na način, ki so ga poznali in obvladali. Delo so lahko opravili samostojno, brez tuje pomoči, zanesli so se lahko na svoje izkušnje. Raziskovali so življenje znanega sodobnega književnika, kjer so svoje zanimanje usmerili v:

- ime in priimek književnika;
- rojstvo;
- književno obdobje;
- poklic;
- književna dela;
- slog pisanja (pesniški z uporabo pesniških sredstev, tudi z besedami prenesenega pomena, …);
- nagrade (najpomembnejše);
- zanimivosti iz življenja;
- vključiš kakšno anekdoto (smešen, kratek dogodek) o njem;
- dodaj svoje razmišljanje, odziv, tudi lepo misel;
- oglej si njegovo fotografijo;
- na koncu navedi vire in literaturo.

Svojo izkušnjo so zapisali v obliki miselnega vzorca ali literarne izkaznice in zapis znali ustno upovediti. Nalogo so poslali v pregled, kjer sem jo preverila in dopolnila vsakemu individualno kot vedno. Popravili so jo ter se tako pripravili za ocenjevanje z raziskovanjem novega književnika po enakem načinu dela in z enakimi ktiteriji. Pouk se je nato preselil v učilnice in oceno so pridobili v šoli po enakih navodilih kot preverjanje zanjo. V dveh razredih je bila ocena pridobljena na osnovi pripravljenega domačega branja. Učenci so imeli na voljo poleg knjige tudi e-bralnike. Navodila za delo in kriterije ocenjevanja so dobili še v času pouka, način priprave je bil preverjen in utrjen. Ravnala sem se po navodilih zapisanih v Izobraževanje na daljavo, Priporočila za ocenjevanje znanja za osnovno šolo, ki ga je izdal Zavod Republike Slovenije za šolstvo,

16. aprila 2020. Ocenila sem znanje, ki je bilo ustrezno obravnavano, utrjeno in z različnimi oblikami ter metodami tudi preverjeno.

Učenec je svoje znanje o književnici Bini Štampe Žmavc povezal z usvajanjem snovi pri jeziku, kjer smo spoznavali besedilno vrsto vabilo.

Slika 2: Izdelek učenca.

3.2 Zaključevanje ocen

Pri določanju zaključne ocene sem dala poudarek na ocenah, pridobljenih do 16. 3. 2020, teh je bilo več in pridobljene so bile na različne načine:
- pisni izdelki,
- ustna ocena,
- govorni nastop,
- drugače pridobljena ocena, …

Pri zaključevanju sem upošteva tudi oceno pridobljeno v 2. ocenjevalnem obdobju na daljavo oz. po prihodu v šolo ter sodelovanje in napredek, ki je bil zaznan v obdobju izobraževanja na daljavo. Zaključevanje ocene je potekalo z utemeljitvijo v sodelovanju z učencem.

4 DODATNO DELO

4.1 Dodatna strokovna pomoč

Vključena sta bila dva učenca: učenka iz 8. in učenec iz 9. razreda. V času pouka v šoli sta oba sodelovala in se trudila po

svojih močeh. Učenka je v času pouka na daljavo sledila delu in ga opravila. Naloge sem ji pošiljala tedensko, sestavljene so bile za zadostitev minimalnega standarda. Delo je opravila takoj, snov je razumela in se je trudila. Zapis sporočila pri oddaji nalog je razkrival željo po telesnem stiku, saj je zelo pogrešala objem. To je potrdila tudi prvo uro, ko sva se srečali v živo.

Učenec 9. razreda, ki je v februarju poslal prijavo za vpis v srednjo šolo, je vsa moja sporočila ignoriral. Ni pomagalo sporočilo razredničarki in ne mami, odziva ni bilo. Ob prihodu v šolo se mi je vljudno opravičil, ker je popolnoma pozabil na dodatno strokovno pomoč pri vseh učiteljih in ne samo pri meni.

4.2 Delo s tujci

Vključena sta bila 2 učenca s povsem različnim predznanjem slovenščine. Prvi je bil tujec drugo leto in je slovenščino odlično obvladal, saj se je jezika učil že pred prihodom v Slovenijo. Delo z njim je bilo prijetno, sledila sva usvajanju standardov za nadarjene učence. Drugi je prišel v Slovenijo na začetku koledarskega leta in komunikacija med nama je bila v angleščini. Pomagala sem mu s slikovnim slovarjem in začela sva z učenjem besed, ki so obsegale: poimenovanje predmetov v šoli, pripomočki pri pouku, oblačila, barve, deli telesa, …. Znal se je tudi predstaviti (kdo je, koliko je star, od kod prihaja, kaj ga zanima, …).

4.3 Novinarski krožek

Bili smo tik pred obiskom BKTV (lokalne televizijske hiše v Mariboru) in zaključevali smo s prispevki za spletni časopis naše šole. V času pouka na daljavo smo tako poslali še zadnje prispevke za spletni časopis in si obljubili, da se srečamo v novem šolskem letu.

5   EVALVACIJA

Delo na daljavo je dalo misliti, kaj spremeniti in kaj obdržati ob podobni situaciji. Na pedagoški konferenci smo se strinjali, da se je vsak znašel po svoje in smo preizkušali različna orodja.

Pomanjkljivosti pri učencih:
- slaba koncentracija
- hiperpozorni (lahko delajo več stvari hkrati),
- podoba pred besedo,
- težave s komunikacijo,
- informacije so iskali samo na spletu,
- doma imajo premalo knjižnega gradiva,
- brez ciljev,
- ne premagajo ovire.

Prednosti pri učenju na daljavo:
- personalizacija,
- formativna spremljava pouka,
- neodvisni od sošolcev (nikogar pri delu niso čakali),
- znali nuditi pomoč sošolcu in jo poiskati (solidarnost),
- učili so se novih veščin,
- diferenciacija pouka.

Potrebne izboljšave:
- preiti v razvoj učenja pri pouku na daljavo,

- dodatno izobraževanje učiteljev in učencev za potrebe pouka na daljavo,
- navezati tedenski stik z video klicem,
- pripraviti PPT predstavitve za razlago nove snovi,
- pripraviti e-razvojni tim na šoli za uskladitev dela vse h deležnikov (učitelji, učenci, starši),
- uporabljati orodja primerna starostni skupini otrok,
- ministrstvo ni dala pravočasno navodil, posnemali so obstoječe.

Ohraniti:
- sodelovanje v aktivu,
- urnik 2+1 (kar narediš v šoli v eni uri, učenci doma naredijo v dveh),
- manj je več,
- spletne učilnice,
- urejenost in primernost nalog,
- primerna selekcija učne snovi (odstranitev balasta),
- e-bralniki za pripravo domačega branja,
- e-DZ Založbe Rokus Klett,
- udeležiti se predavanj po Webinarju Založbe Rokus Klett,
- prijazen in spodbuden stik z deležniki,
- zaupanje vodstva šole,
- pouk na daljavo je pravica in odgovornost učencev.

6   ZAKLJUČEK

Pri izobraževanju na daljavo sem sledila učnemu načrtu, ki smo ga prilagodili v aktivu slovenščine. Delo na daljavo je zahtevalo veliko truda, odrekanj, samostojnega dela in iskanja novih poti za dosego ciljev. Pri delu so me vodile izkušnje, skrb za učence in odgovornost do učiteljskega poklica.

Ne vemo, kaj nam bo prinesla prihodnost, zagotovo se bomo morali naučiti živeti z virusom; v vzgoji in izobraževanju pa učence naučiti usvajanja nove snovi preko spletnih učilnic in samostojnega dela. Znanje posredovanja učne snovi bom z različnimi izobraževanji nadgradila v korist sebe, za lažje delo učencem, predvsem pa v pomoč staršem, ki jim mora ostati skrb za vzgojo otroka, nam učiteljem pa izobraževalno poslanstvo.

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Delavnice snovanja poslovnega modela v kontekstu digitalne preobrazbe

Workshop on business model design in digital transformation

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POVZETEK

Da bi zadostile potrebam stroke, izobraževalne ustanove s področja informatike v svoje kurikulume čedalje pogosteje vključujejo vsebine s področja podjetništva. Prispevek opisuje izvedbo delavnice snovanja inovativnega poslovnega modela na mednarodnem tednu, ki ga je organizirala Univerza v Pragi. Na delavnici smo uporabili orodja za snovanje poslovnega modela in tehnike snovalskega razmišljanja, kar je udeležence vodilo od prve ideje do izdelanega poslovnega modela za zamišljeno rešitev. Prikazan je postopek preko katerega študenti s področja informatike pridobitvajo mehkejše veščine snovanja in testiranja poslovne ideje usmerjene na uporabnika.

KLJUČNE BESEDE

Delavnica, poslovni model, digitalna preobrazba, snovalsko razmišljanje, mednarodni teden, Univerza v Pragi

ABSTRACT

In order to meet the needs of the business, educational institutions in the field of informatics are increasingly including entrepreneurship-related content into their curricula. The article describes the organization of a workshop on designing an innovative business model at the International Week, organized by the University of Prague. In the workshop, we used business modeling tools and design thinking techniques, that guided the participants from the initial idea to the developed business model for their proposed solution. In the paper we describe the process by which students in the field of informatics and economy learn and acquire soft skills for designing and testing a user-centric business idea.

KEYWORDS

Workshop, business model, digital transformation, design thinking, international week, University of Prague

1 UVOD

Univerza v Pragi vsako leto organizira mednarodni teden [1], s katerim spodujajo študente k sodelovanju na interaktivnih delavnicah. K pripravi delavnic vsako leto povabijo tuje predavatelje s partnerskih univerz in organizacij. Gre za način dopolnjevanja kurikuluma z aktualnimi in bolj interaktivnimi vsebinami, ki se vsakoletno spreminjajo, pri čemer lahko študenti z udeležbo pridobijo 3 ECTS. Univerza v Mariboru je pristopila k letošnjem 4. mednarodnem tednu z izvedbo delavnic snovanja poslovnega modela za študente magistrskega študija managementa informacijskih sistemov.

Aktualne raziskave kažejo, da več kot polovica podjetij s področja informatike v svojih prodajnih in marketinških službah uporablja strukturirane pristope razvoja z namenom identificiranja priložnosti za ustvarjanje dodane vrednosti za svoje stranke [2]. To potrjuje, da je vključevanje tovrstnih vsebin v kurikulum v času študija pomembno znanje, ki ga bodo diplomanti v bodoče potrebovali. Namen delavnic snovanja poslovnega modela je študentom omogočiti izkušnjo razvoja poslovne ideje do poslovnega modela, ki je pripravljen za lansiranje na trg.

Na delavnici izvajalci udeležence vodijo, da skozi postopek metode snovalskega razmišljanja (angleško design thinking) [3] in z orodjem kanvas poslovnega modela [4] svojo poslovno idejo razvijejo, testirajo in prilagodijo. Poslovni model se tako oblikuje glede na trg, na katerega želijo udeleženci vstopiti in stranke, katerim želijo ponuditi svoj izdelek ali storitev.

Delavnice na mednarodnem tednu Univerze v Pragi so potekale štiri dni. Prvi trije dnevi so bili namenjeni delu znotraj skupin, četrti dan pa so potekale skupne predstavitve za vse udeležence. Delavnice so bile intenzivne, delo v skupinah je potekalo 8 ur na dan – od ponedeljka do četrtka, od 8h do 16h.

Kljub temu, da gre za udeležence, ki so vajeni dela z informacijsko tehnologijo, v konkretnem primeru je šlo pretežno za študente, ki zaključujejo podiplomski študij management informacijskih sistemov, pri izvedbi tovrstnih delavnic uporabljamo papir večjega formata in barvne flomastre. Delavnice izvajamo v skupinah. Pri tem opažamo, da delo s papirnimi orodji spodbuja interakcijo tako med udeleženci znotraj skupine kot sodelovanje in interakcije med različnimi skupinami. Po izkušnjah izvajalcev, je tudi razprava, ki se med udeleženci delavnic razvije medtem ko v skupnem prostoru

razvijajo ideje in pripravljajo plakate, ki so vsem na vpogled, širša, bolj poglobljena in bolj kreativna.

Gre za preizkušen program delavnice, ki ga izvajalci v različnih obsegih izvajajo že več let, tudi pri pedagoškem procesu. Program je pri udeležencih (tako študentih, udeležencih konferenc in v podjetjih) generalno dobro sprejet. V nadaljevanju bo predstavljena zasnova in izvedba delavnice na primeru mednarodnega tedna Univerze v Pragi 2020.

2 IZVEDBA DELAVNICE

2.1 Prvi dan delavnice

Ker je bila delavnica organizirana na temo digitalizacije in digitalnih poslovnih modelov, smo prvi dan delavnice snovanja poslovnega modela uvodoma študentom predstavili aktualne izzive poslovnega okolja, priložnosti digitalizacije in digitalne preobrazbe ter inovativnih digitalnih poslovnih modelov. Različne informacijske tehnologije in internet so v zadnjih desetletjih krojile razvoj podjetništva [5]. V zadnjih letih govorimo o digitalni preobrazbi podjetij, pri čemer ne gre več zgolj za uporabo digitalnih tehnologij za podporo poslovnih procesov [6]. Digitalne tehnologije so korenito spremenile poslovno okolje, organizacijsko kulturo in pričakovanja potrošnikov [7]. Podjetja, ki se niso zmožna dovolj hitro prilagajati digitaliziranemu poslovnemu okolju, dolgoročno v njem ne morejo obstati, oz. se vanj ne morejo več vključiti [8]. Zato je pomembno, da podjetje svojo poslovno idejo kreira ali podpira z digitalnimi tehnologijami ter vse skupaj poveže s primernim poslovnim modelom [9], ki bo podjetju omogočal učinkovit dostop do trga in zajem finančne vrednosti. Tovrstno razumevanje smo želeli podati študentom in jih s tem spodbuditi h kreativnemu razišljanju in iskanju poslovnih idej, povezanih z uporabo sodobnih digitalnih tehnologij.

V nadaljevanju smo predstavili orodja za snovanje poslovnega modela ter tehnike in metode snovalskega razmišljanja.

Udeležencem smo koncept poslovnega modela predstavili na orodju kanvas poslovnega modela [4], najpogosteje uporabljenega orodja za snovanje poslovnega modela (slika 1). Podrobneje smo predstavili 9 elementov poslovnega modela, ki vključujejo: dodano vrednost, ključne vire (ključni partnerji, ključne aktivnosti in ključni viri), ključne stranke (odnosi s strankami, segmenti strank in kanali za komuniciranje s strankami) ter strukturo stroškov in prihodkovne tokove.

Zadnji sklop uvodnega predavanja je obsegal ključne vsebine snovalskega razmišljanja, metode reševanja problemov in izzivov preko iskanja novih idej. V okviru teh orodij smo izpostavili orodje imenovano persona (slika 2), ki omogoča opredelitev več različnih tipov (potencialnih) strank in kasneje prilagajanje poslovnega modela različnim strankam. Izpostavili smo orodje za prikaz idej (storytelling) ter konceptualne slike za prikaz prototipnih rešitev – zamisli delujočih digitalnih rešitev.

Snovalsko razmišljanje omogoča preseganje izzivov in reševanje problemov preko skupinskega dela. Spodbuja različne poglede na obravnavani problem in zamišljanje različnih možnosti za njegovo reševanje, ki jih lahko kasneje prenesemo v resnično poslovno okolje.
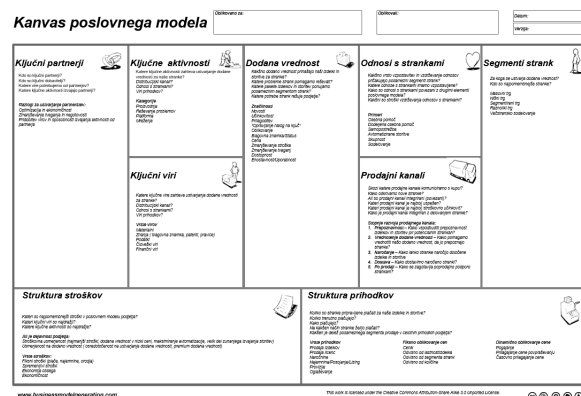
Slika 1: Kanvas poslovnega modela (prirejeno po Osterwalder in Pigneur, 2010)

Slika 2: Orodje persona (Vir: Businessmakeover.eu [10])

2.2 Drugi dan delavnice

Drugi dan delavnice je bil razdeljen na dopoldanski in popoldanski del. V dopoldanskem delu smo z udeleženci pregledali, katera orodja bodo morali uporabiti za predstavitev svoje poslovne ideje. Prav tako smo predstavili več primerov znanih poslovnih modelov in se pogovorili o poslovnih idejah, o katerih so razmišljali in so jih želeli razviti in predstaviti v okviru delavnice.

Študenti so bili razdeljeni v skupine po štiri udeležence. Vse skupine udeležencev so že imele pripravljene okvirne poslovne predloge.

Vsaka skupina je imela enako nalogo. Pripraviti predstavitev za svoj poslovni predlog, ki vključuje 4 papirne plakate – dodana vrednost poslovne rešitve za uporabnika, izdelane persone uporabnikov, kanvas poslovnega modela in papirno prototipno rešitev.

Predstavitev dodane vrednosti za uporabnika mora pojasnjevati, katere probleme uporabnikov bo poslovna rešitev reševala (primer: brezglutenski burger; problemi, ki jih rešuje: hitra potešitev lakote, hrana za ljudi, ki ne jedo glutena). Opredeljena dodana vrednost je osnova za predstavitev person in kanvas poslovnega modela, v katerem razvijemo ideje, na kakšen način bomo opredeljeno vrednost izdelali in jo posredovali na različne načine različnim uporabnikom (primer: spletno

naročanje in dostava na dom, spletno naročanje in osebni prevzem, …).

Pri predstavitvi person skupina razvije več potencialnih tipov uporabnikov (strank) in razmišlja o zanje specifičnih potrebah in zahtevah, ki bodo kasneje uporabljene za prilagodive oblikovanja (kanvasa) poslovnega modela (Primer: kdo bo prišel na naš brezglutenski burger? 1. uporabnik, ki želi spotoma nekaj na hitro pojesti; 2. uporabnik, ki želi naročiti in prevzeti naročilo ob dogovorjenem času, 3. uporabnik želi, da mu naročilo dostavimo).

Predstavitev kanvas poslovnega modela tako izhaja iz dodane vrednosti in person, ki smo jih identificirali. V kanvasu poslovnega modela opredelimo kaj poslovni model ponuja vsakemu segmentu strank (katerim njihovim željam in potrebam bomo zadostili), preko katerih kanalov lahko dosežemo vse segmente strank ter odnose, ki jih bomo z njimi vzpostavili. Iz tega izhajajo elementi ključni partnerji, aktivnosti in resursi, ki jih potrebujemo, da lahko ustvarimo našo dodano vrednost (ponudbo). Na podlagi vsega naštetega lahko nato pripravimo strukturo stroškov in prihodkovne tokove, ter izračunamo ali se nam celoten poslovni model ali njegov del (npr. vključitev posameznega segmenta strank) finančno lahko izide.

Na koncu vsaka skupina nariše še papirni prototip predlagane poslovne rešitve, katerega namen je, da si ostali udeleženci delavnice lažje predstavljajo delovanje in ključne elemente poslovne rešitve v praksi.

V popoldanskem delu drugega dne so se udeleženci razdelili na skupine in začeli delo na lastnih poslovnih idejah. Izvajalci delavnice so bili ves čas na voljo za pojasnila in usmerjanje debate med udeleženci.

V vseh skupinah se je razvila živahna debata o poslovnih idejah, različnih tipih uporabnikov in kaj to pomeni za njihovo poslovno idejo – katere prilagodive bodo morali sprejeti.

Pogosta vprašanja so vključevala ali je smiselno končno rešitev zožati in se usmeriti zgolj na en tip uporabnika ali en distribucijski kanal. Do konca drugega dne so imele vse skupine pripravljene skice za predstavitev svojih poslovnih rešitev.

2.3 Tretji dan delavnice

Tretji dan je bil dopoldanski del delavnice namenjen razjasnitvi zadnjih vprašanj, ki so se v fazi snovanja poslovne ideje še pojavljale med udeleženci in risanju končnih različic plakatov za predstavitev. V popoldanskem delu pa je imela vsaka skupina približno pol ure časa za predstavitev svojega predloga rešitve, ki so jo predstavili s pomočjo štirih plakatov: opredelitve zamisli rešitve in dodane vrednosti, persone, kanvas poslovnega modela in prikaza prototipne rešitve. Sledila je živahna diskusija z izvajalci delavnice in ostalimi udeleženci.

Vse štiri skupine so predstavile vse štiri zahtevane izdelke - plakate, pri čemer je nivo izdelkov nakazoval na dobro razumevanje ključnih konceptov poslovnega modela in ustrezno uporabo metode snovalskega razmišljanja.

Predstavljene poslovne ideje so vključevale aplikacijo za najavo prostovoljcev za pomoč in delo v zavetišče za živali, aplikacijo za pomoč pri izbiri oblačil za različne priložnosti, aplikacjo za mešanje energetskih napitkov, aplikacijo za izbiranje zdrave hrane z avtomatskim preračunavanjem hranilnih vrednosti in sestavin. Dve rešitvi sta bili vezani na uporabo radiofrekvenčnih (RFID) kod in sicer ena v skladišču druga v trgovini, kjer sistem za avtomatsko izmenjavo skladiščne enote

ali blaga v trgovini avtomatsko obdeluje in prikazuje različne podatke za uporabnika. Slika 3 prikazuje predstavitev ideje za aplikacijo, ki glede na karakteristike in navade uporabnika omogoča optimalno izbiro in sestavo zdravega obroka, ki sproti glede na izbrane sestavine uporabniku ponudi podatke o vsebnostih in hranilih vrednostih in predlaga tudi alternative glede na preference uporabnika. Prav tako predlaga izbrano restavracijo oziroma lokacijo za prevzem po željah uporabnika sestavljenega obroka.

Slika 3: Prikaz predstavitve zamisli poslovne ideje

3 POVZETEK

Prispevek prikazuje primer uporabe orodij za snovanje poslovnega modela in tehnik snovalskega mišljenja in sicer na mednarodnem tednu na Univerzi v Pragi. Izkušnje in odzivi sodelujočih študentov na trodnevni delavnici so izredno pozitivni. Kljub napornemu urniku so študenti zavzeto sodelovali pri snovanju poslovnih idej ob upoštevanju priložnosti in možnosti izrabe sodobnih, digitalnih idej. Skupina študentov je bila mednarodna, prihajali so iz različnih držav in študijskih programov oziroma smeri. Največ jih je bilo iz ekonomske smeri in smeri informacijskih sistemov. Kljub temu, da se med seboj niso poznali, so se povezali v skupine in zavzeto in živahno sodelovali pri oblikovanju poslovne ideje. Med delom izvajalci nismo zaznali problemov, ki bi študente odvračali od dokončanja naloge. Vse skupine so dokončale svoje naloge in na zaključni predstavitvi zavzeto predstavile svoje ideje, jih zagovarjale ter tudi sodelovale pri diskusiji z drugimi skupinami. Poslovne ideje so bile različne, inovativne, vse pa so temeljile na sodobnih, digitalnih tehnologijah, kar je bila tudi na začetku izpostavljena naloga. Študenti so sodelovanje na delavnici ocenili kot zanimivo in pozitivno izkušnjo. Uporaba izbranih tehnik in orodij jih je spodbudila k izražanju njihove inovativnosti. Izrazili so željo, da bi tudi pri študiju imeli možnosti tovrstnega razmišljanja, sodelovanja in izražanja.

Avtorji imajo dolgoletne izkušnje uporabe omenjenih orodij pri predmetih na Fakulteti za organizacijske vede Univerze v Mariboru. Pri izvedbi mednarodne delavnice je bila glavna skrb glede omejitve časa. Delavnica je namreč trajala 3 dni, kar je bistveno manj, kakor je v primeru uporabe tovrstnih tehnik pri izvedbi predmetov. Zato smo pri pripravi trodnevne delavnice posebno skrb namenili pripravi vsebine, na katero smo se želeli

osredotočiti glede na sodelujoče študente ter pri izbiri orodij, ki bi jih lahko uporabili pri snovalskem razmišljanju. Dobra priprava vsebine, začrtani cilji in skrbno izbrana orodja glede na časovne zmogljivosti in omejitve so bili ključni za uspešno izvedbo delavnice.

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Pomoč pri pouku na daljavo za učitelje, učence in starše

Online education assistance for teachers, pupils and parents

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POVZETEK

Letošnje šolsko leto je posebno. Iz nekaj teledelavcev (delavcev na daljavo) smo na šolah delavci na daljavo postali praktično vsi, saj je epidemija ohromila možnost klasičnega izobraževalnega dela. Ker je bila situacija nova, novo delo nikakor ni potekalo brez izzivov in zapletov, še posebej na področju informacijsko komunikacijska tehnologije (IKT). Na šolskem področju za pomoč skrbimo računalnikarji – organizatorji informacijskih dejavnosti (ROID). Prispevek izpostavi najpogostejše težave pri izobraževanju od doma in kako smo težave odpravljali s primeri dobrih praks.

KLJUČNE BESEDE

Teledelo, pomoč na daljavo, oddaljeno namizje, uporabniki, izobraževanje na daljavo

ABSTRACT

Year 2020 is really special. Having a few teleworkers (remote workers) in every field of work, suddenly everyone had to become teleworker in a matter of days, as the pandemic has paralysed the possibility of classic work. As the situation was new, the work from home was by no means without challenges and complications, especially in the field of ICT. In the school sphere, the ROIDs coped with the newly appeared difficulties. The article will highlight the most common problems with educating from home and how we solved the problems with some examples of good practices.

KEYWORDS

Telework, remote assistance, remote control, users, distance education

1 UVOD

Četudi se je šolsko leto 2019/2020 začelo kot vsako šolsko leto do zdaj, je vanj izrazito zarezala epidemija COVID-19. Prispevek bo prikazal soočanje z izzivi epidemije pri učiteljskem

delu s poudarkom na tehnični pomoči pri izobraževanju na daljavo.

Z razglasitvijo epidemije pri nas se je izkazalo, da se kljub večletnemu IKT opismenjevanju, temu še vedno vsi ne pripisujejo zadostne pomembnosti. To se je še posebej pokazalo z 12. marcem 2020, ko je tudi šole doseglo izredno stanje, na katerega vnaprej noben iz lastnih izkušenj ni mogel biti pripravljen. Učitelji smo se čez noč kot nindže prelevili v učitelje za virtualno poučevanje, enaka virtualna okretnost pa se je pričakovala tudi od učencev in njihovih staršev. Ravno tako smo se ROID-I prelevili ne le v učitelje računalništva na daljavo, temveč tudi v tehnične pomočnike, katerih delo je obsegalo dolge telefonske pogovore, oddaljeno pomoč, izdelavo video vodičev, pisnih vodičev in še in še. Po svetu se takemu delu, ki smo ga mi poimenovali delo od doma, imenuje "teledelo".[5] Teledelo vključuje tri različne pomene, ki so vsi povezani z delom od doma. Prispevek se bo bolj posvetil tehničnemu vidiku in težavam, ki so stale na poti prav vsem sodelujočim v izobraževanju, ki do takrat teledela nismo bili vajeni. To delo namreč prinaša vrsto prednosti kot tudi pomanjkljivosti, tako za delavca, kot tudi uporabnika storitev – v našem primeru na področju izobraževanja. [5] Stiska, ki so jo nekateri doživljali zaradi pomanjkanja kompetenc na področju uporabnega računalništva, kot tudi socialnih vidikov, je bila izrazita.[10] Prav zato bo prispevek pokazal, kako smo premagovali stisko in kako smo teledelo obrnili v premagovanje takih situacij.

2 POMOČ UČITELJEM, UČENCEM IN STARŠEM

V času izolacije med epidemijo je bila potrebna podpora ROID na različnih nivojih. Posebej sem se moral posvetiti potrebam učiteljev, ki so najpogosteje imeli težave z nedelujočim računalnikom, manjkajočo programsko opremo, znanjem kako se vpisati v določen forum. Vzporedno pa so pomoč potrebovali tudi učenci in z njimi tudi starši, ki sta bili neločljivi kategoriji uporabnikov, saj so v dani situaciji starši sodelovali pri učnem procesu od doma. Učenci in starši so naleteli na podobne težave kot učitelji, vendar za razliko od učiteljev so imeli največ težav zaradi nepoznavanja programske opreme (vpis in uporaba Moodl-a – učno okolje, Office 365, vpis v AAI račune), nekaj krat je prišlo tudi do težav, kjer ni delovala kamera ali mikrofon.

V želji po dobrem in kvalitetnem opravljanju svojega dela, moramo biti ROID na šolah zvedavi ter raziskovalno naravnani. Skladno s tem, smo že prvi dan dela od doma lahko pričakovali, da se bo dan začel z vnemo in zanimanjem. Predvsem nas je

zanimalo, kdaj se bo pokazala prva potreba po naši pomoči v obliki prvega klica, ali e-pošte, … V tej novi in nepredvidljivi situaciji smo bili ROID nepogrešljiv kader, brez katerih (tako sem ugotovil po pogovoru s kolegi ROID in pogovoru z učitelji, učenci in starši) ne bi zmogli speljati pouka na daljavo ali vsaj na takem nivoju

Začetna odločitev Osnovne šole Antona Martina Slomška Vrhnika je bila, da pouk na daljavo spremljamo z gradivi, ki jih podajamo preko spletne strani. Do sem, ni bilo večjih zagat, saj so starši, kot tudi večina učencev, vsaj na predmetni stopnji, tovrstno obliko dela že obvladali. Kasneje pa smo v skladu s potrebami začeli z video konferencami, nekatere šole v manjšem, nekatere pa v večjem obsegu. Tukaj je bila naša pomoč izjemno pomembna. Začele so se prve tehnične težave, kot so nedelujoč mikrofon, video kamera, slaba povezava ali celo pomanjkanje in napačna programska oprema.

Najpomembneje pri vsem je bilo, da sem uspel zaznati težavo pri vsakem od deležnikov – učiteljih, učencih in starših, ter skupaj z njimi poiskal najprimernejšo rešitev, ki je bila po meri predznanja vsakega od njih.

2.1 Težave pri delu od doma

Skladno z novonastalo situacijo so se pojavile tudi težave, ki so zajemale vse spektre in oblike. ROID-i pa smo se z njimi soočali ažurno in v želji po čim hitrejši odpravi za zagotovitev nemotenega dela ter sledenja učnemu načrtu.

Vsesplošni cilj naših skupnih učiteljskih naporov je bilo izobraževanje, zato sem sam, kot tudi drugi ROID-ji, s katerimi smo bili v medsebojni mreži, k temu tako pristopil. K pozitivni usmeritvi je prispevalo tudi splošno znano, da se lahko največ naučimo iz težave oz. problema, saj je to odlična priložnost, da uporabniki vidijo v živo, kako je dobro postopati pri rešitvi težave in pri tudi sami preizkusijo posledičnost lastnega ukrepanja pri vnašanju konstruktivnih rešitev težave.

Na začetku reševanja težav je bilo smiselno, da z informacijami, ki sem jih imel, naredim največ, kar sem lahko. Na prvem mestu je bila ocena tega, koliko lahko uporabniki z mojim vodenjem naredijo sami. Kot večina ROID-jev sem tudi jaz uporabnikom, ki so bili po mojem mnenju vešči uporabe računalnika, najprej poslal povezavo na relevantni forum z možno rešitvijo, da je lahko uporabnik poskušal sam rešiti težavo s podano pomočjo. Na tak način sem zagotovil, da je opolnomočeni uporabnik ostal motiviran za reševanje problema, ki je nastal, in sam reguliral samostojno učenje preko IKT tehnologije. [9] Pri manj veščih, ki so tožili, da napaka še vedno obstaja, sem ubral drugo pot, ki je vodila k drugi obliki rešitve istega problema.

Asistenca vsem deležnikom šolskega dela od doma prek oddaljene pomoči na računalniku je vsekakor zagotavljala prihranek časa in je bila temu tudi namenjena.[6] Obenem je bila to odlična priložnost, da se je lahko uporabnik veliko naučil iz novonastale situacije. V primeru, da je bila težava majhna, jo je lahko naslednjič odpravil sam. V primeru, da se je pojavila večja težava, se je lahko pri ogledu in pogovoru med reševanjem učil, kako postopati naslednjič v primeru, da se bi se podobna težava ponovila.[6] Najbolj zanimiv izid je bil, da so bili na koncu v večini vsi deležniki presenečeni, kako malo je bilo potrebno, da računalnik deluje: "A to je vse? Mi sedaj že vse deluje …?" S tem vedenjem je to postala vsakodnevna dogodivščina, ki je po prvotni frustraciji osrečevala uporabnike na drugi strani ekrana

in s tem so lahko v polnosti uporabljali računalnik kot orodje. V nekaterih primerih je bila potrebna tudi pomoč z video konferencami, ki ne sodijo v pravo tehnično pomoč, so pa v primeru potrebnega uvida, kaj je uporabnik do takrat delal, ob upoštevanju manjše potencialne varnostne luknje, značilne za oddaljeno pomoč, izjemno uporabne.[6]

Vendar pri tem učenci kot uporabniki niso sami, kadar so na vidiku težave z računalnikom.

Tudi njihovim staršem ter tudi učiteljem se je kar hitro zgodilo, da so potrebovali kakšno pomoč za katerega še niso imeli znanja. Pomoč je najprej potekala diagnostično preko telefona. Nato, ko to ni pomagalo je bilo ključno, da je urejeno v najkrajšem možnem času, zato je bilo smiselno uporabiti kar oddaljeno namizje. Uporabniki so v veliki večini povedali, da so že vse poskusili in nič ne deluje. Takratna pomoč preko oddaljene pomoči je potekala v veliki večini kot učenje na daljavo. Najprej so nam pokazali kaj so že naredili in nato smo se lotili reševanja korak po koraku.

Nekateri učenci so bili sramežljivi in so najprej prosili pomoč kar svojega učitelja, ki jih je preusmeril na šolskega ROID, v našem primeru name. Ob opisni težavi sem najprej poskusil pomagati tako, da sem podal dobro povratno informacijo ter prosil za čim več podatkov, ki so bili baza za nadaljnje reševanje težav.

S strokovnega vidika so nastale težave na področju uporabnega računalništva, ki jih uporabniki s časom uspejo rešiti, ko se z njimi samozavestno spopadejo sami. Pri tem smo jim pomagali ravno z namenom, da se v prihodnje sami naučijo rešiti podobne težave.

Ni pa povzročalo preglavic samo to, tudi pomanjkanje računalnikov in mobilnih naprav za delo je bila precejšna zagata, ki so jih uporabniki reševali. Velikokrat se je pojavilo, da je v več članski družini bil na voljo samo en računalnik, ki so si ga izmenjevali in si naredili nekakšen urnik uporabe računalnika. S tem je prišla tudi možnost, da so uporabniki lahko razporedili čas po želji, kar je včasih pomenilo tudi cel dan s prekinitvami. [12]

3 E-GRADIVA

Glede na to, da so se določeni primeri začeli ponavljati kot vzorec, smo se po pogovoru z drugimi ROID-i odločili, da je smiselno narediti e-vodiče kot obliko e-gradiva, ki je lahko podano v različnih oblikah. Oblika vodičev, ki smo jih pripravljali, je bila fleksibilna, od video vodičev do e-gradiva, karkoli bi pomagalo rešiti nek osnovni ponavljajoči se problem, kot je bil vpis v e-učilnico, forume itd. Tako smo zagotovili, da so lahko uporabniki brez dodatne pomoči uspešno rešili nekatere stvari sami.

Pri tem smo na pripravljeno gradivo dobivali različne odzive. Nekateri so pisali, da jim bolj ustrezajo video vodiči, spet drugi so bili mnenja, da se lažje znajdejo iz pisnih virov. To je povsem avtonomna odločitev, ki jo ima tisti, ki oblikuje e-gradivo. O uporabnosti vira, ki ga uporabniki prejmejo, se odločajo sami. Lahko ga sprejmemo kot uporabnega, lahko pa ga celo zavržejo zaradi nerazumevanje njegove uporabne vrednosti. To pa je odvisno od stopnje učenčeve računalniške pismenosti.

Najpomembnejše vodilo pri pripravi e-gradiv je bilo upoštevanje didaktičnih načel. Načela za pripravo e-gradiv so:

aktivnost, postopnost, sistematičnost, pojasnjevanje s primeri in nazornost, z namenom, da jih uporabnik lažje sprejme oz. razume.[9] Vsekakor pa je bilo pri pripravi izjemno koristno vnaprejšnje poznavanje tipa učencev, staršev ali učiteljev. Na ta način je bilo lahko posredovano gradivo pripravljeno tako, da je najbolj ustrezalo njihovim potrebam.

3.1 Primeri nastalega e-gradiva

Prej omenjeno gradivo je lahko v pisni oz. slikovni obliki in je lahko bilo izključno za tehnično podporo pri opravilih ali tudi kot navodilo itd.

Primer za vpis v Office 365 (glej Slika 1).
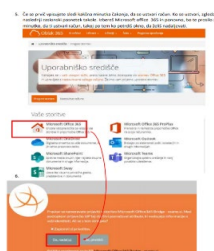
Slika 1. Primer narejenega vodiča v pisni in slikovni obliki

Podano je lahko kot interaktivna vsebina ali kot video vodič (glej Slika 2). Spodnji primer je bil v obliki videa, ki je vseboval tudi razlago in uporabo gradiva, ki so ga učenci dobili. V video je možno s pomočjo vtičnika H5P preko spletne strani: https://video.arnes.si/ narediti tudi interaktivne videe, s katerimi lahko učitelj sproti preveri, ali je uporabnik to razumel, in kako mu je gradivo všeč. To lahko naredi s kratkimi dodatki, kot so da/ne vprašanja, kot tudi z anketo, ki jo izpolni vmes. Tako dobimo hitro povratno informacijo ali je gradivo kvalitetno zasnovano in kaj še manjka do tega, da bo uporabnikom pomoč ustrezala in pomagala.
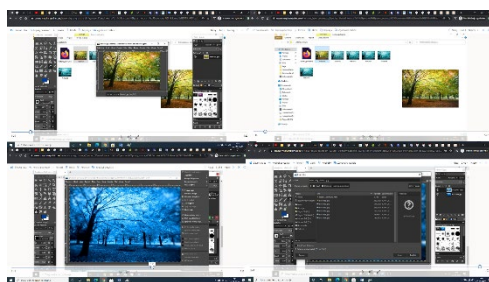
Slika 2. Primer pomoči pri opravljanju nalog

4 SERVIS ZA ODDALJENO POMOČ

Različnih servisov oz. programov, ki omogočajo dostop do oddaljenega namizja je veliko. Najbolj pogosta izbira za osebno uporabo je TeamViewer. Program je brezplačen, preprost za namestitev in uporaben na različnih platformah.[6] TeamViewer se je izkazal kot uporabno orodje tako za pomoč učiteljem, kot učencem in staršem, ob predpostavki izgrajenega temeljnega zaupanja med mano in uporabniki potrebnimi pomoči. V tej situaciji nihče izmed nas ni pomislil na možnost izkoriščanja oddaljenega namizja. Glede na izgrajeno predhodno stopnjo medsebojnega zaupanja, je tako kot v šoli, sodelovanje potekalo v iskanju ustrezne rešitve.

4.1 TeamViewer

Program, ki je bil v veliko pomoč pri oddaljeni pomoči, omogoča vrsto različnih orodij. Najbolj pomembna je ta, da lahko dostopaš in imaš možnost ne le videti uporabnikovega zaslona, ampak tudi to, da lahko prevzameš nadzor nad njim in z njim upravljaš kot s svojim. Po namestitvi je zelo uporaben, potrebna je le povezava do interneta in posredovanje uporabnikove identitete (ID) ter gesla.
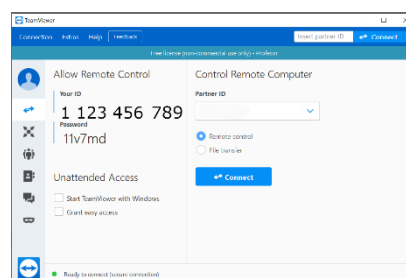
Slika 3. TeamViewer

Tako se lahko prijaviš v sistem in opraviš delo na samem izvoru težave. Program kljub delitvi identitete in gesla zagotavlja visoko varnost, saj uporablja šifrirano sejo s pomočjo AES 256 šifrirnega standard kot tudi z RSA izmenjavo privatnega in javnega ključa. [6]

4.1.1 Primer uporabe

Dober primer pomoči je, ko sem dobil e-poštno sporočilo, da uporabnikom nič ne dela na računalniku. To je največkrat slišana težava, ki jo ROID-i slišimo, če tudi je običajno napaka majhna. V omenjenem primeru se je pojavila napaka, kjer uporabnikom na enkrat ni več delala kamera in tudi programskega paketa Office niso več imeli na računalniku. Najprej smo začeli s pogovorom preko telefona. Na ta način so uporabniki (starš in učenec s šole) uspeli namestiti program TeamViewer (glej Slika 3) in sporočili svoj ID in geslo. To je omogočilo neposreden vpogled v izvor težave, ki jih je močno ovirala zato, ker so ob navodilih za nalogo imeli možnost nastavitve novega urejevalnika besedila. Problem je bil v tem, da jim je osnovni urejevalnik ni več deloval oz. ga niso našli in jim dokumenta ni odpiralo kot privzeti program. Ta problem smo hitro in uspešno rešili. Nato so ob pregledu imeli gonilnik za kamero, ki kljub temu ni delovala. Ob vprašanju, ali se je kdo od družinskih članov igral z računalnikom, je bil odgovor pritrdilen, kar me je usmerilo k razmišljanju, da je nekdo s fizično tipko na računalniku izklopil delovanje kamere. Po tovrstni intervenciji je bila težava v pičlih 15 minutah rešena in uporabniki opremljeni z novimi znanji in uvidi, zelo srečni, da se je zadeva rešila, ter da lahko ponovno uporabljajo računalnik.

Na podoben način, z zagotavljanjem pomoči učencem in njihovim staršem, je potekal moj vsakdanjik med epidemijo. Pomoči pa niso bili potrebni le učenci in starši. Največ pomoči sem namenil ravno sodelavcem, učiteljem in učiteljicam, pri

katerih poznavanje delovanja programov in računalnika ni njihova močna točka in to raje prepustijo tistim, ki to že znajo.

5 REZULTATI

Epidemija je bila ne glede na vse izzive in novo nastale situacije, ki so otežile običajno izobraževalno delo, kljub vsemu izredna priložnost za testiranje dela od doma in oplemenitenje šibkih členov, ki do zdaj niso bili identificirani.

Dobre rezultate je prinašalo e-gradivo, kjer je bilo vključeno upoštevanje kombinacije učno zaznavnih stilov (vizualni, slušni in kinestetični).[9] Hkrati smo lahko opremili večje število ljudi in ker je bilo gradivo pripravljeno na tako nazoren način so uspeli v večini rešiti manjše probleme popolnoma sami in s tem pridobili na samozavesti pri uporabi računalnikov in programov.

V primeru, da pa uporabnik ni znal priti do rešitve sam ali z uporabo e-gradiva, se je najbolje obnesla pomoč na daljavo. To je bilo preprosto narediti s programom za oddaljeno namizje in reševati, kot da sediš za njihovimi računalniki, na tak način smo ROID-i lahko točno ugotovili, kakšno težavo ima uporabnik ter se lotili analitičnega reševanja.

Kljub vsem domiselnim rešitvam, je zaradi preobremenjenosti strežnikov ali slabe povezave še prihajalo do dodatnih težav, ki jih sam nisem uspel rešiti. V tem primeru je bilo nepogrešljivo sodelovanje s tehniki s strani Arnesa, ki so vedno zelo ažurno reševali tovrstne težave. Z zagotovitvijo vseh korakov na poti reševanja težav, je sistem deloval stabilno in dobro.

6 ZAKLJUČEK

Šolanje na domu je svojevrsten izziv. Pri samem izobraževalnem procesu je veliko težav povzročala ravno IKT, ki jo je zagodla vsakemu od deležnikov vsaj enkrat. Tukaj smo bili nepogrešljivi ROID s pomočjo na daljavo in s tem razrešitvi tehničnih težav učiteljev, učencev in staršev. Največ težav sem odpravil ravno preko programa Teamviewer, pri čemer je pomanjkljivost tega programa, da se lahko osredotočiš zgolj na enega uporabnika. To sem rešil s pripravo e-gradiva, kjer sem dal navodila za uporabo ali razrešitev težav več uporabnikom hkrati.

Kaj lahko pričakujemo v prihodnosti? To se je zagotovo vprašal skoraj vsak. Četudi se delo od doma povečuje, e-gradiva in oddaljena pomoč ne morejo popolnoma nadomestiti poučevanja na šolah. [9] Tako tudi pomoči, ki jo lahko uporabniku nudi tehnik v živo z razlago in odzivom, ni ekvivalentna pomoči preko oddaljenega namizja. Gotovo smo po izkušnji izolacije mnogo bolje pripravljeni na tovrstne situacije, nikakor pa ne moremo računati na to, da bi ob ponovitvi epidemije vse potekalo brez težav in gladko. Pri IKT je prostora še za mnogo izboljšav, kakor je tudi jasno, da se njihove pomembnosti zdaj zaveda večje število uporabnikov. Vse to

nakazuje na potrebo po večji stopnji opismenjevanja IKT in tem, da uporabnike zavestno pripravljamo na večjo stopnjo samostojnosti.

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Učenje na daljavo v času pandemije covid-19

Distance learning during the pandemic covid-19

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POVZETEK

V prispevku je predstavljeno interaktivno učenje o pomenu zdrave prehrane in presnove, ki je v času odraščanja za mladostnike ključnega pomena, saj omogoča zdrav telesni razvoj. Mladostniki se v našem učnem sistemu pogosto srečajo s pomenom zdrave prehrane, prav tako pa je zdrava prehrana pogosto tema v medijih. Kljub pogostem omenjanju pomenu zdrave prehrane, je raziskava pokazala, da mladostniki velikokrat posežejo po nezdravi hrani. Več kot polovica anketiranih mladostnikov je mnenja, da se prehranjujejo zdravo, vendar so rezultati pokazali, da je v resnici takšnih zgolj 28%. Potrošniki pogosto v trgovini kupujemo hrano glede na izgled embalaže, mladostniki pa so glede na vizualni izgled in oglaševanje določenega izdelka še bolj dovzetni. Posledično nezdravo hrano pogosto zamenjajo za zdravo in jo v prepričanju, da je dobra, jedo. V prispevku je predstavljeno učenje na daljavo o pomenu zdrave prehrane in presnove, ki je potekalo v času pandemije covid – 19. Da bi mladostnikom na drugačen način približali pomen zdrave prehrane, je bila opravljena raziskava, v kateri so dijaki najprej preverili svoje znanje o zdravi prehrani, izpolnili anketo o njihovih prehranjevalnih navadah in bili nato vključeni v interaktivne delavnice o pomenu zdrave prehrane in presnove. Na teh delavnicah so dijaki s pomočjo aplikacije Energy for life na interaktivni način spoznali pomen zdrave prehrane in kako se hranila presnovijo v našem telesu. Svoje znanje so nato preverili z vprašalnikom. Na koncu delavnice so dijaki s pomočjo aplikacije Veš kaj ješ? naredili primere zdravih jedilnikov.

KLJUČNE BESEDE

Zdrava prehrana, delavnice, presnova, aplikacija

ABSTRACT

The article presents interactive learning about the importance of healthy nutrition and metabolism, which is crucial for adolescents as they grow up, as they enable healthy physical development. Adolescents are often confronted with the importance of healthy eating in our learning system, and healthy eating is often a topic in the media. Despite the frequent mention of the importance of a healthy diet, research has shown that adolescents often resort to unhealthy foods. More than half of the adolescents surveyed said they were eating healthy, but the results showed that only 28% actually did. Consumers often buy food at the store based on the appearance of the packaging, and adolescents are even more receptive to the visual appearance and advertising of a particular product. As a result, unhealthy foods are often mistaken for healthy foods and eaten in good faith. The paper presents distance learning about the importance of a healthy diet and metabolism, which takes place during the covid - 19 pandemic. In order to approach adolescents in a different way the importance of a healthy diet for their development and metabolism, a study was conducted in which students first tested their knowledge of healthy eating, completed a survey of their eating habits, and then participated in interactive Šworkshops on the importance of healthy eating and metabolism. Through the Energy for life application, students learned the importance of a healthy diet and how nutrients are metabolised in our bodies, and then tested their knowledge with a questionnaire. At the end of the workshop, students used the application Veš kaj ješ? and made examples of healthy menus.

KEYWORDS

Healthy nutrition, workshop, metabolism, aplication

1 UVOD

Zdrava prehrana je nekaj o čemer se zadnje čase zelo pogosto govori. Pomen zdrave prehrane je ključen za zdrav razvoj, saj telo za izgradnjo notranjih ogranov, mišic, kostnine in živčevja nujno potrebuje hranila, ki jih vsebuje hrana. V zgodnjem otroštvu se običajno prehranjujemo bolj zdravo in uživamo raznoliko prehrano, ki nam omogoča zdrav razvoj. Otrokov jedilnik določajo starši oz. skrbniki in posledično ne moremo kot posamezniki vplivati na izbor hrane in uživati zgolj hrane, ki nam je všeč. V času pubertete, pa mladostniki počasi začnejo sami določati svoj jedilnik in pri tem večkrat ne upoštevajo smernic zdravega prehranjevanja. Nepravilen izbor živil in njihovo uživanje pa lahko pusti posledice, ki se pokažejo kot nepravilna, neenakomerna rast za vse življenje, prav tako pa lahko vpliva na oblikovanje prehranjevalnih navad v kasnejšem življenju. [6] Zaradi upada upoštevanja smernic zdrave prehrane skozi obdobje pubertete je bila posledično opravljena raziskava katere namen je ugotoviti prehranske navade mladostnikov, v kateri so sodelovali dijaki tretjih letnikov III. gimnazije Maribor. Dijaki

so sprva izpolnili vprašalnik, ki je preveril njihove prehranske navade, nato pa so preko didaktične delavnice, pri katerih so uporabljali interaktivni aplikaciji, ki mladostnike spodbudita k boljšem razumevanju pomena zdrave prehrane in njene presnove, spoznavali načela zdravega prehranjevanja. Z vidika varovanja zdravja je namreč zdrava prehrana za mladostnike izredno pomembna, saj imajo ravno v tem obdobju veliko večje potrebe po beljakovinah, vitaminih in mineralih ter energiji. [1]

2 POMEN ZDRAVE PREHRANE

Mladostniki se že v času osnovne šole pri pouku gospodinjstva srečajo s pomenom zdrave prehrane, kjer se učijo o prehranski piramidi in različni pripravi hrane. Nato se o prehrani in presnovi učijo pri pouku biologije, kjer največ poudarka namenijo presnovi ter vgradnji hranil v človeško telo in posledicah nepravilne prehrane in prehranskih navad. Njihove prehranske navade so v času osnovne šole običajno dobre, vsaj v prvi in drugi triadi. V tretji trijadi pa mladostniki med glavnimi obroki pogosto uživajo prigrizke za katere je značilno, da vsebujejo veliko energije, zaradi prisotnosti sladkorjev in maščob, ne vsebujejo pa hranilnih snovi, ki jih telo potrebuje za krepitev odpornosti. Ena izmed praks mladostnikov v tretji triadi je opuščanje zajtrka in neustrezen ritem prehranjevanja ter premajhne količine zaužite zelenjave. Vendar se prehranske navade osnovnošolskih otrok v tretji triadi v veliki meri razlikujejo od navad srednješolskih otrok, saj le ti velikokrat nimajo primerne šolske malice. [5]

Zdravo prehrano bi lahko opredelili z naslednjimi smernicami:

- redna prehrana (vsaj 5 obrokov dnevno),
- uživanje hrane glede na prehransko piramido,
- raznolikost hrane,
- počasno uživanje hrane, ki jo dobro prežvečimo,
- izogibanje sladkim in mastnim jedem,
- izogibanje prigrizkom [2].

Iskanje krivca slabih prehranskih navad mladostnikov ni enostavno, saj na njihove navade vpliva mnogo različnih dejavnikov. Živimo v okolju, ki spodbuja debelost, saj smo kot družba izredno potrošniko naravnani in nam mediji dnevno posredujejo vedno nove in nove proizvode. Poleg tega, pa nas okolje spodbuja k temu, da smo vedno manj aktivni (električna kolesa, električni skiroji, uporaba osebnega vozila...). Podatki za Slovenijo kažejo naraščajoče gibanje prekomeno hranjenih in debelih mladostnikov in odraslih pri nas, kar kaže, da se navade pogosto prenašajo s starejše na mlajšo generacijo [7]. Debelost pri mladostnikih je namreč eden izmed največjih problemov današnjega časa, saj prekomerna telesna teža v mladostniškem obdobju zelo pogosto nakaže na prekomerno telesno težo tudi v odraslem obdobju. Pri mladostniku neuravnotežena prehrana povzroča manjšo delovno storilnost, utrujenost, manjšo sposobnost pomnenja in kronične bolezni. Strokovnjaki so ugotovili, da so številne bolezni neposredno povezane s hrano, kar pomeni da je od prehrane odvisno naše zdravje. Nepravilna prehrana pa je večkrat povezana z različnimi slabimi navadami kot je telesna neaktivnost in kajenje. Bolezni katere lahko neposredno povežemo s prehrano so:

- beri-beri (posledica, dolgoročnega pomankanja vitamina B1),
- skorbut (nastane zaradi pomanjkanja vitamina C v daljšem časovnem obdobju),
- hipertenzija (povišan krvni tlak zaradi hrane, ki vsebuje visoke vrednosti nitratov),
- zobna gniloba (posledica prekomernega uživanja sladke hrane in slabe ustne nege).

Obstaja še množica drugi bolezni, vendar njihovega nastanka ne morejo povezati izključno s slabimi prehranskimi navadami. [8]

Ker so bolezni, ki jih povzroča nezdrava prehrana velik javnozdravstveni problem, se veliko pozornosti namenja k omilitvami posledic le teh.

3 INTERAKTIVNO POUČEVANJE

Ustaljena praksa poučevanja mladostnikov o pomenu zdrave prehrane, očitno ne prinaša dobrih rezultatov, saj se delež mladostnikov, ki imajo slabe prehranske navade in posledično zdravstvene težave, ki se lahko razvijejo tudi v odrasli dobi. Razlog za slabe navade mladostnikov, bi lahko bili tudi zastareli načini poučevanja v šoli, saj so učenci zaradi uporabe interneta, mobilov in televizije navajeni na interaktivno pridobivanje informacij. Frontalen način poučevanja, katerega uporablja večina učiteljev, v večini primerov ne doprinaša k trajnostnem znanju, saj so učenci do takšnega pridobivanja informacij vedno manj motivirani pri učnem procesu [4]. Učitelj mora dan danes učence spodbujati, da sami pridejo do določenih spoznanj, ne da jim zgolj posreduje znanje. Z uporabo in upoštevanjem konstruktivističnega pristopa pri izkustvenem učenju lahko učitelj učencem pomaga povezati ugotovitve s praktičnimi zakonitostmi. Uporaba IKT (informacijsko komunikacijske tehnologije) lahko omogoči posredovanje učne snovi na bolj atraktiven način. Pri pouku lahko uporabimo tako računalnike, kot tudi mobilne telefone, sploh v primeru, ko imamo v vzgojno izobraževalnem zavodu težave zagotoviti primerno število računalnikov za večjo skupino učencev. Uporaba mobilnih telefonov pri pouku ima tudi svoje omejitve in predstavlja določene izzive, sploh od učiteljev. Prednost mobilnih telefonov je v tem, da jih ima večina učencev in da so običajno zmogljivejši od šolskih računalnikov [3].

3.1 Aplikacije za poučevanje o zdravi prehrani in presnovi

Na spletu je množica različnih aplikacij in spletnih strani, ki opisujejo zdravo prehranjevanje in presnovo, vendar je zgolj peščica didaktično primernih za uporabo v učnem procesu. Večina aplikacij je namenjena ali izobraževanju ali zabavi, vendar le malo je takšnih, ki bi združevale oba spektra. Ena izmed aplikacij, ki je tako poučna, da uporabnik pridobi in utrdi svoje znanje, kot tudi zabavna, da se ne naveliča in je pripravljen dlje časa ostati motiviran, se imenuje Energy for life. Aplikacija sicer ne ponuja uporabe v slovenskem jeziku, temveč je zgolj v angleškem in španskem jeziku. Posledično se lahko aplicijo uporabi kot primer medpredmetnega povezovanja biologije in angleščine. Prednost aplikacije je tudi v tem, da je popolnoma brezplačna in omogoča več različnih učnih modulov. Aplikacija s pomočjo igrifikacije – uporaba dinozavra, ki pritegne pozornost uporabnika, uči novih konceptov in ga motivira za interakcijo, kar izboljša učni proces. Zaradi enostavnega umesnika je ta

aplikacija dostopna vsem učencem različnih starosti, tako v osnovni, kot tudi v srednji šoli. Vizualen prikaz in strokovna natančnost izrazov, se določi s pismenimi sposobnostmi uporabnika. Velik poudarek je na znanstveni pismenosti, povezan z vizualnimi dražljaji, ki uporabnika spodbujajo k aktivni uporabi aplikacije. Aplikacija je zasnovana tako, da se jo lahko uporablja ob spremstvu vodje učnega procesa ali pa se jo uporablja samostojno. Slika 1 prikazuje dinozavra, ki mladostnika nagovarja, kaj vse lahko s pomočjo aplikacije izve. Uporabnik lahko izbira med različnimi področji, ki jih lahko s pomočjo aplikacije osvoji in utrdi svoje znanje. Slika 2 prikazuje modul prebavil, katerega uporabnik lahko izbere v aplikaciji in s pomočjo njega pregleda kaj vse njegovo telo potrebuje za delovanje. Nato uporabnik preveri kaj se zgodi, če tega hranila ne dobi (nastanek različnih obolenj). Prav tako, ga aplikacija spodbuja k nadaljnjem razmišljanju in preizkušanju naučenega znanja.

Slika 1: Prikaz različnih modulov aplikacije
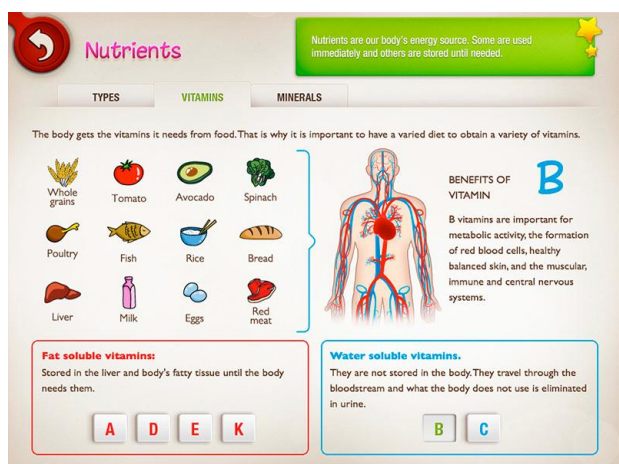
Slika 2: Prikaz modula hranila

Aplikacija Veš kaj ješ? omogoča uporabniku preveriti energijsko vrednost hrane. Prav tako uporabniku omogoča, da s pomočjo prehranskega semaforja ugotovi, katerih živil naj se zaradi prekoračenih vrednosti določenih hranil izogiba. Namen aplikacije je pomoč pri sestavi jedilnika, katerega lahko vsak posameznik sestavi glede na svoje prehranske navade. Slika 3 prikazuje primer uporabe aplikacije na pametnem telefonu med

opravljanjem nakupov. Aplikacija nam omogoča uporabo kamere pri pametnem telefonu in s tem skeniranje črtne kode izdelka, katerega prehransko vrednost želi uporabnik preveriti. Aplikacija nam nato s pomočjo barvnega semaforja prikaže katerih hranil je v izdelku v zadostnih, prekomernih ali premajhnih količinah. Pri sliki 4 lahko vidimo kako je razčlenjen prehranski semafor, ki uporabniku sporoča še dopustno vrednost določenih hranil v izdelku. Aplikacija Veš kaj ješ? ni namenjena zabavi in je posledično manj atraktivna kot aplikacija Energy for life, zato je vsaj uvodna uporaba aplikacije priporočljiva pod vodstvom učitelja. Učitelj mora pred uporabo mobilnih telefonov kot učnega pripomočka med poukom oceniti smiselnost, pri kateri učni snovi ga bo uporabil in katere učne cilje bo s pomočjo njih usvojil. Prav tako ni namen vsakodnevne uporabe mobilnih telefonov pri učnem procesu, saj bi s tem njegova atraktivnost izzvenela, prav tako pa bi lahko postal moteči faktor v razredu zaradi morebitne nedovoljene uporabe iz strani učencev.

Slika 3: Prikaz aplikacije Veš kaj ješ?

Slika 4: Prikaz prehranskega semaforja

4 RAZISKAVA

Da bi ugotovili odnos do zdrave prehrane mladostnikov in preverili znanje o pomenu zdravega prehranjevanja in presnove, je bila opravljena raziskava, v kateri so sodelovali dijaki tretjih letnikov III. gimnazije Maribor. Za namen raziskave je bilo izbranih 42 dijakov, ki so sprva izpolnili vprašalnik, ki je bil sestavljen iz 14 vprašanj, katerih namen je bil ovrednotiti znanje učencev o zdravi prehrani in presnovi, prav tako pa je bil namen vprašalnika preveriti njihove prehranske navade. Nato so bile izvedene 3 učne ure, pri katerih so dijaki s pomočjo aplikacije

Energy for life ugotovili pomen zdrave prehrane in presnove, nato pa so s pomočjo aplikacije tudi preverili svoje znanje. Pri učni uri je bila vloga učitelja zgolj kot usmerjevalec učnega procesa in ne posredovalca znanja. Po uporabi aplikacije so bili učenci pozvani kakšne so njihove prehanske navade in opisu njihovega tedenskega jedilnika. Ker so imeli pri jedilniku večje težave, so nato s pomočjo aplikacije Veš kaj ješ? preverili kakšne jedi so primerne za določen del dneva in katerih jedi se morajo izogibati pri svoji prehrani. Po zaključku dela z aplikacijo so učenci s pomočjo razgovora posredovali kaj so se naučili in izročke oblikovane skupaj z učiteljem zapisali v zvezke. Nato so ponovno izpolnjevali vprašalnik, s katerim je bilo preverjeno, kaj so se naučili. Določeni rezultati vprašalnika so bili pričakovani, saj se je tako znanje kot tudi odnos do zdrave prehrane izboljšal. Presenetljivo je bilo to, da je bilo 54% odstotkov učencev mnenja, da se prehranjuje zdravo, vendar je bilo nato v nadaljnjem delu rezultatov vprašalnika prikazano, da so zmotno prepričani v svoj zdrav način prehranjevanja. Kar 48% učencev navaja premalo časa kot glaven krivec za njihove slabe prehranske navade, 35% učencev pa navaja, da stres močno pripomore k njihovimi prehranskimi navadami. Kot glaven razlog zakaj kupijo določen proizvod so učenci podali izgled in njegovo oglaševanje. Večina učencev ne pregleda hranilnih vrednosti pred nakupom produkta. Pri vprašanju katera pijača ima najvišjo vrednost sladkorja, je sprva od 42 učencev pravilno odgovorilo zgolj 5 učencev, kar nakazuje na njihovo zmotno znanje o hranilih v sladkanih pijačah. Pri zapoznelen vprašalniku pa je pravilno odgovorilo 18 učencev. Večina učencev, kar 34 od 42 je odgovorila pri zapoznelen vprašalnikov, da bodo več pozornosti namenili svojim prehanskim navadam.

5 ZAKLJUČEK

Ključno je, da se o zdravi prehrani začnemo pogovarjati čim prej v začetku izobraževalnega procesa. Vendar zgolj frontalno poučevanje ne prinaša željenih rezultatov, saj se delež prekomerno debelih mladostnikov v zadnjem časovnem obdobju drastično povečuje. V raziskavi je predstavljen eden kot načinov,

da izboljšamo prehranske navade mladostnikov, uporaba interaktivnega pouka s pomočjo aplikacij. Aplikacije, ki jih dan danes lahko učenci uporabljajo pri pouku, se lahko dostopajo preko mobilnih telefonov, kar pomeni, da lahko tudi vzgojno izobraževalni zavodi z omejitvami pri omogočanju dovolj velikega števila računalnikov za vse učence, omogočijo svojim učencem izvedbo pouka na takšen način. Ali bo uporaba takšnih aplikacij drastično vplivala na prehranske navade učencev je neodgovorno trditi, vendar njihova uporaba lahko pripomore k boljšem ozaveščanju zdravega načina prehranjevanja in razumevanju presnove hranil ter zdravemu načinu življenja.

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Uporaba elektronskih gradiv za delo na daljavo v času epidemije pri mlajših učencih v osnovni šoli

Use of electronic materials for remote work during the epidemic with younger students in primary school

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POVZETEK

V članku je predstavljeno delo na daljavo z uporabo informacijsko-komunikacijske tehnologije (v nadaljevanju: IKT) v času epidemije. Delo od doma je od učitelja za komunikacijo s starši in učenci zahtevalo vsakodnevno uporabo IKT. Potrebna je bila prilagoditev načina prenosa informacij, učne snovi, načinov preverjanja in ocenjevanja znanja, poučevanja učencev z učnimi težavami in učencev priseljencev. Za uspešno in nemoteno delo ter doseganje ciljev in pozitivnih rezultatov je bila uporabljena cela vrsta interaktivnih vsebin, programov za komunikacijo, spletna učilnica, vrsta programov za izdelavo kvizov, nalog, posnetkov, predstavitev. Pri njihovi uporabi smo se učitelji soočali tako s težavami kot tudi primeri dobre prakse uporabe IK tehnologije.

KLJUČNE BESEDE

Delo na daljavo, interaktivne vsebine, spletne učilnice, spletni kvizi

ABSTRACT

The article presents remote work using Information and communication technology (hereinafter "ICT") with working from home during the epidemic. Working from home required the teacher to use ICT on a daily basis to communicate with parents and students. It was necessary to adjust the method of information transfer, learning programme, methods of checking and assessing knowledge, teaching students with learning difficulties and immigrant students. For successful and smooth work as well as achieving goals and positive results, a whole range of interactive content, communication programs, online classroom, programs for making quizzes, assignments, recordings, presentations were used. In using them, teachers faced both problems and examples of good practice in the use of IC technology.

KEYWORDS

Remote work, interactive content, online classrooms, online quizzes

1 UVOD

Delo oziroma študij na daljavo se je pojavilo že v 18. stoletju. V Severni Ameriki so ljudje dobili učno gradivo kar po pošti. S pomočjo prejetega gradiva so se doma učili in pripravljali na ocenjevanje znanja. Te oblike študija pa zaradi izoliranosti in osamljenosti učencev niso bile uspešne.

Študij na daljavo (angl. distance education) predstavlja izobraževanje, ki poteka ločeno od mesta poučevanja, danes ob uporabi sodobnih IKT, oziroma preko interneta. Pri tem so zahtevane specifične tehnike načrtovanja izobraževalnih gradiv, poučevanja in komuniciranja. Sodobne oblike izobraževanja na daljavo izvajamo v virtualnih učnih okoljih, kjer so vključena interaktivna, večpredstavnostna učna gradiva, ki omogočajo aktivno učenje. [3]

Z napredkom v informacijski tehnologiji (IT) lahko danes to težavo delno odpravijo nove tehnologije, kljub temu pa to ni zanesljiv način za uspešno poučevanje in doseganje pozitivnih rezultatov pri učencih. Pri tem je potrebno upoštevati tudi učenčevo zadostno aktivnost pri opravljanju nalog. Veliko vlogo ima učenčevo prizadevanje za lastno delovanje, kar pa je povezano s predhodnim znanjem učenca, njegovo samopodobo in že usvojenimi učnimi navadami.

E-učenje pogosto definirajo kot učenje s pomočjo IKT. Učenje je, po definiciji UNESCO/ISCED iz leta 1993, vsaka sprememba v vedenju, informiranosti, znanju, razumevanju, stališčih, spretnostih ali zmožnostih, ki je trajna in ki je ne moremo pripisati fizični rasti ali razvoju podedovanih vedenjskih vzorcev. [2]

Učenci morajo biti bolj samostojni pri učenju in tudi bolj ustvarjalni. Ker se učijo samostojno, si lahko tempo učenja prilagodijo lastnim potrebam in se osredotočijo samo na določene dele vsebine, ki jim povzročajo težave. Prednost je tudi v sprotnem preverjanju znanja in interakciji z učiteljem. Hkrati imajo učenci tudi hitrejši dostop do podatkov preko spleta. [3]

Pri tem pa se postavlja vprašanje, dilema, kako uspešno se lahko posamezni učenec uči v domačem okolju s pomočjo tehnologije, ki jo ima doma, in predhodnemu znanju o uporabi le-te. Ali lahko zagotovimo vsem učencem glede na različne stile

učenja enake možnosti za usvojitev zahtevanega znanja? Kako dobro smo učitelji sploh opremljeni z znanjem za poučevanje na daljavo?

2 NAČRTOVANJE E-IZOBRAŽEVANJA IN IZVEDBA

Za izvedbo e-izobraževanja je potrebno zagotoviti ustrezno učno platformo, dostop preko interneta ter strojno in programsko opremo. Učni viri morajo biti interaktivni, večpredstavni. Omogočiti je potrebno zadostno pedagoško podporo, in sicer izdelavo e-gradiv, izvedbo e-predmetov ter usposabljanje pedagogov za izvajanje e-izobraževanja. Pomembna je tudi tehnična pomoč, organizacija izvedbe e-predmetov, administracija, upravljanje in evalvacija. [1]

V kolikor bi bilo delo na daljavo vnaprej načrtovano in dobro premišljeno, bi bilo e-poučevanje učitelju lažje. V primeru zaprtja šol tako rekoč čez noč pa smo bili učitelji potisnjeni v povsem nov način poučevanja, kljub poznavanju tehnologije in programov za e-poučevanje nam povsem neznan.

Ob začetku dela na daljavo je bilo potrebno najprej vzpostaviti komunikacijo s starši in se dogovoriti, na kakšen način in kako pogosto bo potekala komunikacija. Ob dobri strojni opremi je bil naslednji korak iskanje primerne programske opreme na internetu. Ta je ključnega pomena pri delu na daljavo, saj omogoča učitelju in učencem lažje predajanje informacij, kvalitetnejše delo in posledično pozitivnejše rezultate. Ključnega pomena je bilo sodelovanje tako med kolegi kot tudi z učitelji drugih šol. S predajanjem informacij dobre prakse in deljenjem že pripravljenih vsebin je bilo olajšano delo slehernemu učitelju.

Poznavanje programske opreme namreč še ni dovolj za uspešno delo, ogromno časa zahteva poznavanje posameznega programa, pripravljanje vsebin, ki bi jih lahko posredovali s pomočjo izbranega programa, pa snemanje zvoka, videa, fotografiranje, urejanje podatkov.

Pri usposabljanju za izvajanje e-izobraževanja smo imeli učitelji na voljo tudi nekaj spletnih izobraževanj, s pomočjo katerih smo lahko dopolnili svoje znanje o uporabi spletnih programov.

3 SLEDENJE AKTIVNOSTI UČENCEV

Učitelj ima pri delu na daljavo izjemno pomembno vlogo. Čeprav ni v fizičnem stiku z učencem, lahko usmerja učne aktivnosti in spodbuja uporabo primernih učnih strategij. Učence usmerja k učnim ciljem ter pospešuje aktivno sodelovanje in komunikacijo med učenci. Sproti lahko odgovarja na morebitna vprašanja učencev, pri tem pa je nujno, da zagotavlja kvalitetne in razumljive povratne informacije.

Učence motivira in spodbuja razvoj njihovih samoregulacijskih procesov (postavljanje ciljev, uporaba strategij, planiranje in upravljanje s časom, samoevalvacija, samoopazovanje, iskanje pomoči), kar je vsekakor lažje pri učencih drugega in tretjega triletja, ker so že samostojnejši. Vsakodnevno tudi spremlja delo učencev in opazuje njihov napredek.

Glede na uspešnost dela in povratne informacije preverja in ocenjuje izdelke učencev. Ob koncu pa pripravi sumativno preverjanje znanja in učence oceni.

4 DELO NA DALJAVO

Od prvega dne dela na daljavo je bilo izrednega pomena sodelovanje s kolegi po celotni vertikali. Vsak je prispeval del svoje računalniške pismenosti za kvalitetnejše in lažje delo. Vsakodnevno smo spoznavali nove aplikacije, programe za navodila za vsakodnevno delo, sestavljanje nalog, kvizov, posnetkov, predstavitev, preverjanj in preizkusov znanja, za komunikacijo in podajanje povratnih informacij.

Učenci so bili pri delu od doma kar naenkrat postavljeni v položaj, ko so morali snov prebrati, gledati ali poslušati, vendar niso mogli spremljati razlage v živo, ob prisotnosti učitelja. Učitelj pa je moral skrbeti, da bodo kljub danim okoliščinam zastavljeni cilji doseženi. Pri tem je bilo ključnega pomena tudi, ali so imeli doma ustrezno računalniško opremo.

Ob upoštevanju dejstva, da je morala biti snov za učenca predstavljena skozi raznovrstne aktivnosti, da bi si jo lažje zapomnil, je bilo potrebnega veliko načrtovanja in preizkušanja metod, ki jih do sedaj še nismo izkusili v praksi niti učitelji.

Pri izbiri medijev kot učno gradivo se je večkrat pojavila dilema, ali bo izbran medij dovolj dober, bo učencu dovolj jasno predstavljena vsebina za doseganje ciljev.

4.1 Dostopnost računalniške opreme in e-gradiva

Kot sem že omenila, je bilo v začetku dela na daljavo nujno preveriti, kako dobro so družine opremljene z računalniško opremo. V prvem tednu smo tako morali imeti v mislih tudi dejstvo, da vsi učenci morda ne morejo dostopati niti do spletne učilnice.

Druga težava so bila e-gradiva, e-učbeniki in delovni zvezki. Učitelji, ki poučujemo v več oddelkih in delamo z učenci z učnimi težavami, nismo imeli dostopa do e-gradiv različnih iz razredov. Tu so bile založbe učiteljem v veliko pomoč, saj so odklenile svoje platforme, da bi učitelji lahko nemoteno uporabljali učno gradivo pri delu z vsemi učenci.

Pojavljale so se težave v komunikaciji, saj nekateri starši niso imeli niti svojega elektronskega naslova, nekateri starši pa so v začetku celo zavračali pomoč. Tako je bilo nujno vzpostaviti povezavo preko telefona, da bi poiskali skupno rešitev za komuniciranje.

Veliko težavo je za določene učence predstavljala tudi fizična odsotnost učitelja. Starši so bili potisnjeni v vlogo pomočnika pri opravljanju vsakodnevnega šolskega dela, kar pa je marsikomu predstavljalo veliko težavo. Nekaj staršev je bilo kljub karanteni v službi, nekateri starši niso razumeli snovi, ki jo je moral njihov otrok predelati, starši, ki so se priselili iz tujine pa zaradi jezikovnih ovir ravno tako niso zmogli pomagati svojemu otroku.

Učenci so imeli kar naenkrat manj nadzora pri šolskemu delu. Za tiste učence, ki so pri svojem delu tudi sicer samostojni in suvereni, to ni predstavljalo težav. Učenci, ki pa imajo sicer učne težave, manj samokontrole in delovne vneme, pa so predstavljali dodaten izziv tako staršem kot učiteljem, saj je brez osebnega stika učencu težko pomagati. Težava se pojavi pri učencih v prvem triletju, ki se na samostojnost pri delu še navajajo, vendar se podobne težave pojavljajo tudi pri nekaterih starejših učencih.

4.2 E-gradiva, e-programi

Pri svojem delu smo uporabljali različna orodja za podajanje učne snovi. Nekaj jih je v uporabi že dalj časa, kar nekaj

programov pa smo morali spoznati povsem na novo. V prvem tednu dela od doma smo tako veliko časa preživeli za računalnikom in iskali primerne programe, ki bi nam bili v pomoč pri poučevanju na daljavo.

PowerPoint

PowerPoint, ki smo ga do sedaj večinoma uporabljali bolj kot pomoč pri predstavitvah v živo, se je izkazal kot dober pripomoček tudi za snemanje vsebin (slika 1). Omogoča kar nekaj dodatnih funkcij, ki so lahko v pomoč učitelju za kvalitetnejšo in razumljivejšo pripravo obravnavane snovi.
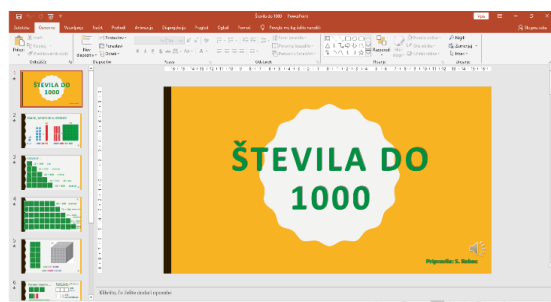

Slika 1. PowerPoint predstavitev števil do 1000 z glasovno razlago (Vir: Suzana Rebec, 2020)

Zoom

Zoom je služil tedenskim videokonferencam z učitelji. V času dela na daljavo je postal nepogrešljiv način izmenjave informacij, primerov dobre prakse, prenosa aktualnih vsebin, vezanih na epidemijo in delo na daljavo, poročanja o delu in morebitnih težavah ter reševanju le-teh.

Discord

Discord se je izkazal kot dober pripomoček za vsakodnevno delo z učenci na individualni ravni (slika 2). Pomanjkljivost programa je ta, da video način komunikacije ni bil mogoč, čeprav program to omogoča. Nedelovanje je bilo posledica preobremenjenosti sistema, slabe računalniške opreme ter slabe internetne povezave.
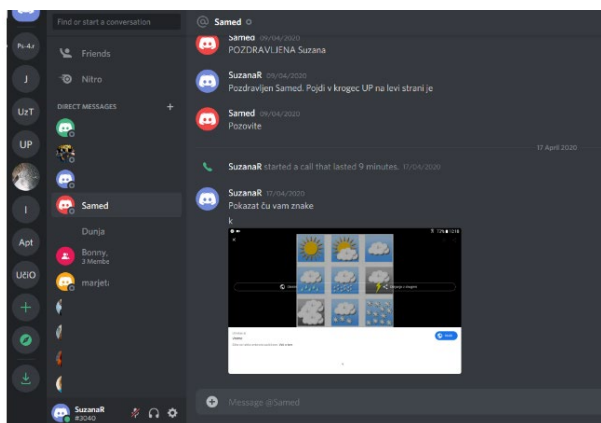
Slika 2. Aplikacija Discord za vodenje vsakodnevnih učnih ur

EBralec

EBralec je program na internetu, ki omogoča poslušanje vnesenega besedila v slovenskem jeziku (slika 3). Bil je v veliko pomoč pri poučevanju slovenskega jezika kot tujega jezika z učenci priseljenci. Poslušanje kot ena temeljnih sporazumevalnih

dejavnosti poleg branja, pisanja in govorjenja je ključna za uspešno učenje jezika. Vseeno pa mora imeti učenec dnevno možnost, da se pogovarja z učiteljem tudi s pomočjo video klica ali po telefonu.

Slika 3. Raba glagolov v povedih – poslušanje v eBralcu

Spletna učilnica

Arnesova spletna učilnica (slika 4) je bila od samega začetka dela na daljavo ključnega pomena za prenos učne snovi. Učitelji razredniki in ostali učitelji smo v učilnico dnevno dodajali vsebine za lažje delo učencev doma. Poleg snovi za posamezne predmete so v spletni učilnici učenci lahko našli dejavnosti za popoldansko ustvarjanje v okviru podaljšanega bivanja, tedensko so dobivali naloge za učenje slovenskega jezika učenci priseljenci, učenci z učnimi težavami so lahko s pomočjo vaj, kvizov, križank, nalog v posebni mapi utrjevali svoje znanje.
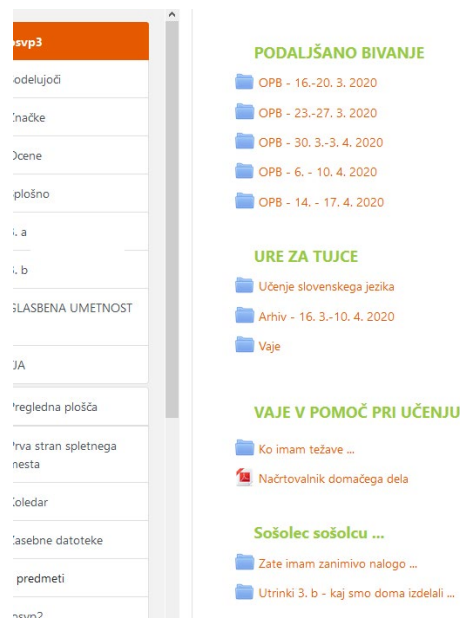
Slika 4. Učne vsebine v spletni učilnici

Glede na aktualne vsebine in obeležitve pomembnih datumov so bile za popestritev dela doma izbrane določene vsebine in učencem ponujene dodatne aktivnosti, tako gibalne kot ustvarjalne (slika 5).

Slika 5. Aktivnosti ob svetovnem dnevu Zemlje v spletni učilnici (Vir: Suzana Rebec, 2020)

Programi za izdelovanje kvizov, križank, učnih listov
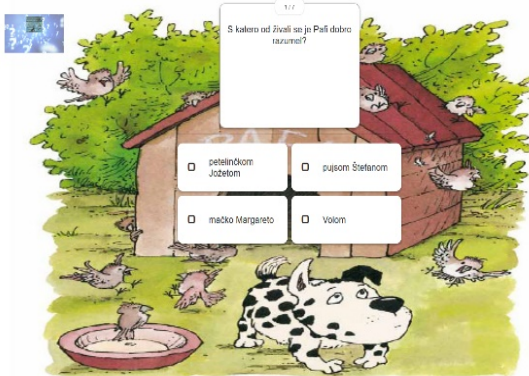
Uporabni programi za izdelovanje kvizov, križank za utrjevanje snovi, učnih listov za ponavljanje so bili zagotovo »Liveworksheets« (slika 6 in 7), »Learningapps« (slika 8 in 9), »Quizmaker« (slika 10), »That-quiz« in »Puzzlemaker«. Vsi našteti programi so omogočili pripravo dodatnih vsebin tako za učinkovitejše poučevanje na daljavo kot tudi za lažje učenje in pomnjenje.
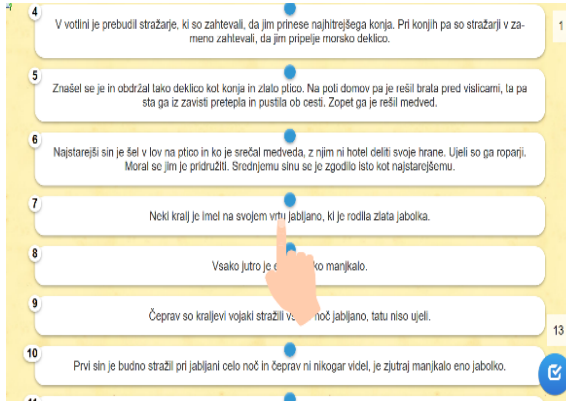
Slika 6. Učni list v aplikaciji Liveworksheets – notranji organi (3. razred)

Slika 7. Učni list v aplikaciji Liveworksheets – stopnjevanje pridevnikov (2. razred)

Slika 8. Naloga v aplikaciji Learningapps – utrjevanje po branju književnega besedila (4. razred)

Slika 9. Naloga v aplikaciji Learningapps – utrjevanje po branju književnega besedila (5. razred)

Slika 10. Kviz v aplikaciji Quizmaker – utrjevanje po branju književnega besedila (3. razred)

5 DISKUSIJA

V nastali situaciji smo bili skoraj v celoti odvisni od e-tehnologije, ki se je v več pogledih izkazala kot zelo uporaben in nepogrešljiv del poučevanja na daljavo. Zagotovo ne more zamenjati osebnega stika, lahko pa je v veliko pomoč pri delu učitelju in pri učenju učencu.

Programi, e-gradiva in drugi pripomočki pri pouku na daljavo so bili v času karantene edina možna vez med učiteljem in učenci ter njihovimi starši. Izkazali so se kot odličen pripomoček pri podajanju snovi, aplikacije za video in glasovne klice so bile nujen del vsakdana pri delu z učenci priseljenci in učenci z učnimi težavami, za posamezne oddelke pa stik z razrednikom. Videokonference so postale obvezen del komunikacije znotraj kolektiva na tedenski ravni in nam omogočile izmenjavo informacij, pomenile so tudi začasno zamenjavo osebnega stika, ki je zelo pomemben za dobro sodelovanje.

Srečevali smo se tudi z nekaterimi težavami in pomanjkljivostmi. Nekaterim učencem ni bil v dovolj veliki meri omogočen dostop do računalniške opreme, saj je bilo doma več otrok in samo en računalnik. Nekaj učencev je v začetku delalo celo preko telefona svojih staršev. Prenekateri starš kot tudi učitelj je imel težave pri nameščanju programske opreme, kot tudi pri njeni uporabi. Pri učencih pa je bila včasih težava tudi

pomanjkanje samodiscipline. Nekateri starši kot tudi učenci so bili v začetku, pa tudi kasneje, neodzivni, kar je dodatno otežilo delo učitelju. Težava je bila tudi samostojnost pri uporabi programske opreme, sploh pri mlajših učencih, ki še niso tako vešči uporabe.

V kolikor bomo učitelji primorani ponovno delati na daljavo, bo tokrat delo zagotovo potekalo drugače, lažje, IKT pa nam bo v veliko oporo pri delu.

6 ZAKLJUČEK

Pri delu na daljavo v času epidemije je bilo dobro poznavanje in uporaba IKT nujno za uspešno delo. Mlajši učenci so pri uporabi IKT potrebovali pomoč odraslih, saj le-te še ne poznajo v tolikšni meri, da bi lahko samostojno delali.

Ključnega pomena za uspešno delo je bilo dobro načrtovanje in priprava e-gradiva, vsakodnevno sledenje aktivnosti učencev, poskrbeti pa je bilo treba tudi, da so imeli vsi učenci doma dostop do računalniške opreme in e-gradiv.

Vse predstavljene aplikacije so pripomogle k uspešnejšemu delu, spletna učilnica pa je bila steber za prenos učne snovi, saj so bile tam zbrane vse vsebine, napotki, pomoči in naloge za utrjevanje znanja.

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Steganografija

Steganography

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POVZETEK

Steganografija je znanstvena disciplina, ki se ukvarja s prikrito izmenjavo informacij. Temeljno načelo steganografije je skrívnost komunikacije, to je prikrivanje obstoja posredovanih informacij znotraj na videz neškodljivega medija ali nabora podatkov. Sodobna steganografija uporablja prednosti digitalne tehnologije in najpogosteje vključuje skrivanje sporočila znotraj nekaterih večpredstavnostnih datotek, na primer slike in zvočne ali video datoteke. Drugi cilj steganografije je vodni žig, to je postopek podpisovanja digitalnih medijev z namenom varovanja pravic intelektualne lastnine. Članek predstavi uporabo različnih metod za skrivanje informacij in seznanja z izzivi steganografije glede zlonamerne programske opreme, shranjevanja in varovanja podatkov. Opiše tudi nekatere metode odkrivanja steganografskih datotek s pomočjo steganalize.

KLJUČNE BESEDE

Steganografija, digitalni mediji, vodni žig, steganaliza

ABSTRACT

Steganography is a scientific discipline, which deals with a secret exchange of information. Its primordial principle is concealment of communication, i.e. hiding the existence of forwarded information within a seemingly harmless medium or dataset. Contemporary steganography uses advantages of digital technology and most frequently includes hiding messages in some media files such as pictures, and sound or video files. Another goal of steganography is watermark, i.e. a process of signing digital media to protect the rights of intellectual property. The article presents use of different methods of hiding information and gives information on challenges of steganography regarding malicious software, storing and protecting data. Some methods of detecting steganographic files with the help of steganalysis.

KEYWORDS

Steganography, digital media, watermark, steganalysis

1 UVOD

Steganografija je postopek zakrivanja sporočil na način, da samo pošiljatelj in prejemnik poznata oz. razumeta vsebino sporočila. To omogoča eni strani, da komunicira z drugo stranjo, ne da bi se tretja oseba zavedala, da med njima poteka komunikacija. Podatki se običajno skrivajo v neškodljivem ovitku, tako da tudi če tretja oseba odkrije ovitek, ne more posumiti na podatke, ki se skrivajo znotraj ovitka. Če skrite podatke vendarle odkrije tretja oseba, je tehnika steganografije neuspešna.

Pri steganografiji gre za skrivanje sporočila v druge neškodljive vire informacij, kot so besedilo/dokumenti, avdio, video posnetki in slike, ki niso vidne nepooblaščenim uporabnikom. Lahko se skrije celotno particijo na trdem disku ali vdela podatke v razdelek glave datotek in omrežnih paketov. Učinkovitost teh metod je odvisna od tega, koliko podatkov lahko skrijejo in kako enostavno jih je zaznati.

Uporabljata se dva glavna cilja steganografije, in sicer skrivna komunikacija in vodni žig. Skrívnost komunikacije zajema veliko načinov zagotavljanja alternativnih rešitev za slike, avdio, video datoteke itd. Vodni žig je postopek podpisovanja digitalnih medijev (slik, besedil, avdio in videoposnetkov) z namenom varovanja pravic intelektualne lastnine. Vodni žig pomaga vstaviti prstni odtis, ki ga je mogoče prepoznati [1][2].

Steganografija je pogosto orodje različnih vrst kriminalcev, saj omogoča komunikacijo, ne da bi jo odkrili. Tipični primeri so komunikacija med terorističnimi celicami, razširjanje nezakonitega materiala, pridobivanje poslovnih skrívnosti ali njihova uporaba kot orodje za skrivanje zlonamerne programske opreme ali ukazov, ki daljinsko nadzorujejo zlonamerno programsko opremo. Steganografija je eno od pomembnih orodij vohunov in zlonamernih hekerjev ter borcev za človekove pravice in političnih disidentov. Zaradi svojega temeljnega načela "nevidnosti" informacij se pogosto uvršča med nezakonite dejavnosti.

Za odkrivanje steganografskih datotek uporabimo katero od metod steganalize, s pomočjo katerih je mogoče prepoznati in razkriti skrivna sporočila s preučevanjem variacij vzorčnih bitov in nenavadne velikosti datotek.
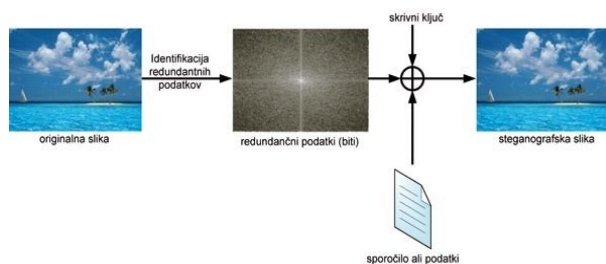
2 STEGANOGRAFIJA

Postopek steganografije običajno vključuje vstavljanje skrivnega sporočila v prenosni medij, ki se v tem primeru imenuje nosilec in ima vlogo prikrivanja skritega sporočila besedila, slike, zvoka ali video zapisa. Če želi pošiljatelj poslati skrivno sporočilo

prejemniku s pomočjo stegosistema, ga s steganografsko metodo vgradi skozi naslovni predmet. Postopek vdelave ustvari stego objekt. Pošiljatelj jasno pošlje stego objekt po omrežju, brez šifriranja, na primer s pomočjo spletne ali mobilne aplikacije. Na drugi strani mora prejemnik uporabiti isto steganografsko metodo, da izvleče skrivno sporočilo iz prejetega stego predmeta.

Za dodatno zaščito je možna tudi uporaba steganografskega ključa, ki kodira skrivno sporočilo, preden se ga vstavi v nosilec. V tem primeru mora imeti prejemnik enak steganografski ključ, kakršnega je uporabil pošiljatelj za izpis skrivnega sporočila [3]. Uporabo ključa v slikovni datoteki ponazarja slika 1.

Slika 1. Steganografski ključ v slikovni datoteki [4]

2.1 Uporaba steganografije

Kot številne druge varnostne metode in orodja se tudi steganografijo lahko uporablja na različnih področjih in dejavnostih.

Napredne strukture podatkov: Oblikujemo podatkovne strukture za prikrivanje nenačrtovanih informacij, ne da bi pri tem kršili združljivost s staro programsko opremo. Na primer, če potrebujemo dodatne informacije o fotografijah, jih lahko postavimo na fotografije. Informacije bodo potovale s fotografijami, vendar ne bo motila stare programske opreme, ki ne ve za njen obstoj. Poleg tega lahko oblikujemo napredne podatkovne strukture, ki nam omogočajo uporabo majhnih kosov trdih diskov za prikrivanje pomembnih informacij [5][6].

Medicinski posnetki: Bolnišnice in zdravniki lahko sestavijo kartoteke bolnikov, ki vsebujejo posnetke (slike) in njihove podatke. Ko zdravnik analizira radiološki pregled, se bolnikove informacije vtisnejo v sliko, kar zmanjša možnost napačne diagnoze in/ali goljufije. Pri vgradnji dodatnih podatkov v medicinske slike se zahteva izjemna previdnost: dodatne informacije ne smejo vplivati na kakovost slike [5][6].

Močni vodni žigi: Ustvarjalci digitalnih vsebin vedno uporabljajo tehnike za opisovanje omejitev, ki jih postavljajo na njihovo vsebino. Ta tehnika je lahko preprosto sporočilo "Leto avtorskih pravic s strani nekoga" in vsebuje sistem za upravljanje digitalnih pravic, ki ga je razvil Apple za trgovino iTunes, ali vodni žigi v vsebini vatikanske knjižnice [5][6][7].

Vojaške agencije: Dejanja vojakov lahko temeljijo na skritih in zaščitenih komunikacijah. Tudi s šifrirano vsebino zaznavanje signala na sodobnem bojišču lahko privede do hitre identifikacije in napada vpletenih strani v komunikacijo. Zaradi tega vojaška oprema v svojih komunikacijah uporablja modulacijo in tehnike razširjenega spektra [5][6].

Obveščevalne agencije: Pravosodne in obveščevalne agencije so zainteresirane za preučevanje teh tehnologij in prepoznavanje njihovih pomanjkljivosti, da lahko odkrijejo in spremljajo skrita sporočila [5][6].

Orodja za sledenje dokumentov: Skrite podatke lahko uporabimo za identifikacijo zakonitega lastnika dokumenta. Če je dokument spremenjen ali se ga distribuira nepooblaščenim strankam, ga lahko izsledimo in odkrijemo, katera stranka je prekršila pogodbo o distribuciji licence [5][6].

Avtentikacija dokumenta: Skriti podatki, zbrani v dokument, lahko vsebujejo digitalni podpis, ki potrjuje njegovo pristnost [5][6].

Splošna komunikacija: Ljudje so zainteresirani za te tehnike, ki zagotavljajo večjo varnost pri svojih vsakodnevnih komunikacijah. Internet, korporacije in elektronski pogovor se še vedno vidijo kot priložnost za nadzor [5][6].

Digitalne volitve in elektronski denar: Digitalne volitve in elektronski denar temeljijo na tajnih in anonimnih komunikacijskih tehnik [5][6].

Radarski sistemi: Sodobni tranzitni radarski sistemi lahko integrirajo informacije, zbrane v radarski bazni postaji, pri čemer se izognejo potrebi po pošiljanju ločenega besedila in slik na bazne postaje sprejemnika [5][6].

Daljinsko zaznavanje: Sestavimo lahko vektorske zemljevide in digitalne posnetke spletnega mesta, kar še izboljša analizo obdelovalnih površin [5].

2.2 Tehnike in metode steganografije

Predstavljamo nekaj pomembnih steganografskih metod in tehnik.

Prostorska domena: Steganografske tehnike prostorske domene, znane tudi kot nadomestne tehnike, na delih slike ustvarijo prikrit kanal, v katerem bodo spremembe verjetno nekoliko manjše in prikrite človeškim očem. Eden od načinov je skrivanje slikovnih podatkov v najmanj pomembnem bitu (LSB). Pri tej metodi se LSB vsakega bajta na sliki uporablja za shranjevanje tajnih podatkov. Pomanjkljivost te tehnike je, da je treba za sliko uporabiti vsak slikovni piksel v sliki, zato je za sliko treba uporabiti format stiskanja brez izgube, kot je bmp ali gif. Če uporabimo stiskanje izgube, se lahko nekateri skriti podatki izgubijo [6].

Preoblikovanje domene: To tehniko je mogoče opredeliti kot domeno tehnik vdelave, za katere je predlagano več algoritmov. Proces vdelave podatkov v frekvenčno domeno signala je veliko varnejši od principov vdelave, ki delujejo v časovni domeni. Tehnike preoblikovanja domen imajo prednost pred LSB tehnikami, ker skrivajo informacije na področjih slike, ki so manj izpostavljene stiskanju, obrezovanju in obdelavi slike [6].

Tehnika širjenja spektra: Prenos spektra v radijskih komunikacijah prenaša sporočila pod nivojem hrupa za katero koli frekvenco. Ko se uporablja za steganografijo, razpršeni spekter obravnava naslovno sliko kot hrup ali poskuša dodati slikovni psevdo hrup [8].

Statistična metoda: Te tehnike modulirajo ali spreminjajo statistične lastnosti slike, poleg tega, da jih ohranijo v postopku vdelave. Ta sprememba je običajno majhna, zato lahko izkoristi človeško šibkost pri zaznavanju spreminjanja svetlosti [8].

Tehnika izkrivljanja: Tehnike izkrivljanja zahtevajo poznavanje izvirne slike med postopkom dekodiranja, pri čemer dekoder preverja razlike med prvotno sliko in izkrivljeno sliko, da bi obnovil skrivno sporočilo. Prejemnik na drugi strani doda zaporedje sprememb slike. Informacije so torej opisane kot shranjene z izkrivljanjem signala [3][8].

Ukrep uspešnosti: Kot merilo učinkovitosti za popačenje slike zaradi vdelave se lahko za stego posnetke uporabi razmerje med najvišjim signalom in šumom (PSNR), ki je razvrščeno po meritvah izkrivljanja. Opredeljen je kot [5]:

$$PSNR = 10 \log_{10}\left(\frac{R^2}{MSE}\right)$$

V enačbi je R največje nihanje vrste podatkov vhodne slike. Na primer, če ima vhodna slika dvojno natančno vrsto podatkov s plavajočo vejico, potem je R 1. Če ima 8-bitno nepodpisan celoten podatkovni tip, je R 255 itd. MSE označuje povprečno kvadratno napako, ki je dan kot

$$MSE = \frac{\sum_{M,N}[I_1(m,n) - I_2(m,n)]^2}{M*N}$$

Indeks kakovosti strukturne podobnosti (SSIM) temelji na izračunavanju treh pojmov, in sicer izraza svetlilnosti, kontrastnega in strukturnega izraza. Celoten indeks je multiplikativna kombinacija treh pojmov [5].

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)(\sigma_x^2 + \sigma_y^2 + C_2)}$$

Skupne metode prikrivanja podatkov v digitalnih slikah vključujejo:

Maskiranje in filtriranje: Te metode skrivajo podatke na način, podoben vodnim žigom na papirju. To lahko storimo na primer s spreminjanjem svetlilnosti delov slike. Vidne lastnosti slike se sicer spreminjajo, vendar je popačenje komaj opazno. Ta metoda je glede na stiskanje veliko bolj robustna od modifikacije LSB, saj so informacije skrite na vidnih delih slike [5][9].

Transformacije: To je bolj zapleten način skrivanja informacij v sliki. Na sliki se uporabijo različni algoritmi in preobrazbe, da se v njej skrijejo informacije. DCT (Neposredna transformacija kosinusa) je ena takih metod. Ta algoritem stiskanja uporablja za pretvorbo zaporednih blokov slike 8 x 8 slikovnih pik v 64 koeficientov DCT. Orodja za steganografijo lahko uporabijo LSB kvantiziranega koeficienta DCT za skrivanje informacij. Poleg DCT lahko slike obdelujemo s hitro Fourierovo transformacijo in valutno transformacijo. Z drugimi lastnostmi slike, kot je svetlilnost, je mogoče manipulirati.

V prihodnosti bo najpomembnejša uporaba steganografskih tehnik verjetno na področju digitalnega vodnega označevanja za sledenje avtorskih pravic in lastništva elektronskih medijev. V organih pregona je tudi vedno večja zaskrbljenost glede uporabe steganografije za izmenjavo nezakonitega gradiva prek slik na spletnih straneh, zvočnih in drugih datotek [7].

2.3 Steganografija v digitalnih medijih

Glede na pojavnost v digitalnih medijih govorimo o steganografiji v besedilnih, slikovnih, avdio in video datotekah ter o mrežni steganografiji.

Steganografija v besedilnih datotekah: Skrivanje sporočil v besedilnih datotekah je najlažja in najstarejša tehnika, ki vključuje sprememba oblike obstoječega besedila, spreminjanje besed v besedilu in ustvarjanje naključnih zaporedij znakov.

Danes se jo uporablja s spreminjanjem postavitve dokumenta in dodajanjem dodatnih presledkov in z uporabo skritih znakov v besedilu. Pomanjkljivost besedilne steganografije je šibkost pred napadi. Dodane presledke, črte in znake je mogoče zlahka zaznati z odpiranjem besedila v urejevalniku besedil. Prikrito sporočilo bo izgubljeno, če bo dokument ponovno formatiran [8].

Besedilo lahko vstavimo v glasbene ali video datoteke tako, da datoteko namestimo na vnaprej določena mesta, tako da bo razlika ustrezala črki v abecedi. Slike imajo lahko več določenih slikovnih pik, glasbena datoteka nekaj vzorcev in video datoteko, nekateri okvirji se nekoliko spremenijo, v glavnem pa ohranijo svojo funkcionalnost nedotaknjeno. Spremembe so tako majhne, da je ob gledanju ali poslušanju gradiva težko opaziti dodano besedilno sporočilo [5][10][11].

Steganografija v slikovnih datotekah: Je najpogosteje uporabljena. Slikovni steganogrami so lahko krhki ali robustni glede na metodo, uporabljeno v slikovni datoteki. Slike enake velikosti lahko enostavno skrijemo v slikovne datoteke nosilca z uporabo zadnjih 2 ali 3 bitov vsake RGB vrednosti vsakega piksla vsebnika, kot da se dve sliki prekrivata, ena od njih pa je skoraj nevidna. Sprememba se nam na pogled zdi nespremenjena. "Skrito" sliko se pridobi s črtanjem, z uporabo določenega programa, bitov slike nosilca in povečanjem svetlosti [9][5].

Mrežna steganografija: Podatke lahko skrijemo v protokolu za nadzor omrežja, katerega se uporablja kot nosilec v omrežnih protokolih TCP, UDP ali ICMP. V modelu OSI obstajajo kanali, kamor s pomočjo steganografije lahko vstavimo skrivna sporočila v neporabljenih glavah TCP/IP paketa [8].

Avdio steganografija: Steganografijo z zvočnimi datotekami je težko zaznati, ker majhne spremembe v zvočni datoteki lahko zaznamo kot šum ali degradacijo, ki jo lahko povzroči postopek snemanja. Pri tej metodi je tajno sporočilo običajno skrito v zvočnem signalu, ki se spremeni v binarno zaporedje povezane zvočne datoteke. Vendar je to veliko težji način uporabe naslovnega predmeta kot steganografija slike in besedila. Ker so avdio in video datoteke večje velikosti, se dodatne prostore v njihovih glavah lahko uporabi tudi za vstavljanje skritih podatkov.

Slike lahko vstavimo v video datoteko tako, da zamenjamo okvir v videoposnetku ali dele slike na več določenih okvirih. Te slike si lahko ogledamo tako, da video posnetek zaustavimo ali predvajamo z večjo hitrostjo. Ko se videoposnetek predvaja z normalno hitrostjo, je sprememba tako majhna, da človeško oko ne zazna razlike [5][11].

Video steganografija: Je tehnika skrivanja vseh vrst datotek ali informacij v digitalni video format. Prednost te tehnike je velika količina podatkov, ki jo je mogoče skriti v notranjosti in dejstvo, da gre za gibljiv tok slik in zvokov. To si lahko predstavljamo kot kombinacijo slikovne stenografije in zvočne steganografije. Video kot kombinacijo slik se uporablja kot nosilec za skrite informacije. Diskretna kosinusna transformacija t.i. DCT spremeni vrednosti, npr. 8.667 do 9, v ta spremenjeni del se skrije podatke v vsaki od slik v videoposnetku, česar človeško oko ne opazi. Uporablja se formate H.264, Mp4, MPEG, AVI ali druge [8][11].

2.4 Značilnosti steganografskih datotek

V steganografiji mora sporočilo, ki je skrito znotraj datoteke, upoštevati nekatere od spodaj navedenih značilnosti.

Skrivanje zmogljivosti: Ta funkcija obravnava velikost informacij, ki jih je mogoče skriti znotraj naslovne datoteke. Večja zmogljivost skrivanja omogoča uporabo majhnega ovitka in tako zmanjša širino pasu, ki je potrebna za prenos stego-medijev. Na primer, če imamo RGB sliko velikosti 200 x 200 slikovnih pik, to pomeni, da imamo 120.000 barvnih vrednosti, ki jih je treba uporabiti kot naslovnice skrivnega sporočila (200: širina x 200: višina x 3: R, G , B). Če za skrivanje sporočila uporabimo samo en bit po barvnem kanalu, imamo kapaciteto skrivanja 120.000 bitov ali 15.000 bajtov, če za skrivanje sporočila uporabimo 2 bita na barvni kanal, imamo 30.000 bajtov, če pa uporabimo samo en barvni kanal in en bit na piksel, bo zmogljivost skrivanja 40.000 bitov ali 5.000 bajtov.

Zaznavna preglednost: Zaznavna preglednost je pomembna značilnost steganografije. Vsak medij ima določene podatke za skrivanje informacij. Če se v ovitku skriva več informacij ali podatkov, potem to povzroči razkroj medija. Kot rezultat so stego-mediji in naslovnice na videz drugačni. Če napadalec opazi to izkrivljanje, potem naša steganografska tehnika ne uspe in obstaja možnost, da napadalec razkrije ali poškoduje naše izvirno sporočilo.

Robustnost: Robustnost je zmožnost skritega sporočila, da ostane nepoškodovano, tudi če je stego-medij podvržen transformaciji, ostrenju, linearnemu in nelinearnemu filtriranju, skaliranju in zamegljevanju, obrezovanju ter različnim drugim tehnikam.

Odpornost na nedovoljene posege: Od vseh lastnosti je ta funkcija skoraj najpomembnejša. Če je napadalec uspel uničiti steganografsko tehniko, potem lastnost odpornosti proti napadalcem otežuje spreminjanje ali poškodovanje izvirnih podatkov.

3 VODNI ŽIG

Vodni žig je postopek podpisovanja digitalnih medijev (slik, besedil, avdio in videoposnetkov) z namenom varovanja pravic intelektualne lastnine. Vodni žig pomaga vstaviti prstni odtis, ki ga je mogoče prepoznati [8].

Digitalni vodni žig temelji na vstavljanju dodatnih informacij v izvirno datoteko (imetnik) na način, da se kakovost nosilca ne spremeni do te mere, da bi postalo opazno dodajanje žiga [1][9].

3.1 Uporaba vodnega žiga

Danes se vodni žig uporablja za naslednje namene:

Varovanje avtorskih pravic: Onemogoči krajo lastništva digitalne multimedije. Pomembno je, da žiga ne moremo odstraniti nepooblaščeno in je odporen različnim spremembam nosilnega signala [7].

Zaščita pred kopiranjem: Nadzira naprave za kopiranje podatkov in preprečuje kopiranje zaščitene večpredstavnostne vsebine.

Avtentikacija: Avtentikacija večpredstavnostnih vsebin doda žig po celotnem nosilnem signalu.

Shranjevanje dodatnih informacij: Dodajanje podatkov, ki lahko služijo kot zapiski z večpredstavnostnimi datotekami. Uporablja se posebne metode dodajanja žiga, ki podpirajo shranjevanje večjega nabora podatkov, hkrati pa ohranjajo združljivost s starejšimi brskalniki medijev.

Vodni žig se vstavi neposredno v datoteko, po navadi z rahlimi nihanji svetlosti slikovnih pik. Te spremembe so zelo subtilne in jih človeško oko ne vidi. Vzorci večkrat omogočijo obnovitev vodnega žiga, tudi če odstranimo dele večpredstavnostne datoteke. Nekateri vodni žigi lahko preživijo tudi po omejenem številu urejanj večpredstavnostne datoteke, ki vključuje spreminjanje kontrasta in filtriranje.

3.2 Testiranje in izboljšanje vstavljanja vodnega žiga

Za testiranje in izboljšanje tehnik vstavljanja vodnih žigov je bilo razvitih več metod za napad ali razbijanje le-tega: uničenje vodnega žiga (napadi robustnosti), onemogočanje odkrivanje predstavitvenih napadov, ponarejanje vodnih žigov, interpretacijski napadi, izkoriščanje pravnih napak.

Uničenje vodnega žiga: Način uničenja vodnega žiga temelji na poskusu odstranitve vodnega žiga brez poškodbe večpredstavnostne datoteke. Poznamo dve skupini takšnih napadov: obdelavo signalov ter analitične in algoritmične napade. V prvo skupino spadajo skupne operacije obdelave večpredstavnostnih datotek, kot so stiskanje, filtriranje, spreminjanje velikosti, tiskanje in skeniranje. Druga skupina temelji na odstranitvi ali oslabitvi vodnega žiga z uporabo posebne metode vstavljanja in odkrivanja vodnega tesnila. Primer takega napada je generiranje nove večpredstavnostne datoteke s kombiniranjem različnih variant iste datoteke z vodnim žigom. Na takšen način se zmanjšuje moč vodnega žiga.

Onemogočenje odkrivanja vodnih žigov: Za preprečitev zaznave vodnega žiga se uporablja različne tehnike manipulacije z vsebino tesnila, vendar tako, da žig ni odstranjen. Primeri takih napadov vključujejo spreminjanje lokacije vodnega žiga v večpredstavnostne datoteke, njihovo vrtenje ali spreminjanje velikosti.

Ponarejanje vodnih žigov: Ti napadi temeljijo na napačnih ali večkratnih interpretacijah vodnega žiga. Napadalec lahko na primer poskuša v ciljno večpredstavnostno datoteko vstaviti dodaten vodni žig, ki je enake trdnosti kot originalni vodni pečat. Na ta način je nemogoče nedvoumno in pravilno določiti lastništvo datoteke.

Izkoriščanje pravnih napak: Takšni napadi lahko izzovejo vodni žig z izkoriščanjem možnih napak v naslednje komponente: pravna zakonodaja v zvezi z varstvom avtorskih pravic in lastništva digitalne informacije, verodostojnost lastnikov in napadalcev, finančna lastništva lastnikov in napadalci, izvedenci in odvetniške pristojnosti.

4 STEGANALIZA

Steganaliza je postopek odkrivanja steganografskih datotek, ki temelji na preučevanju variacij vzorčnih bitov in nenavadno velikih datotek. Steganaliza bi bila lahko preprosto opredeljena kot odkrivanje steganografije s strani tretje osebe. To poteka na različne načine in običajno temelji na tem, koliko je predhodnih informacij na voljo. Ali ima analitik dostop do vseh medijev in algoritmov, bo to močno vplivalo na metodo, ki jo uporablja.

Cilji steganalize so med drugim, da prepoznamo sumljive nize podatkov, na primer signalov ali datotek, znotraj katerih je potencialno skrivno sporočilo. Določiti je potrebno, ali so bili tajni podatki šifrirani v steganografski datoteki. Prav tako je

potrebno ugotoviti obstoj hrupa ali nepomembnih informacij znotraj domnevnega signala ali datoteke. Iz steganografske datoteke moramo izvleči in dešifrirati vstavljeno sporočilo.

Za razliko od kriptoanalize, pri kateri je očitno, da šifrirani podatki vsebujejo sporočilo, se steganaliza po navadi začne z nekaj sumljivimi zbirkami podatkov, od katerih nobeden ni skrivno sporočilo. Z uporabo različnih naprednih metod statistične analize steganalizator zmanjša nabor sumljivih informacij, dokler ne najde prave steganografske datoteke. Informacije je mogoče skriti skoraj povsod na internetu in zato postopek precej otežujejo steganalizo.

4.1 Odkrivanje steganografije

Steganaliza je učinkovita, kadar vemo, kje iskati skrivne informacije, in/ali znamo prepoznati posamezne napade.

Mesta skrivnih informacij: Ena možnost je besedilo, ki je lahko skrito znotraj strani, če je enake barve kot ozadje.

Tudi majhne razlike v prostorski razporeditvi besed in črt vsebujejo tajne podatke.

Nebesedilni elementi, kot so slike, avdio ali video datoteke, na strani lahko vsebujejo skrite povezave ali sporočila. Povezave so lahko skrite s spremenjenim videzom. Na primer besedilo ni poudarjeno ali ne spremeni barve ali oblike, ko gremo z miško nad njim. Najlažje najdemo skrite povezave na strani z iskalnim nizom "HREF =" znotraj HTML-ja spletne strani. S pritiskom na tipko Tab se aktivirajo tudi povezave [10].

Komentarji so lahko prav tako priročen kraj za skrivanje tajnih podatkov, ker je vsebina komentarjev vidna samo v kodi HTML. Mnogi spletni brskalniki ignorirajo informacije v HTML, ki jih ne morejo razlagati. Tako lahko na primer nenavadni strukturni elementi znotraj oznak HTML vsebujejo tajne podatke [10].

Informacije se lahko skrije tudi v kodo HTML vsakega okvira strani.

Oblike staganografskih napadov: Prepoznavanje oblik staganografskih napadov je lahko učinkovito za izvedbo steganalize. Lahko imamo na primer opraviti z napadom znanega nosilca, pri katerem znana izvirna datoteka vsebuje skrivno sporočilo. V steganografski datoteki je včasih možno prepoznati steganografsko orodje, torej algoritem, ki je bil uporabljen za vstavljanje skrivnega sporočila.

4.2 Osnovne tehnike steganalize

Analiza skritih podatkov vključuje različne dejavnosti: odkrivanje, črpanje ter onemogočanje ali uničevanje skritih informacij.

Skrivanje informacij znotraj digitalnega medija povzroči spremembe v značilnostih tega medija, na primer z neko obliko degradacije ali druge nenavadne lastnosti. Preglejmo nekatere najbolj priljubljene tehnike steganalize.

Nenavadni vzorci: Nenavadni vzorci v steganografskih datotekah pomenijo, da je znotraj njih morda skrito sporočilo. Z različnimi orodji in tehnikami je mogoče prepoznati te vzorce. Če želimo najti skrite podatke v neuporabljenih particijah, lahko uporabimo različne filtre za prepoznavanje paketov TCP/IP, ki vsebujejo skrite ali napačne podatke. S pregledom besedila v urejevalniku besedila lahko najdemo majhne nepravilnosti pri umeščanju besed in vrstic ali prevelike razmike, ki pomenijo

obstoj skritega sporočila. Slike lahko vsebujejo izkrivljanja in spremembe v barvi in svetilnosti[9].

Ponavljajoči se vzorci: Z analizo ponavljajočih se vzorcev je mogoče prepoznati uporabljeno steganografsko orodje ali skrite informacije. Preskušanje vzorcev se opravi s primerjanjem originalnega steganografskega nosilca s steganografsko datoteko, ki vsebuje skrito sporočilo [9].

Primerjava steganografskih datotek: S primerjavo različnih steganografskih datotek je mogoče najti vzorce, ki predstavljajo podpis oz. specifično steganografsko orodje. Zaznavanje takšnih podpisov je mogoče z uporabo posebnih avtomatiziranih orodij za iskanje pikslov, ki odstopajo od neke standardne vrednosti v določenem razdelku slik [9].

Dopolnitev ali rezanje: Slika, izdelana z nekaterimi orodji za steganografijo, ne ustreza nekaterim fiksnim velikostim, zato jo je potrebno rezati ali dopolniti s črnimi površinami. Možnost vdelanega sporočila v sliko nakazujejo tudi razlike v velikosti steganografske datoteke ter nenavadno veliko ali majhno število edinstvenih barv znotraj palete slik [9].

5 ZAKLJUČEK

Steganografija je prikrita izmenjava informacij, pri kateri samo pošiljatelj in prejemnik razumeta vsebino posredovanega sporočila. Glavna cilja steganografije sta skrivna komunikacija in vodni žig. Skrívnost komunikacije zajema zagotavljanje alternativnih rešitev za besedilne in medijske datoteke. Vodni žig je postopek podpisovanja digitalnih medijev namenom varovanja pravic intelektualne lastnine. Za dodatno zaščito je možna tudi uporaba steganografskega ključa, ki kodira skrivno sporočilo, preden se ga vstavi v nosilec.

Steganografija omogoča komunikacijo, ne da bi jo odkrili. Zaradi svojega temeljnega načela "nevidnosti" informacij se pogosto uvršča med nezakonite dejavnosti. Kot varnostno metodo pa se jo lahko uporablja tudi na različnih povsem legalnih področjih in dejavnostih, kot so: strukturiranje podatkov, medicinski posnetki, močni vodni žigi, vojaške aktivnosti, sledenje in avtentikacija dokumentov, volitve in elektronski denar, radarski sistemi in daljinsko zaznavanje. Vsem pa je skupno vsebovanje skrivnega sporočila za različne namene.

Glede na pojavnost v digitalnih medijih govorimo o steganografiji v besedilnih, slikovnih, avdio in video datotekah ter o mrežni steganografiji. Med pomembnimi staganografskimi tehnikami in metodami so: prostorska domena, preoblikovanje domene, širjenje spektra, statistična metoda, ukrep uspešnosti, tehnika izkrivljanja, maksiranje in filtriranje ter transformacije.

V steganografiji mora v datoteki ali mediju skrito sporočilo upoštevati določene značilnosti, na primer zmogljivost skrivanja glede na velikost informacij, zaznavno preglednost, odpornost na nedovoljene posege in robustnost oz. zmožnost skritega sporočila, da ostane nepoškodovano.

Steganaliza ponuja učinkovite metode za uspešno zaznavanje in preprečevanje skritih informacij, zlasti v kriminalnih dejavnostih. Skrivanje informacij znotraj digitalnega medija povzroči spremembe v značilnostih tega medija. Steganaliza z opazovanjem in prepoznavanjem teh sprememb omogoča zaščito pred skrito komunikacijo.

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Varnost informacijskih sistemov

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POVZETEK

Računalniki in druge digitalne naprave so postale bistvenega pomena za poslovanje, izobraževanje, trgovino itd., vendar postajajo tudi vedno bolj tarča napadov. Da lahko podjetje ali posameznik zaupno uporablja računalniško napravo, je potrebno najprej zagotoviti, da naprava na kakršen koli način ni ogrožena in da bodo vse komunikacije varne. Pričujoči članek prinaša pregled temeljnih načel varnosti informacijskih sistemov kot tudi poglobljen pregled nekaterih orodjih in ukrepov, ki jih je mogoče sprejeti za ublažitev varnostnih groženj in izboljšanje varnosti v organizacijah, ter opisuje pomembnost varnosti mobilnih naprav in osebnih podatkov.

KLJUČNE BESEDE

Informacijska varnost, orodja za varnost informacij, mobilna varnost, varnost osebnih podatkov

ABSTRACT

Computers and other digital devices have become essential for business, education, trade etc., however, they are also becoming targets of attacks. To enable a company or an individual to use a computer device confidentially, it must be assured first, that the device is not endangered in any way and that all communications are safe. This paper brings an overview of basic principles of safety of information systems, a comprehensive overview of some tools and measures, which can be taken to palliate safety threats and to improve safety in organizations, and it describes the importance of safety of mobile devices and personal data.

KEYWORDS

Information safety, tools for information safety, mobile safety, safety of personal data

1 TEMELJNA NAČELA INFORMACIJSKE VARNOSTI

Vse postopke zagotavljanja varnosti in preprečevanja različnih tveganj lahko združimo v pojem varnost informacijskih sistemov. Dobri postopki za zagotavljanje varnosti informacijskih sistemov skušajo preprečiti nevarnosti in ranljivosti znotraj in zunaj organizacije ali podjetja. Sestavljati jih morajo procesi in načrti za zagotavljanje temeljnih načel varnosti, ki so zaupnost, celovitost in razpoložljivost.

1.1 Zaupnost

Pri zaščiti informacij želimo omejiti dostop do zaupnih informacij le na pooblaščene uporabnike, ki jim je le-ta dovoljen; vsi drugi ne bi smeli ničesar vedeti o vsebini informacij, kar je bistvo zaupnosti. Ukrepe za zaščito zaupnih informacij je treba sprejeti glede na pomembnost podatkov. Večja kot je pomembnost podatkov, večje je tveganje. Za varovanje zaupnosti informacij pred kibernetskimi napadi se lahko uporablja različne metode: šifriranje podatkov, biometrično preverjanje, uporaba močnega ID-ja uporabnika in gesla ter ozaveščenost uporabnikov [1].

Včasih varnostna zaupnost vključuje posebne treninge za osebe, ki imajo dostop do občutljivih dokumentov. Takšni treningi zajemajo seznanitev s tipičnimi varnostnimi tveganji, ki lahko ogrožajo informacije, ter možnostmi zaščite pred tveganji. Uporabniki pridobijo tudi znanje o kreiranju gesel in se naučijo preprečevati neupoštevanje pravil glede ravnanja s podatki, ki bi ga sicer zagrešili ponevedoma in z dobrimi nameni, a bi lahko imelo katastrofalne posledice [2].

1.2 Celovitost

Celovitost pomeni zaščito informacij in podatkov na spletu pred spreminjanjem kibernetskih kriminalcev in zagotavlja doslednost in točnost informacij v omrežju. Celovitost informacij in podatkov v kibernetskem prostoru je mogoče ohraniti z ustreznimi koraki, kot so dovoljenja do datotek, nadzor dostopa uporabnikov in digitalni podpis. Celovitost je zagotovilo, da informacije, do katerih dostopamo, niso bile spremenjene.

Informacijska integriteta tudi pomeni, da informacija resnično predstavlja njen predvideni pomen. Informacije lahko izgubijo svojo integriteto s škodljivimi namerami, na primer, ko nepooblaščena oseba izvede spremembo. Integriteto se lahko izgubi tudi nenamerno, na primer, ko računalnik zaradi napajanja poškoduje datoteko ali nekdo, ki je sicer pooblaščen za spremembo, pomotoma izbriše datoteko ali vnese napačne podatke [3].

1.3 Razpoložljivost

Tretje temeljno načelo informacijske varnosti je razpoložljivost. Razpoložljivost je varnostna politika, ki zagotavlja, da lahko

vsak posameznik, zaposlen v organizaciji (javni ali zasebni), s pooblaščenim dostopom uporablja informacije in podatke na spletu v skladu z določeno stopnjo dostopa, potrjeno s strani organizacije. Razpoložljivost pomeni, da lahko do informacij dostopajo in jih spreminjajo vsi, ki so za to pooblaščeni, v ustreznem časovnem okviru. Ustrezen časovni okvir lahko glede na vrsto informacij pomeni različno. Podjetja, kot je Amazon.com, bodo zahtevala, da bodo njihovi strežniki na voljo štiriindvajset ur na dan, sedem dni v tednu. Druga podjetja morda ne bodo nezadovoljna, če njihovi spletni strežniki nekajkrat na leto ne bodo dosegljivi [1].

2 ORODJA ZA VARNOST INFORMACIJ

Za zagotovitev zaupnosti, celovitosti in razpoložljivosti informacij lahko organizacije izbirajo med različnimi orodji. Vsako od teh orodij je mogoče uporabiti kot del splošne politike informacijske varnosti, ki bo obravnavana v ndaljevanju.

2.1 Preverjanje pristnosti

Orodja za preverjanje pristnosti se uporabljajo za zagotovitev, da je oseba, ki dostopa do informacij, dejansko tista, za katero se predstavlja.

Preverjanje pristnosti je mogoče doseči z identifikacijo uporabnika po treh dejavnikih: nekaj, kar vedo; nekaj, kar imajo; ali nekaj, kar so. Najpogostejša oblika overjanja je ID uporabnika in geslo. V tem primeru se avtentikacija opravi s potrditvijo nečesa, kar uporabnik pozna (svojo ID in geslo). Toda to obliko overjanja je mogoče enostavno zlomiti in včasih so potrebne močnejše oblike avtentikacije. Identificirati nekoga samo po nečem, kar imajo, na primer ključu ali kartici, je lahko tudi problematično. Če se identifikacijski žeton izgubi ali ukrade, se identiteto uporabnika zlahka zlorabi. Končni dejavnik, to je nekaj, kar nekdo je, je veliko težje zlomiti. Ta dejavnik prepozna uporabnika na podlagi fizičnih lastnosti, kot sta skeniranje oči ali prstni odtis. Prepoznavanje nekoga po njihovih fizičnih lastnostih se imenuje biometrija.

Varnejši način za preverjanje pristnosti uporabnika je preverjanje pristnosti z več faktorji. Če združimo dva ali več predhodno naštetih dejavnikov, postane vdor v sistem težji. Primer večfaktorske zaščite je uporaba žetona RSA SecurID, ki ustvarja novo kodo za dostop vsakih šestdeset sekund. Če se želimo prijaviti v informacijski vir s pomočjo naprave RSA, združimo štirimestno kodo PIN (nekaj, kar vemo) s kodo, ki jo ustvari naprava. Edini način pravilne avtentifikacije je tako poznavanje kode kot tudi naprave RSA (slika 1).

Slika 1. Žeton RSA SecurID [4]

2.2 Nadzor dostopa

Ko je uporabnik overjen, je naslednji korak zagotoviti, da lahko dostopa le do tistih informacijskih virov, za katere je overjen s strani organizacije. To se izvede z uporabo nadzora dostopa, ki določa, kateri uporabniki so pooblaščeni za branje, spreminjanje, dodajanje in/ali brisanje informacij. Obstaja več različnih modelov nadzora dostopa. Najpomembnejša sta seznam nadzora

dostopa (ACL) in nadzor dostopa na podlagi vlog (RBAC) (slika 2).

Za vsak vir informacij, ki ga organizacija želi upravljati, se lahko ustvari seznam uporabnikov, ki lahko izvajajo določena dejanja, ki jih imenujemo seznam za nadzor dostopa ali ACL. Za vsakega uporabnika so dodeljene posebne pravice dostopa, kot so branje, pisanje, brisanje ali dodajanje. Samo uporabniki s temi pravicami lahko izvajajo željene funkcije.

ACL-ji so preprosti za razumevanje in vzdrževanje, vendar pa imajo več pomanjkljivosti. Primarna pomanjkljivost je, da se z vsakim informacijskim virom upravlja ločeno. Ko se število uporabnikov in virov povečuje, je ACL težje vzdrževati. To je privedlo do izboljšane metode nadzora dostopa, ki se imenuje nadzor dostopa na podlagi vlog ali RBAC. RBAC namesto dajanja določenih pravic uporabnikom za dostop do vira informacij najprej dodeli vloge uporabnikom in jim nato dodeli dovoljen dostop. To omogoča administratorjem, da ločeno upravljajo z uporabniki in vlogami, kar poenostavlja administracijo in izboljša varnost.
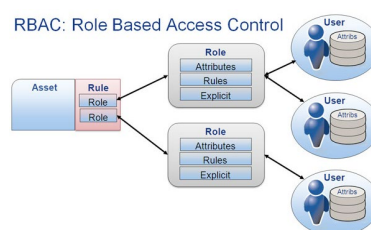
Slika 2. Nadzor dostopa na podlagi vlog [5]

2.3 Šifriranje

Organizacija mora večkrat prenašati informacije po spletu ali jih prenesti na zunanje medije, kot sta DVD ali bliskovni pogon. V teh primerih bi lahko tudi s pravilno avtentifikacijo in nadzorom nepooblaščena oseba dostopala do podatkov, zato je priporočljivo šifriranje. Šifriranje je postopek kodiranja podatkov ob njegovem prenosu ali shranjevanju, tako da jih lahko preberejo samo pooblaščeni posamezniki. Kodiranje opravi računalniški program, ki kodira navadno besedilo, ki ga je treba prenesti; nato prejemnik prejme šifrirano besedilo in ga dešifrira. Da bi to delovalo, se morata pošiljatelj in prejemnik dogovoriti o načinu kodiranja, da lahko obe strani pravilno komunicirata. Obe strani si delita šifrirni ključ, ki jima omogoča, da drug drugemu zakodirata in dekodirata sporočila. Temu rečemo simetrično šifriranje. Ta vrsta šifriranja je problematična, ker je ključ na voljo na dveh različnih mestih.

Namesto simetričnega šifriranja se uporablja asimetrično šifriranje, pri katerem se uporabljata dva ključa: javni in zasebni ključ. Če želimo poslati šifrirano sporočilo, pridobimo javni ključ, ga kodiramo in pošljemo. Prejemnik nato zasebni ključ uporabi za dekodiranje. Javni ključ lahko prejme vsak, ki želi prejemniku poslati sporočilo. Vsak uporabnik potrebuje en zasebni in en javni ključ za zaščito sporočil. Zasebni ključ je potreben za dešifriranje nečesa, kar je poslano z javnim ključem.

2.4 Varnost z geslom

Uporaba preprostega uporabniškega ID-ja/gesla ne velja za varen način preverjanja pristnosti, saj je enofaktorsko preverjanje pristnosti izredno enostavno zlomiti. Za zagotovitev, da gesla ne morejo biti ogrožena, je treba sprejeti dobro varnostno politiko o

geslih. V nadaljevanju je nekaj pogostejših politik, ki bi jih morale sprejeti organizacije.

Zapletenost gesla

Eden od razlogov, da so gesla ogrožena je, da jih je mogoče enostavno uganiti. Nedavna raziskava je pokazala, da so prva tri gesla, ki so jih uporabniki uporabljali v letu 2020 gesla, 123456, 12345678 in password [6]. Geslo ne sme biti preprosto ali beseda, ki jo je mogoče najti v slovarju. Ena prvih stvari, ki jo bo naredil heker je, da bo poskusil zlomiti geslo s preizkušanjem vsakega izraza v slovarju. Namesto tega je dober pravilnik o geslih tisti, ki zahteva uporabo najmanj osmih znakov in vsaj ene velike črke, enega posebnega znaka in ene številke.

Redno menjanje gesla

Bistveno je, da uporabniki redno spreminjajo gesla. Uporabniki bi morali spremeniti gesla vsakih šestdeset do devetdeset dni, s čimer bi zagotovili, da nobenega gesla, ki je bilo ukradeno ali uganjeno, ni mogoče uporabiti.

Nedeljenje gesel

Usposobiti je potrebno zaposlene, da ne bodo delili gesel. Ena od glavnih metod napadalcev za krajo gesel je, da jih preprosto razberejo tako, da povprašajo uporabnike ali skrbnike. Pred vdorom napadalec pokliče službo za pomoč ali skrbnika sistema in se pretvarja, da je pooblaščeni uporabnik, ki ima težave pri prijavi. Nato napadalec z zagotavljanjem osebnih podatkov o pooblaščenem uporabniku prepriča varnostno osebo, da ponastavi geslo. Drug način, da napadalec pride do gesla je lažno predstavljanje po e-pošti. Do lažnega predstavljanja pride, ko uporabnik prejme e-pošto, ki je videti, kot da je iz zaupanja vrednega vira, na primer njihove banke ali od delodajalca. V e-pošti uporabnika prosi, da klikne povezavo in se prijavi na spletno mesto, ki posnema pristno spletno mesto in vnese njegovo ID in geslo, ki jih napadalec nato zajame. Zelo pomembno je tudi, da gesel ne hranimo zapisanih na dostopnih ali vidnih mestih, raje iznajdemo način, kako si bomo svoje geslo lažje zapomnili (Glej poglavje 2.10).

Slika 3 povzema neka načela za kreiranje močnih in varnih gesel. Podobno sliko bi lahko priporočili vsakemu uporabniku, da si jo namesti na vidno mesto ob svojem računalniku.

Slika 3. Načela kreiranja močnih gesel [7]

2.5 Varnostne kopije

Orodje, bistvenega pomena za varnost informacij, je celovit rezervni načrt varnostnega kopiranja podatkov za celotno organizacijo. Ne samo, da je treba varnostno kopirati podatke na podjetniških strežnikih, ampak bi morala obstajati tudi varnostna kopija posameznih računalnikov, ki se uporabljajo v celotni organizaciji. Dober rezervni načrt mora biti sestavljen iz več komponent, ki jih navajamo spodaj.

Popolno razumevanje organizacijskih informacijskih virov

Kakšne podatke organizacija dejansko ima? Kje so shranjeni? Nekateri podatki so lahko shranjeni na strežnikih organizacije, drugi podatki na uporabnikovih trdih diskih, nekateri v oblaku in nekateri na drugih spletnih mestih. Organizacija mora narediti popoln seznam vseh informacij, ki jih je treba varnostno kopirati in določiti najboljši način za njihovo varnostno kopijo.

Redno varnostno kopiranje vseh podatkov

Pogostost kopiranja varnostnih kopij mora temeljiti na tem, kako pomembni so podatki za podjetje, skupaj z zmožnostjo podjetja, da nadomesti vse izgubljene podatke. Kritične podatke je treba varnostno kopirati najmanj enkrat na dan, manj kritične podatke pa bi bilo mogoče varnostno kopirati najmanj enkrat na teden.

Shranjevanje rezervnih nizov podatkov izven organizacije

Če so vsi varnostni podatki shranjujejo v istem objektu kot izvirne kopije podatkov, bi en sam dogodek, na primer potres, požar ali tornado, uničil tako originalne podatke kot varnostno kopijo! Bistveno je, da je rezervna kopija shranjena na drugi lokaciji.

Test obnovitve podatkov

Redno je treba varnostne kopije preizkusiti tako, da se nekateri podatki obnovijo. To bo zagotovilo, da bo postopek deloval in bo zagotovilo zaupanje organizacije v rezervni načrt.

Organizacije bi morale preučiti svoje delovanje, da ugotovijo, kakšen učinek bi imeli izpadi oz. izguba podatkov za poslovanje, če njihova informacijska tehnologija ne bi bila na voljo za dolgo obdobje in kako bi to vplivalo na njihovo poslovanje.

Dodatni pojmi, povezani z varnostnim kopiranjem so: naprave za neprekinjeno napajanje (UPS) in nadomestna spletna mesta.

Za primere izpada električne napetosti so v sistemskem prostoru nameščene naprave za neprekinjeno napajanje (UPS). To so baterije, ki s pomočjo inteligentne elektronike v primeru električnih izpadov varno izključijo strežnike. V nasprotnem primeru bi prišlo zaradi prehodnega pojava izpada napetosti do nepredvidljivih napak na podatkih ali strežniški opremi (diskovnih enotah, napajalnikih ipd.).

Nekatere organizacije se odločijo za nadomestno spletno mesto, kjer je vedno posodobljena natančna kopija njihovih kritičnih podatkov. Ko primarno spletno mesto odpade, se nadomestno spletno mesto nemudoma prikaže na spletu, tako da je izpadov malo ali nič.

Ker so informacije postale strateška prednost, se je celotna industrija razvila okoli tehnologij, potrebnih za izvajanje ustrezne varnostne strategije. Podjetje lahko sklene pogodbo s ponudnikom storitev, da ustvari varnostno kopijo vseh njihovih podatkov ali pa kupi velike količine spletnega prostora za shranjevanje in to stori sam. Tehnologije, kot so omrežja skladiščnih prostorov in arhivski sistemi, zdaj uporablja večina velikih podjetij.

Grafikon na sliki 4 prikazuje najpomembnejše razloge za izgubo podatkov, ki naj vsakega uporabnika motivirajo za to, da redno in preudarjeno varnostno kopiranje podatkov.

Slika 4. Razlogi za izgubo podatkov [8]

2.6 Požarni zidovi

Metoda, ki jo mora organizacija uporabiti za povečanje varnosti v svojem omrežju, je tudi požarni zid. Požarni zid je kot strojna ali programska oprema (ali oboje). Strojni požarni zid je naprava, ki je povezana z omrežjem in filtrira pakete na podlagi nabora pravil. Programski požarni zid deluje v operacijskem sistemu in prestreže pakete, ko prispejo do računalnika. Požarni zid zaščiti vse strežnike in računalnike podjetja tako, da ustavi pakete zunaj omrežja organizacije, ki ne ustrezajo strogim naborom kriterijev. Požarni zid je lahko konfiguriran tudi tako, da omeji pretok paketov, ki zapustijo organizacijo.

Nekatere organizacije se lahko odločijo za uporabo več požarnih zidov kot del svoje varnostne konfiguracije omrežja, tako da ustvarijo en ali več odsekov svojega omrežja, ki so delno zavarovani. Ta segment omrežja se imenuje DMZ, na njem organizacija razpolaga z viri, ki potrebujejo širši dostop, vendar jih je še vedno treba zavarovati.

2.7 Sistemi za zaznavanje vdorov

Sistem, ki ga je mogoče zaradi varnosti postaviti v omrežje, je sistem za zaznavanje vdorov ali IDS (Intrusion Detection System). IDS ne dodaja dodatne varnosti; namesto tega ponuja funkcijo za prepoznavanje, ali je omrežje napadeno. IDS je mogoče konfigurirati za spremljanje določenih vrst dejavnosti in nato opozoriti varnostno osebje, če se ta dejavnost pojavi. IDS prav tako lahko pozneje zabeleži različne vrste prometa v omrežju za analizo. IDS je bistven del vsake dobre varnostne nastavitve.

2.8 Navidezna zasebna omrežja

Z uporabo požarnih zidov in drugih varnostnih tehnologij lahko organizacije učinkovito zaščitijo številne svoje informacijske vire, tako da postanejo nevidne za zunanji svet. Če zaposleni, ki dela od doma, zahteva dostop do nekaterih teh virov ali če je najet svetovalec, ki mora delati v internem podjetniškem omrežju z oddaljene lokacije, se uporablja navidezno zasebno omrežje ali VPN (Virtual Private Network).

VPN je razširitev podjetniškega zasebnega intraneta prek javnih omrežij, kot je splet, z gradnjo varnih zasebnih povezav in skozi zasebne tunele. VPN omogoča varno sporočanje informacij prek spleta s povezovanjem oddaljenih uporabnikov, poslovalnic in poslovnih partnerjev v razširjeno skupno privatno omrežje. S kombinacijo programske opreme in dodatnih varnostnih ukrepov omogoča organizaciji omejen dostop do svojih omrežij in hkrati zagotavlja splošno varnost.

2.9 Fizična varnost

Organizacija lahko izvaja najboljšo shemo za preverjanje pristnosti tako da, razvije najboljši nadzor dostopa in namesti požarne zidove in omogoča preprečevanje vdorov, vendar njena varnost ne more biti popolna brez izvajanja fizične varnosti. Fizična varnost je zaščita dejanskih strojnih in mrežnih komponent, ki shranjujejo in prenašajo informacijske vire. Za izvajanje fizične varnosti mora organizacija prepoznati vse ranljive vire in sprejeti ukrepe za zagotovitev, da teh virov ni mogoče fizično posegati ali ukrasti. Najpomembnejše ukrepe navajamo v nadaljevanju.

Zaklenjena vrata
Vsa varnost je neuporabna, če lahko vsiljivec preprosto vstopi v računalnik in fizično odstrani varovanje računalniške naprave. Podatke z informacijami visoke vrednosti bi bilo treba zavarovati na lokaciji z omejenim dostopom.

Zaznavanje fizičnega vdora
Sredstva z informacijami z visoko vrednostjo je treba spremljati z uporabo varnostnih kamer in drugih sredstev za odkrivanje nepooblaščenega dostopa do fizičnih lokacij, kjer obstajajo.

Zavarovana oprema
Naprave je treba zakleniti, da se prepreči, da bi jih ukradli. Trdi disk enega zaposlenega lahko vsebuje vse podatke o stranki, zato je nujno, da je zavarovan.

Spremljanje okolja
Strežniki organizacije in druga oprema z visoko vrednostjo morajo biti vedno shranjeni v prostoru, v katerem se spremlja temperatura, vlaga in pretok zraka. Tveganje za okvaro strežnika se poveča, ko ti dejavniki presežejo določen obseg.

Izobraževanje zaposlenih
Eden najpogostejših načinov tatov za pridobivanje podatkov o podjetju je, da ukradejo prenosne računalnike zaposlenih, medtem ko zaposleni potujejo. Zaposleni morajo biti usposobljeni za zavarovanje svoje opreme, kadar so zunaj pisarne.

2.10 Uporabnost

Pri iskanju varnih informacijskih virov morajo organizacije uravnotežiti potrebo po varnosti s potrebami uporabnikov za učinkovit dostop do teh virov in njihovo uporabo. Če varnostni ukrepi sistema otežijo uporabo, potem uporabniki najdejo načine, kako varnost lahko postane bolj ranljiva, kot bi bila brez varnostnih ukrepov. Vzemimo za primer pravilnike o geslu. Če organizacija zahteva izjemno dolgo geslo z več posebnimi znaki, se lahko zaposleni zateče k temu, da ga zapiše in da v predal, saj si ga ne bo mogel zapomniti. Bolj varno je, da iznajdemo system, po katerem si lahko geslo zapomnimo. Slika 5 prikazuje predlog, kako ustvariti močno geslo.
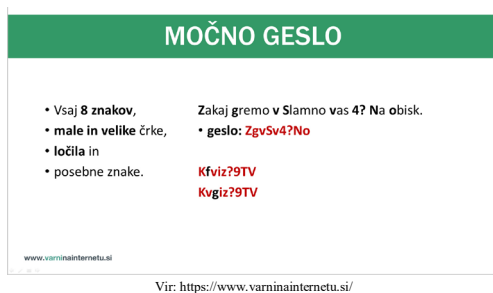
Slika 5. Predlog za kreiranje močnega gesla [9]

2.11 Varnostna politika

Poleg zgoraj naštetega tehničnega nadzora morajo organizacije izvajati tudi varnostne politike kot obliko upravnega nadzora. Varnostna politika je dokument, ki pisno potrdi, kako podjetje načrtuje zaščito organizacije in informacijske tehnologije [10]. Dobra politika varovanja informacij določa smernice za zaposlene glede uporabe informacijskih virov podjetja in omogoča podjetju možnosti ukrepanja, če zaposleni krši politiko.

Po mnenju inštituta SANS je dobra politika "uradna, kratka in na visoki ravni izjava ali načrt, ki vključuje splošna prepričanja, cilje organizacije in sprejemljive postopke za določeno področje." Politike zahtevajo skladnost, saj bo neupoštevanje politike privedlo do disciplinskih ukrepov. Politika ne določa posebnih tehničnih podrobnosti, temveč se osredotoča na želene rezultate. Varnostna politika mora temeljiti na vodilnih načelih zaupnosti, celovitosti in razpoložljivosti.

Dober primer varnostne politike, s katero se bodo mnogi seznanili, je politika uporabe spletnih strani. Politika uporabe spletnih strani določa odgovornosti zaposlenih v podjetju, ko za dostop do spleta uporabljajo vire podjetja.

3 MOBILNA VARNOST

Ker se uporaba mobilnih naprav, kot so pametni telefoni in tablični računalniki, povečuje, morajo biti organizacije pripravljene na sprejemanje varnostnih ukrepov. Eno prvih vprašanj v razmislek vsake organizacije je, ali sploh dovoljuje mobilne naprave na delovnem mestu. Večina zaposlenih že ima te naprave, zato se postavlja vprašanje, ali naj organizacije omogočijo zaposlenim, da prinesejo svoje naprave in jih uporabljajo kot del svojih zaposlitvenih dejavnosti ali pa naj naprave svojim zaposlenim priskrbijo organizacije. Uporaba lastnih mobilnih naprav omogoča zaposlenim, da se bolj integrirajo v svoje delo ter lahko prinesejo večje zadovoljstvo in produktivnost zaposlenih. V mnogih primerih je zaposlenim praktično nemogoče preprečiti, da bi imeli na delovnem mestu svoje pametne telefone ali tablice. Če organizacija zagotavlja svoje naprave zaposlenim, pridobi večji nadzor nad uporabo naprav, hkrati pa se prepreči možnosti upravnega in varnostnega nereda [1].

Mobilne naprave lahko predstavljajo številne edinstvene varnostne izzive za organizacijo in kmalu postane njena največja skrb tatvina intelektualne lastnine. Za zaposlenega z zlonamernimi nameni je zelo preprost postopek, da mobilno napravo poveže z računalnikom prek USB vrat ali brezžično v poslovno omrežje in naloži zaupne podatke. Prav tako bi bilo enostavno na skrivaj fotografirati proizvod ali storitev v organizaciji.

Ko ima uslužbenec dovoljenje za dostop in shranjevanje podatkov podjetja na svoji napravi, se pojavi drugačna varnostna grožnja, saj ta naprava lahko postane tarča tatov. Kraja mobilnih naprav (prenosnih računalnikov) je ena od glavnih metod, ki jih uporabljajo tatovi podatkov.

Za zaščito mobilnih naprav so nekateri mobilni proizvjalci uvedli različico nabora funkcij Tier Two. Te so na splošno združene pod naslovom MTD (Mobile Threat Defense). Čeprav je MTD učinkovit in pogosto zadostuje za zaščito mobilnih končnih točk, je še vedno do neke mere omejen s stopnjo vključitve teh rešitev v celotni varnostni system [11].

Organizacije bi morale razmisliti o pravilniku o mobilnih napravah, ki obravnava naslednja vprašanja: uporaba kamere, uporaba snemanja glasu, nakupih aplikacij, šifriranje v mirovanju, nastavitve samodejnega povezovanja Wi-Fi, nastavitve bluetooth, uporaba VPN, nastavitve gesla, poročanje o izgubljenih ali ukradenih napravah in varnostno kopijo.

Poleg politik obstaja več različnih orodij, ki jih lahko organizacija uporabi za zmanjšanje nekaterih teh tveganj. Na primer, če je naprava ukradena ali izgubljena, lahko geolokacijska programska oprema pomaga, da jo organizacija najde. V nekaterih primerih je morda smiselno namestiti programsko opremo za odstranjevanje oddaljenih podatkov, ki bo odstranila podatke iz naprave, če to postane varnostno tveganje.

4 VARNOST OSEBNIH PODATKOV

Vsak od nas lahko kot posameznik sprejme ukrepe za zagotovitev varnosti svojih računalniških tehnologij. Ni možnosti, da bi imeli stoodstotno varnost, vendar obstaja nekaj preprostih korakov, ki jih lahko naredimo za svojo varnost.

Posodobimo svojo programsko opremo. Kadar koli prodajalec programske opreme ugotovi, da je bila v njihovi programski opremi odkrita pomanjkljivost v varnosti, bo sprožil posodobitev programske opreme, ki jo lahko prenesemo, da odpravimo težavo. Za avtomatizacijo tega procesa vklopimo samodejno posodabljanje v računalniku.

Namestimo protivirusno programsko opremo in jo posodabljajmo. Na trgu je veliko dobrih paketov protivirusne programske opreme, tudi brezplačnih.

Bodimo previdni pri povezovanju v omrežjem Wi-Fi. Uporabniki bi se morali zavedati svoje okolice, ko se na javnem mestu povežejo z omrežjem Wi-Fi in morajo biti pozorni na ostale uporabnike, ki tudi delijo to omrežje. Priporočljivo je, da ne dostopajo do svojih finančnih ali osebnih podatkov. Prav tako se morajo zavedati, da lahko tudi povezovanje USB bliskovnih pogonov z napravo ogrozi varnost. Na napravo ne priklopimo neznanega bliskovnega pogona, razen če ga lahko najprej pregledamo s svojo varnostno programsko opremo.

Varnostno kopirajmo svoje podatke. Tako kot morajo organizacije varnostno kopirati svoje podatke, tako jih morajo tudi uporabniki. In veljajo enaka pravila: to moramo storite redno in kopijo shraniti na drugem mestu. Preprosta rešitev je, da nastavimo račun s spletno varnostno kopijo za avtomatizacijo varnostnih kopij.

Zavarujmo svoje račune z dvofaktorno avtentikacijo. Večina ponudnikov e-pošte in družbenih medijev ima možnost dvofaktorne avtentikacije. Uporaba tega načina je preprosta: ko se prvič v račun prijavimo z neznanega računalnika, nam strežnik

pošlje besedilno sporočilo s kodo, ki jo moramo vnesti, da potrdimo, da smo v resnici ta oseba. To pomeni, da se nihče več ne more prijaviti v naše račune, ne da bi poznal geslo in imel svoj mobilni telefon.

Gesla naj bodo dolga, močna in edinstvena. Za svoja osebna gesla upoštevajmo ista pravila, ki se jih priporoča organizacijam. Gesla morajo biti dolga (osem ali več znakov) in vsebovati vsaj dve od naslednjih: velike črke, številke in posebni znaki. Uporabljajmo tudi različna gesla za različne račune, tako da če nekdo ukrade naše geslo za en račun, še vedno ne more dostopati do naših drugih računov.

Bodimo previdni pri uporabi sumljivih povezav in prilog. Ko prejmemo e-pošto, tvit (čivk) ali Facebook objavo, bodimo pozorni na vse povezave ali priloge, ki so tam vključene. Ne klikajmo neposredno na povezavo, če nam je povezava sumljiva. Če želimo dostopati do spletnega mesta, ga poiščimo sami v brskalniku in ga obiščimo neposredno od tam.

5 ZAKLJUČEK

Varnost informacijskih sistemov, znana tudi pod imenom INFOSEC, je široka tema na področju informacijske tehnologije, ki se osredotoča na zaščito računalnikov, omrežij in njihovih uporabnikov. Skoraj vsa sodobna podjetja, pa tudi številne družine in posamezniki, so utemeljeno zaskrbljeni zaradi digitalnih tveganj. Te grožnje prihajajo v različnih oblikah in velikostih, vključno s krajo zasebnih informacij, krajo baze podatkov, namestitvijo zlonamerne programske opreme na računalnik in namernimi motnjami v storitvah.

Varnost informacij je praksa preprečevanja nepooblaščenega dostopa, uporabe, razkritja, motenj, spreminjanja, pregledovanja, beleženja ali uničenja informacij. Zagotoviti je treba, da informacije ne bodo ogrožene na kakršen koli način, ko se pojavijo kritične težave. Te težave vključujejo naravne nesreče, okvaro računalnika/strežnika in fizične kraje, vendar niso omejene nanje.

Področje informacijske varnosti se je v zadnjih letih močno povečalo in razvijalo. Ponuja številna področja za specializacijo, vključno z varovanjem omrežij in sorodne infrastrukture, zaščito aplikacij in baz podatkov, varnostnim testiranjem, revizijo informacijskih sistemov, načrtovanjem neprekinjenega poslovanja, odkrivanjem elektronskih zapisov in digitalno forenziko.

Varnost informacijskih sistemov je mogoče zagotavljati samo s celovitim metodičnim pristopom, ki ne vključuje samo ključne vstopne točke v omrežje, temveč celotno omrežje. Ključ do celovitega pristopa je varnostna politika, s katero definiramo vse varnostne procese in mehanizme za zaščito. Te varnostne procese, mehanizme in druge elemente varnosti pa je potrebno uporabiti na mrežnem sistemskem in aplikativnem nivoju informacijske infrastrukture.

Informacijski sistemi obdelujejo in shranjujejo informacije, ki omogočajo opravljanje primarnih storitev podjetij. Prav tako pa vsebujejo tudi osebne podatke in informacije posameznikov in o posameznikih. Uporabniki informacijskih sistemov zato pričakujejo, da bo sistem opravljal svojo funkcijo učinkovito in zanesljivo ter bo nudil varen dostop do podatkov in ščitil zaupne informacije pred nedovoljenim dostopom, spreminjanjem in izgubo.

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Izzivi poučevanja slovenskega jezika in književnosti na daljavo

Challenges of distance learning by Slovene teachers

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POVZETEK

Pouk od doma je od učencev zahteval veliko mero samostojnosti in samoiniciativnosti. Tudi učitelji smo se znašli v situaciji, v kateri še nismo bili. V svojem prispevku sem opisala, kako sem se lotila poučevanja slovenščine na daljavo in katera orodja, aplikacije so mi bile v pomoč. Predstavila sem tudi nekatere vidike šolanja na daljavo, ki bi lahko bile tudi del klasičnega pouka že v osnovni šoli. Šola na daljavo je namreč prinesla tudi določene segmente, ki bi jih bilo vredno obdržati. Še posebej to velja za uvajanje sodobne tehnologije, brez katere si poučevanja v 21. stoletju ne moremo več zamišljati.

KLJUČNE BESEDE

Poučevanje na daljavo, slovenščina, IKT

ABSTRACT

Pupils were supposed to be independent and self-directed in the time when school were closed. Teachers were also in totally new situation. This paper describes the pedagogic methods and tools for distance learning which I used during lockdown. I've tried to demonstrate some aspects of distance learning that could be included in all lessons in primary school, not just during emergency circumstances of lockdown. More and more teachers realize the importance of computer usage in the learning process, especially in the 21st century.

KEYWORDS

Distance learning, Slovene, ICT

1   UVOD

Kljub številnim projektom, izobraževanjem, vezanim na IKT, je učitelje šola na daljavo v marcu 2020 ujela nepripravljene. Ta način dela se je namreč popolnoma razlikoval od metod poučevanja, ki smo jih bili vajeni. Vsak učitelj se je z novim

izzivom spoprijemal po svoje. Nihče izmed nas pa ni mogel obiti tehnologije, brez katere sam pouk na daljavo ne bi bil mogoč.

Izvedba pouka, podprtega s tehnologijo, zahteva temeljit premislek. Katero aplikacijo uporabiti? Katero orodje bi bilo najustreznejše? Tovrstne odločitve pa so bile v času šole na daljavo še toliko težje. Kaj bo učencem v tem nenavadnem času ustrezalo? Jim bo to orodje pomagalo doseči učne cilje? Bom s to aplikacijo kot učiteljica dobila ustrezno povratno informacijo? Spraševala sem se tudi, ali aplikacija omogoča sodelovanje na daljavo.

2   IZZIVI ŠOLE NA DALJAVO V ŠOLSKEM LETU 2019/2020

V marcu 2020 smo se učitelji znašli v čisto novi vlogi. Večinoma smo se najprej osredotočili na aplikacijo, s katero so bili učenci seznanjeni. Sama sem se tako osredotočila na MS Teams in MS OneNote.

2.1   Predstavitev dela z MS Teams

Teams je integrirano orodje, ki omogoča hkratno urejanje dokumentov v oblaku in komuniciranje. Namenjeno je sodelovalnemu učenju znotraj enega okolja. [4]

Sama sem že pred šolo na daljavo v okolju MS Teams oblikovala ekipe in način dela s Teamsi predstavila v razredu. Vsak razred oz. skupina v 8. in 9. r. je imela v Teamsih svojo ekipo. Sprva sem na ta način komunicirala z učenci, a večina tega načina še ni bila vajena. Pravzaprav sem v celotnem obdobju šole na daljavo nagovarjala učence prek eAsistenta in prek klepeta znotraj Teamsov. Veliko učencev si je že v marcu naložilo aplikacijo Teams na telefon, tako da je naša komunikacija lepo potekala. S preostalimi pa smo klepetali prek eAsistenta. Naloga učitelja je bila in je, da je prilagodljiv.

Prek Teamsa smo imeli tudi video konference. Sprva smo se tako dobivali v času razredne ure, kasneje sem prek video konference razložila težje dele snovi, izvedla pa sem tudi utrjevanje. Prek video konference sem tudi ocenjevala govorne nastope. Teams omogoča deljenje zaslona in aplikacij, ena od funkcij je tudi tabla, na katero se lahko riše. Predavanje se lahko tudi snema, saj se prenese znotraj Office 365 v MS Stream. To je dobrodošlo, da si lahko učenci, ki se niso mogli udeležiti video konference, kasneje vse skupaj še enkrat ogledajo.

V maju 2020 so se učenci začeli pritoževati, da je video srečanj preveč in da jim le-te zmedejo ustaljen urnik dela, kot so

ga načrtovali od marca 2020. Vsekakor so bile video konference potrebne, saj so ustrezna nadgradnja vnaprej posnetih razlag. Prek video konferenc so se učenci lahko pogovarjali, obenem pa so učenci razvijali komunikacijske veščine, ki so sicer pomemben del pouka slovenščine.

Orodje Teams omogoča tudi, da z učenci delim vsebino in jim dodelim naloge. Tvorbne naloge je bilo prek Teamsa lažje vrednotiti, saj mi besedila ni bilo potrebno shranjevati, ampak sem popravljala Wordove dokumente direktno v brskalniku.

Kvalitetna gradiva, poustvarjalne naloge, ki jih učitelj prejme od učencev, je smiselno urediti tako, da jih vsi lahko vidijo. V ta namen sem v spletnih učilnicah Teams pripravila neko skupno mesto, kamor dajem gradiva vsem na ogled. Podobno bi se dalo narediti tudi v Padletu.

2.2 Predstavitev dela z MS OneNote

Znotraj Teamsov se lahko oblikuje tudi Zvezek za predavanja, v ozadju le-tega pa je aplikacija OneNote (slika 1). To je v bistvu digitalni zvezek, v katerem je več odsekov. Za vsak razred sem oblikovala svoj zvezek, zato so učenci delali samostojno, a vendar so prav zaradi medvrstniškega vrednotenja, ki bo razloženo v nadaljevanju, imeli priložnost, da sodelujejo med seboj. Učenci so kljub oddaljenosti skupaj oblikovali namene učenja in kriterije uspešnosti v OneNotu (odsek prostor za sodelovanje).

Učencem lahko delim zadolžitve pod odsek domača naloga. Kasneje lahko zelo enostavno pregledujem vse naloge naenkrat.

Zelo uporaben je tudi odsek prostor za sodelovanje, saj omogoča, da učenci skupaj oblikujejo dokument. Ta funkcija je podobna aplikaciji Padlet.

Slika 59. Delo v OneNotu

Pogosto sem v času šole na daljavo v odsek domača naloga postavila vprašanje, vezano na snov, da sem dobila hitro povratno informacijo, ali lahko sledijo učni snovi. Pogosto so tudi odgovarjali na vprašanja, vezana na posnetek, film, ki so si ga morali ogledati.

Uporabnost digitalnega zvezka pa se je izkazala predvsem, ko sem ugotovila, da lahko preko OneNota izpeljem medvrstniško vrednotenje. To je ena izmed zelo uporabnih sodobnih pedagoških metod, ki je vezana na formativno spremljanje. [1] Najprej so učenci sami tvorili neko besedilo (npr. pri pouku književnosti so v 7. razredu tvorili basen). Basen so oddali v odsek domača naloga. Vsakemu učencu sem v odsek domača naloga v OneNotu naložila basen sošolca, ki jo je kritično ovrednotil po naprej postavljenih kriterijih: značilnosti besedilne

vrste – basen; vsebina je izvirna, prav tak je naslov; besedilo je ustrezno členjeno (razdeljeno je na odstavke; vsaj 3); pravopisna pravilnost. Vse basni sem pregledala še sama in ocenila delo učenca, ki je popravljal basen, in učenca, ki je napisal basen. Učencem sem v OneNotu, kjer sem podajala navodila za delo, naročila, naj najprej poskušajo najti pohvalo: dosežke drug drugega presojajo tako, da najprej iščejo pozitivne stvari. Nato dodajo predloge za izboljšanje (npr. svetujem ti, da pišeš odstavke; predlagam ti, da preden oddaš besedilo, še enkrat prebereš in popraviš pravopisne napake; menim, da bi bilo bolje, da bi dopolnil del, ko zajec ukrade med; mislim, da bi lahko medvedov odnos do lisice natančneje opisal).

MS Teams in MS OneNote sta orodji, ki sta učitelju v veliko pomoč. V Teamsu lahko oblikujemo spletne učilnice, prek Formsa pripravljamo preverjanja in jih delimo preko Teamsa. Teamsi omogočajo dajanje povratne informacije (slika 2), preko koledarja zlahka skličemo video konferenco.

Slika 60. Dajanje povratne informacije učencu

OneNote mi je v času šole na daljavo pomagal, da sem lahko po datumih uredila učno snov, tako da učenci niso imeli težav. Do zvezka zlahka dostopajo in določene strani lahko tudi spreminjajo, sooblikujejo. Zdi pa se, da ti dve orodji nista ravno enostavni za učence. Kljub navodilom, ki so jih dobili, se nekateri učenci niso znašli v Oblaku 365. Posneti bi morala video posnetek, kako uporabljati OneNote in Teams ali pa imeti vsaj videokonferenco na to temo. Le-to sem imela, a prepozno, saj je kar nekaj učencev potožilo, da se jim zdi delo zahtevno. V letošnjem šolskem letu bom večkrat znotraj klasičnega pouka pokazala, kako se Teamsi in OneNote uporabljajo. S pomočjo tabličnih računalnikov bodo vse tudi sami preizkusili. Tako bomo bolje pripravljeni na morebitno karanteno in posledično šolo na daljavo.

3 SLABE PLATI ŠOLANJA NA DALJAVO

Zdi se, da je bilo najbolj problematično to, da učitelj ni mogel zaznati odziva učencev. Ni bilo prave povratne informacije, učitelj je lahko samo ugibal o učenčevem predznanju. Kljub video konferencam pa je bil učitelj še vedno negotov, saj spletno okolje ne more nadomestiti pristnega stika z učenci.

Učitelj pa je naletel še na problem, ko je uvajal novo aplikacijo, orodje. Ko učenci samostojno uporabljajo npr. tablične računalnike, lahko hitro opaziš, da je aplikacija za učence prezahtevna, da ne vedo, kako jo uporabljati. Normalno je, da so na začetku težave. A sčasoma bi morala postati

aplikacija učencem tako pisana na kožo, da se z njo ne bi posebej ubadali, ampak bi s pomočjo aplikacije dosegali učne cilje. Na daljavo je bilo pa še posebej težavno ugotoviti, kako učencem aplikacija ustreza.

4 PRILOŽNOSTI ZA IZBOLJŠAVO

Ena izmed slabosti šolanja na daljavo je bila tudi to, da je bilo delo zgolj individualno. Iz dokumenta, ki ga je izdalo Ministrstvo za izobraževanje, znanost in šport avgusta 2020, naj bi bilo delo vezano tudi na delo dvojicah. [5] Potrebno je izbrati spletno okolje, ki omogoča tovrstno delo. Sama sem izbrala delo z OneNote, s katerim sem izvedla medvrstniško vrednotenje, ko so učenci drug drugemu popravljali besedila. Tako so med seboj sodelovali, si izmenjavali svoje ideje, misli. S tem so tudi vzdrževali socialne stike med seboj, kar je bilo za njihovo počutje takrat zelo pomembno.

Potrebno je bilo dobro premisliti, katere vsebine so primerne za delo na daljavo. Na študijskih skupinah v avgustu 2020 nam je bilo predlagano, katere vsebine iz učnega načrta so primerne za delo na daljavo. Učni načrt bo tudi digitaliziran, kar nam bo v pomoč v primeru, če bi moralo delo ponovno potekati od doma. [5]

Kar se obravnave književnosti tiče, bi bilo smotrno brati daljše besedilo po delih. Vmes naj bi učitelj pripravil vprašanja, morda organiziral video srečanje, da bi preveril, ali je besedilo učencem razumljivo, razjasnil bi morebitne neznane besede. V času šole na daljavo so imeli učenci nalogo, da preberejo knjigo, ki so jo imeli doma. Lahko so si jo seveda tudi izposodili preko Biblosa. Brali so po delih in po prebranih začetnih poglavjih so v odseku domača naloga (v OneNotu) odgovarjali na naslednja vprašanja: kaj vam je zaenkrat pri knjigi najbolj všeč, kateri je tvoj najljubši junak, kako mislite, da se bo knjiga končala. S tem sem spodbudila zanimanje za nadaljnje branje knjige.

Zdi se, da smo učitelji v času dela na daljavo premalo pozornosti namenili sprotnemu preverjanju. To bi bilo najbolj smotrno narediti kar v spletni učilnici, saj so jo učenci redno pregledovali. Preverjanje bi moralo biti po sklopih, in to večkrat mesečno. Le tako bi učitelj lahko sledil napredku učencev oz. opazil pomanjkljivosti v znanju. Odločila sem se, da bodo sprotna preverjanja v spletni učilnici v letošnjem šolskem letu učenci reševali tudi med klasičnim poukom, da bi se tega načina dela navadili, če bi razred morebiti moral ostati v karanteni.

Zelo pomemben segment šole na daljavo je posnetek razlage. Obvezno morajo biti na posnetku tudi dodana navodila za delo, saj se znanje pridobiva le z aktivnim delom in ne le poslušanjem. Posnetek naj ne bo daljši od nekaj minut. [3] Pri slovenščini so se izkazale video razlage dobre predvsem za obravnavo slovničnih vsebin in za zgodovinski pregled literarnih obdobij. Sama sem za pripravo razlag uporabila program ActivePresenter.

Video konference lahko pripomorejo k temu, da učenci ostanejo med seboj povezani in da jih lahko učitelj nagovori. Navsezadnje lahko urijo svoje konverzacijske spretnosti, saj brez video konferenc te veščine ne bi mogli razvijati. Strokovnjaki menijo, da je video konferenca primerna takrat, ko učence spodbudimo k sodelovanju, k razpravi, dajanju mnenj, razčiščevanju dilem, koristna pa je tudi za pridobivanje povratnih informacij. [3]

Potrebno se je zavedati, da moramo učitelji učence spodbujati, da so učenčevi izdelki kot dokazi čim izvirnejši. V času šole na daljavo je nastalo veliko zanimivih izdelkov, npr. učenci so posneli svoje vloge o prebranih knjigah, vsebino prebranega so preoblikovali v strip s pomočjo aplikacija Storyboard That (slika 3).

Slika 61. Strip na temo pesmi Zabušant – avtor pesmi J. Prevert (avtorica stripa: sedmošolka)

Pozitivna plat te aplikacije je, da je brezplačna in da za učence ni zelo zahtevna. Bolj pomembno je, da se učenci osredotočijo na samo poustvarjanje kot pa na to, kako ravnati z orodjem. Če je vsega preveč, postane učencem delo mukotrpno.

Je pa kar nekaj možnosti, kar se dokazov tiče. Lahko bi na določeno temo posneli multimedijsko predstavitev (film, zvočno oddajo, fotografijo, projekcijo), lahko bi oblikovali publicistično besedilo, kviz za sošolce, lahko bi govorno predstavili neko vsebino, lahko bi likovno poustvarjali, naredili izdelek itd. Možnosti je veliko in prav je, da učitelj spodbuja svoje učence k izvirnosti.

Po raziskavi Zavoda za šolstvo je kar slaba polovica (48,9 %) učiteljic in učiteljev v času šole na daljavo največkrat uporabljala elektronsko pošto za stik z učenci. Sledita uporaba videokonferenc (19,1 %) in spletno učno okolje (17,4 %). [6]

Elektronska pošta ne omogoča stika med učenci, kot to omogočajo videokonference in določena spletna okolja. Učenci morajo imeti kljub oddaljenosti občutek, da so povezani, da imajo možnost izmenjave svojih misli, idej. V času šole na daljavo so večino učencev prevevali občutki osamljenosti. Zagotovo bi uporaba aplikacij, ki omogočajo medsebojno sodelovanje, stisko učencev omilila.

5 ZAKLJUČEK

Šolanje na daljavo je nas, učitelje, prisililo, da smo se lotili metod poučevanja, ki so nam bile doslej neznanka. Posnetki razlag, videokonference, delo v spletnih učilnicah so postali temelj učnega procesa. Čeprav smo si vsi učitelji želeli klasičnega pouka, smo zaznali, da so določeni segmenti šolanja na daljavo taki, ki bi jih bilo vredno ohraniti. Delo v spletnih učilnicah bi moralo biti pomemben segment pouka tudi takrat, ko poteka pouk v šoli. Če bodo učenci vajeni dela v spletnih učilnicah, bo šolski proces čim manj moten, če učenci ostanejo doma. Tudi raziskovalec dr. Saša Prešern [2] meni, da naj del pouka (npr. dve uri na teden) učitelji še naprej izvajamo prek spleta zato, ker je to dobro za učence in ker smo tako pripravljeni na podobne izzive, kot je covid-19.

Učitelj je dolžan organizirati delo tako, da se vzdržujejo socialni stiki in da imajo učenci možnost med seboj sodelovati. Izbirajo naj se učna okolja in aplikacije, ki ta način dela spodbujajo. Uporaba IKT pri poučevanju pa zahteva nekoliko drugačne pristope pri poučevanju, zato se je učitelj dolžan izobraževati in krepiti svoje digitalne kompetence.

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Medpredmetno povezovanje in uporaba informacijsko-komunikacijske tehnologije pri poučevanju na daljavo v osnovni šoli

Cross-curricular integration and use of information communication technologies in distance learning in primary school

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POVZETEK

Prispevek predstavlja možnosti medpredmetnega povezovanja in uporabo informacijsko-komunikacijske tehnologije pri poučevanju na daljavo v osnovni šoli. Osredotočamo se na sodobno šolo, ki v središče postavlja inovativne in aktivne učence. Učence, ki jih z inovativnimi pristopi pripeljemo k samostojnemu razmišljanju in raziskovanju v skladu s sodobnimi smernicami didaktike. Pouk v sodobni šoli naj bi bil zasnovan na tistih pristopih poučevanja, ki omogočajo celostno učenje, ustvarjajo bogato učno okolje ter temeljijo na aktivnih metodah in oblikah dela. Medpredmetno povezovanje podprto z uporabo informacijsko-komunikacijske tehnologije predstavlja pomemben del učenja in poučevanja, saj je to celosten pristop, kjer se povezujejo znanja, vsebine in učne spretnosti. Učenci pri medpredmetnem povezovanju preko različnih informacijsko-komunikacijskih orodij razvijajo interes in motivacijo za učenje. Vzpostavitev in izbira ustreznega digitalnega učnega okolja pri poučevanju na daljavo ter premišljena uporaba sodobnih didaktičnih pristopov predstavljata osnovni temelj kakovostne izvedbe pouka na daljavo. Prispevek prikazuje možnosti izpeljave medpredmetnega pouka v petem razredu z uporabo informacijsko-komunikacijske tehnologije pri poučevanju in učenju na daljavo.

KLJUČNE BESEDE

Medpredmetno povezovanje, informacijsko-komunikacijska tehnologija, izobraževanje na daljavo, celostno učenje

ABSTRACT

The paper presents the possibilities of interdisciplinary integration and use of information and communication technology in distance learning in primary school. We focus on a modern school that puts innovative and active students at the centre. Students who are brought to independent with innovative approaches thinking and research in accordance with modern guidelines didactics. Teaching in a modern school is supposed to be based on those teaching approaches that enable holistic learning. They create a rich learning environment which is based on active methods and team works. Cross-curricular integration supported by application information and communication technology is important part of learning and teaching, as this is an integrated approach where pupils are combining knowledge, content and learning skills. Students develop interest and motivation to learn while using information communication tools. Establishment and selection of an appropriate digital learning environment at distance learning and the thoughtful use of modern didactic approaches represent the basic foundation of quality conducting distance learning. The paper shows the derivation options interdisciplinary lessons in the fifth grade using information communication technologies in distance learning and learning.

KEYWORDS

Cross-curricular integration, information and communication technology, distance education, integrated learning

1 UVOD

Sodobna šola v središče postavlja inovativnega in aktivnega učenca, ki preko inovativnih pristopov poučevanja samostojno razmišlja in raziskuje. Pouk v sodobni šoli naj bi temeljil na celostnem učenju z uporabo aktivnih učnih oblik in metod dela. Medpredmetno povezovanje predstavlja pomemben del učenja in poučevanja, saj stremi k povezovanju znanj in s tem ciljev znotraj enega predmeta in med različnimi predmeti. Učenci pri medpredmetnem povezovanju razvijajo interes in motivacijo za učenje. Pri tem dosegajo visok učni uspeh in kažejo večjo radovednost za usvajanje interdisciplinarnih znanj. Še posebej je medpredmetno povezovanje smiselno pri izobraževanju na daljavo, saj delo po učnih in tematskih sklopih v okviru več predmetov omogoča lažje sledenje in spremljanje napredka, osmišlja znanje, pri učencih dviga učno motivacijo in interes za učenje. Če je uporaba informacijsko-komunikacijske tehnologije pri klasičnem pouku predstavljala zgolj dopolnitev in popestritev

izobraževanja, je postala pri izobraževanju na daljavo nujno in neobhodno potrebna. Vzpostavitev ustreznega digitalno podprtega učnega okolja je postala ključna za kakovostno izvedbo pouka na daljavo. Ustrezno e-kompetenten učitelj, ki v takšnem digitalno podprtem učnem okolju pri svojem delu premišljeno uporablja sodobne in inovativne didaktične pristope, lahko učence pripelje do višjih oblik učenja in znanja.

S prispevkom želimo prikazati možnosti izpeljave izobraževanja na daljavo usmerjeno v medpredmetni koncept izobraževanja podprt z informacijsko-komunikacijsko tehnologijo.

2 MEDPREDMETNO POVEZOVANJE

Medpredmetno povezovanje je celosten didaktični pristop s katerim horizontalno in vertikalno povezujemo znanja, vsebine in učne spretnosti. Medpredmetno povezovanje spodbuja samostojno in aktivno pridobivanje učnih izkušenj, in poteka v celoviti dejavnosti učenca, vključuje njegove spoznavne, čustvene in telesne funkcije [8]. Medpredmetno povezovanje je nastalo zaradi težnje po doseganju večje kakovosti pouka in prilagajanja načinov poučevanja sodobnim spoznanjem o naravi učenja, pri katerem se upošteva celostno spoznavanje učne stvarnosti [13]. Takšno načrtovanje pouka prinaša vsebinsko racionalnost, ekonomičnost, boljšo učno uspešnost [9]. Medpredmetno povezovanje temelji na idejah konstruktivizma Piageta, Deweya, Brunerja in drugih, ki so učenje z razumevanjem ali smiselno učenje povezovali z razumevanjem pojmov in njihovim povezovanjem v strukture znanja. Tako je učenje z medpredmetnim povezovanjem nasprotje učenju na pamet posameznih izoliranih vsebin. Ta posnema resnične življenjske situacije, kar je za učence dober zgled in močan motiv za učenje. Medpredmetno povezovanje podpirajo tudi različne raziskave z drugih področij, na primer raziskave o delovanju možganov in obdelavi informacij. Novo znanje se organizira po vzorcu prejšnjih izkušenj in pomenu, ki iz njih izhaja. Učenje novih vsebin je torej uspešnejše, če izhaja iz otrokovih izkušenj in poteka v zanj znanih in razumljivih okoliščinah [6]. Medpredmetno povezovanje upošteva učenčevo predznanje, stališča, pričakovanja, čustva in socialno komponento. Uresničuje načelo celovitosti učnega procesa, povezuje učenje z življenjem ob spodbujanju izkušenjskega učenja pri učencih, priznava otrokovo individualnost z upoštevanjem njegovih potreb, interesov, zmogljivosti. Je odprt učni model, ki omogoča učitelju in učencem fleksibilno prilagajanje sprotnim potrebam in situacijam. Od učitelja takšen pristop dela zahteva prožnost, širino v znanju, empatijo in posluh za potrebe, interese in sposobnosti učencev [7].

2.1 Zakaj medpredmetno povezovati učne vsebine?

Medpredmetno povezovanje je nastalo zaradi težnje po doseganju boljše kakovosti pouka in prilagajanja načinov poučevanja sodobnim spoznanjem učenčeve učne stvarnosti [13]. Medpredmetni pristop za učence prinaša mnoge prednosti, kot so celostno dojemanje sveta, izkušenjsko učenje, prenašanje usvojenega znanja in procesov na druga področja, individualizacija in diferenciacija pouka. Tovrstno poučevanje in učenje presega okvirje posameznega učnega predmeta, saj

omogoča povezovanje in združevanje različnih učnih ciljev v smiselno celoto. Tako celostno učenje zagotavlja povezavo in poenotenje znanja, učence globoko motivira k drugačnemu zaznavanju ustvarjalnemu povezovanju vsebin in oblikovanju novih in drugačnih miselnih modelov, struktur in sistemov [6]. Temeljni cilji, ki obsegajo zahtevo po usklajenem načrtovanju učiteljev različnih predmetov in področij, so doseganje večje stopnje povezanosti med disciplinarnimi znanji, preprečitev preobremenjenosti učencev, priprava na vseživljenjsko izobraževanje in kakovostno življenje, povečanje kakovosti in trajnosti pridobljenega znanja ter razvijanje sposobnosti samostojnega, ustvarjalnega in kritičnega mišljenja ter presojanja [1].

2.2 Kdaj in kako povezovati vsebine?

Medpredmetnega pristopa poučevanja se poslužujemo takrat, ko je to smiselno, ko je učna snov primerna in imamo zadovoljive možnosti za izvedbo. Možnosti medpredmetnih povezav zasledimo v učnih načrtih posameznih predmetov. Iz njih lahko razberemo, kateri predmeti se najbolje vežejo med seboj in katere vsebine lahko povežemo, da uresničimo cilje iz učnih načrtov posameznih predmetov [10].

Poznamo več načinov udejanjanja medpredmetnih povezav. Nekatere lahko uresničimo vsako učno uro, nekatere pa preko različnih organizacijskih oblik, kot so šole v naravi, projektni dnevi, dnevi dejavnosti, le-te zahtevajo več časa, bolj poglobljeno obravnavo vsebin posameznih predmetov in bolj prilagodljiv urnik [10]. Medpredmetne povezave morajo biti prilagojene predznanju učencev in učenčevi razvojni stopnji. Povezujemo le tiste vsebine, ki so smiselne in ne delamo povezav tam, kjer ni smiselno, da bi jih medpredmetno povezovali [4].

2.3 Medpredmetno povezovanje pri pouku na daljavo v osnovni šoli

Pri pouku na daljavo je potrebno racionalizirati učne vsebine in se osredotočiti na temeljne cilje posameznih učnih predmetov, saj naj bi učenci pri tovrstni obliki pouka za usvajanje in razumevanje znanja porabili tudi do trikrat več časa. Če se poslužujemo medpredmetnega povezovanja kot didaktičnega pristopa, lahko vsebine posameznih učnih predmetov obravnavamo ekonomično, celostno, poglobljeno in z večjim motivacijskim učinkom. Še posebej je medpredmetno povezovanje enostavno izpeljati v prvem in drugem triletju osnovne šole, saj večino predmetov poučuje razredni učitelj, ki ima poglobljen vpogled v učno vsebino in cilje učnih predmetov, ki jih poučuje. Učitelji se pri medpredmetnem pristopu osredotočajo na doseganje ciljev ter na krepitev znanj skozi povezovanje vsebin. Učencem je pri tovrstnem pristopu učna snov bolj približana, celostno obravnavana, lažje razumljiva, hkrati pa dviga učno motivacijo in interes za učenje.

Primeri medpredmetnih učnih tem v petem razredu:

- prazgodovina, koliš* * *čarji, Karantanija, Rimljani, srednjeveški gradovi – družba, likovna umetnost, glasbena umetnost, slovenščina;

- opis rastline, naravna barvila – slovenščina, gospodinjstvo;

- naravno-geografske enote Slovenije, kulinarika, šege in navade – družba, glasbena umetnost, likovna umetnost, gospodinjstvo;

- geometrija – matematika, šport;
- zdrava prehrana – naravoslovje in tehnika, gospodinjstvo, matematika;
- soda in liha števila, števila do milijona – matematika šport.

Možnosti medpredmetnih povezav je v prvem in drugem triletju zelo veliko, pri tem je pomembno, da povezave učnih vsebin ne nastajajo na silo. Potrebno je upoštevati tudi posebnosti specialno didaktičnega načrtovanja posameznih predmetov, saj lahko v nasprotnem primeru siromašimo proces učenja. Medpredmetno povezovanje bo kakovostno takrat, ko bo smiselno vključevalo vsebine, procese, znanja, spretnosti itd., ki spodbujajo učenje iz različnih zornih kotov posameznih predmetnih področij. Na podlagi tega nastane učni transfer znanj in spretnosti, ki omogočajo razvijanje sistemskega mišljenja in mrežo znanja za ustvarjalno reševanje učnih in življenjskih okoliščin [8]..

3 INFORMACIJSKO-KOMUNIKACIJSKA TEHNOLOGIJA

Raba informacijsko-komunikacijske tehnologije postaja integralni del pouka. Uporaba le-te je v veliki meri odvisna od učitelja, od njegovega individualnega znanja in njegovih pristopov poučevanja. Sodoben in kvaliteten pouk sovpada z ustrezno izbiro učne tehnologije [11].

Informacijsko-komunikacijska tehnologija je vključena v vse procese, ki se dogajajo v šolskem okolju. Tehnologija pripomore k učenju s širitvijo dostopa kot tudi z vpeljevanjem raznovrstnih poti učenja. Učni proces in vsebine so z uporabo informacijsko-komunikacijske tehnologije atraktivnejše. Uporaba informacijsko-komunikacijske tehnologije pri pouku poveča produktivnost učiteljev in prihrani čas predvsem pri pripravi in posodabljanju dnevnih priprav, prilagajanju individualnim potrebam učencev in predstavljanju učne snovi [2].

Kompetenten učitelj je z uporabo informacijsko-komunikacijske tehnologije uspešnejši, ustvarjalnejši in inovativnejši, saj uporablja veljavne in zanesljive podatke ter se zaveda pravnih in etičnih načel varne in odgovorne uporabe tehnologije [3]. Različne študije uporabe informacijsko komunikacijske tehnologije v izobraževanju kažejo, da informacijsko-komunikacijska tehnologija olajša učenje otrokom z drugačnimi sposobnostmi in načini učenja, omogoča učinkovitejše učenje in poučevanje z vključevanjem več čutov ter daje možnost boljšega prilagajanja in sledenje pouku [2].

V zadnjem času se namesto računalniške pismenosti uporablja pojem digitalna zmožnost oziroma digitalna kompetenca. »Digitalna zmožnost oz. kompetenca je zavedanje, odnos in sposobnost vsakega posameznika, da smiselno uporablja digitalna orodja in storitve za razločevanje, dostopanje, upravljanje, vključevanje, vrednotenje, analiziranje in sintetiziranje digitalnih virov, da ustvarja nova znanja, nove medijske izraze in se sporazumeva z drugimi v specifičnih življenjskih okoliščinah, da bi tako omogočil konstruktivna družbena dejanja in da bi lahko razmišljal o teh procesih«. [5]

Učni načrt za slovenščino razvijanje digitalnih zmožnosti povezuje z razvijanjem sporazumevalne zmožnosti v slovenskem jeziku. Ta vključuje zavestno in kritično rabo informacijske tehnologije pri opravljanju šolskih obveznosti in dejavnosti.

Omogoča rabo raznih oblik in metod dela, učence večinoma motivira za pouk in omogoča hitrejše in kakovostnejše doseganje ciljev pouka [12].

4 IZOBRAŽEVANJE NA DALJAVO

Če je uporaba informacijsko-komunikacijske tehnologije pri klasičnem pouku predstavljala zgolj dopolnitev in popestritev izobraževanja, je postala pri izobraževanju na daljavo nujno in neobhodno potrebna. Vzpostavitev ustreznega digitalno podprtega učnega okolja je postala ključna za kakovostno izvedbo pouka na daljavo.

4.1 Orodja za učenje in poučevanje na daljavo

Za poučevanje na daljavo se uporabljajo različna orodja, ki prenašajo informacije, ali pa služijo kot pomoč pri usvajanju in razumevanju učnih vsebin.

Elektronska pošta je eden izmed najpogostejših načinov komuniciranja med učiteljem in učenci, saj poleg osnovne pisne komunikacije omogoča tudi pošiljanje različnih dokumentov.

Zelo pogosto uporabljeno orodje je spletna učilnica. Spletna učilnica Moodle je eden izmed programskih paketov za izvajanje e-izobraževanja. Učitelj lahko v spletni učilnici objavlja gradiva, daje domače naloge, pripenja videoposnetke z razlagami, objavlja fotografije izdelkov, s svojimi učenci klepeta v klepetalnici. Učenci v spletni učilnici odpirajo dokumente, ki jih je pripel učitelj, oddajajo domače naloge, klepetajo v klepetalnici, rešujejo kvize. Učitelj lahko v spletni učilnici spremlja in pregleduje aktivnost učencev, pregleduje domače naloge in daje povratne informacije učencem, spremlja uspešnost reševanja kvizov itd.

Videokonferenčne storitve so namenjene organizaciji sestankov, predavanj, pa tudi za vzpostavljanje stikov z učenci ali za komunikacijo in sodelovanje med samimi učenci.

Orodje Kahoot! je namenjeno izdelavi kvizov, razprav, vprašalnikov in je ena izmed atraktivnejših aplikacij za ponavljanje in utrjevanje znanja. Kahoot! omogoča sestavljanje lastnih kvizov ali uporabo že obstoječih, ki jih ustvarjalci delijo z drugimi uporabniki portala. Kviz je mogoče reševati individualno, ali pa v obliki razrednega tekmovanja. Časovna omejitev reševanja posameznega vprašanja, točkovanje in privlačna glasba pripomorejo k napetosti med reševanjem kviza in dvigajo učno motivacijo.

5 ZAKLJUČEK

Medpredmetno povezovanje in uporaba informacijsko-komunikacijske tehnologije sta nepogrešljivi komponenti sodobnega in inovativnega izobraževanja na daljavo. Izpostavljamo celosten pristop, kjer se povezujejo znanja, vsebine in učne spretnosti. Učenci preko sodobnih in inovativnih metod ter uporabe različnih informacijsko-komunikacijskih orodij usvajajo učno snov, dosegajo višje oblike učenja ter povezujejo znanja. Pri učenju so motivirani, osredotočeni in radovedni, saj je pot do usvajanja znanja podprta z digitalnimi učnimi okolji, ki so v današnjem času nujna in neobhodno potrebna. Z medpredmetnimi povezavami lahko vsebine posameznih učnih predmetov obravnavamo bolj ekonomično,

celostno in poglobljeno, kar se še posebej obrestuje pri izobraževanju na daljavo.

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Preverjanje in ocenjevanje znanja z aplikacijo Liveworksheet

Assessment of knowledge with Liveworksheet App

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POVZETEK

Učenje s pomočjo sodobne tehnologije ni več le popestritev vsakodnevnega učnega procesa, ampak je postala že stalna praksa v večinoma vseh razredih in pri večini predmetov. Učenci živijo s sodobno tehnologijo na vsakem koraku, prav tako pa se s pomočjo sodobnih spletnih aplikacij lahko veliko naučijo. Te niso le način njihovega komuniciranja, ampak tudi močno motivacijsko orodje za učenje, utrjevanje znanja in, kot smo se lahko prepričali v času karantene in izobraževanja na daljavo, tudi učinkovito orodje za preverjanje in ocenjevanje znanja na daljavo. Eno izmed takšnih uporabnih spletnih orodij je LiveWorksheet, ki nam omogoča preprosto sestavo interaktivnega učnega lista za sprotno utrjevanje, preverjanje ali ocenjevanje znanja.

KLJUČNE BESEDE

Sodobna tehnologija, preverjanje in ocenjevanje znanja, učenje na daljavo, Liveworksheet

ABSTRACT

Learning with the help of modern technology is no longer just a diversification of the everyday learning process, but it has already become everyday routine in almost all classes and almost all subjects. Students live with modern technology all the time and they can also learn a lot with the help of modern web applications. These are not only a way of communicating, but also a powerful motivational tool for learning and, as we were able to see during quarantine, also an effective tool for checking and assessing knowledge at a distance learning. One such useful online tool is LiveWorksheet which allows us to easily compile an interactive worksheet to test knowledge.

KEYWORDS

Modern technology, assessment of knowledge, distance learning, Liveworksheet

1 UVOD

V učnem procesu je neizbežno potrebno stalno prizadevanje učiteljev za iskanje različnih načinov, da uspemo pri učencih sprožiti željo po znanju. Vse več učiteljev ugotavlja, da tradicionalni pristopi pri vzgojno-izobraževalnem delu niso več ustrezni, ker ne vodijo k zadovoljivim dosežkom učencev. Za učinkovito učenje je namreč ključno, da učence pouk pritegne, da lahko učni izkušnji pripišejo pomen oziroma povezanost z življenjem [4]. Bolj so učenci motivirani za delo, boljši je uspeh. Če uspemo učence motivirati in v njih vzbuditi pozitivna čustva, smo na dobri poti [5]. Če bi bile dejavnosti vedno zanimive in zabavne, bi učence že same po sebi pritegnile, zato moramo učitelji prilagajati poučevanje tako, da pripravljamo za učence zanimive didaktične dejavnosti, ki ustrezajo namenu in ki jih učenci z veseljem opravljajo. Za eno izmed uspešnih načinov se je pokazala aplikacija Liveworksheet. Z njo lahko popestrimo vsakodnevno rutino v razredu, pokazala pa se je tudi kot uspešno orodje za učenje na daljavo. Namenjena je spreminjanju različnih tradicionalnih učnih listov, pisnih preverjanj ali ocenjevanj znanja npr. v wordu, pdf-ju, power pointu, v interaktivne učne liste. Liveworksheet je orodje, do katerega lahko dostopamo zelo hitro in preprosto ter brezplačno, potebujemo le računalnik ali tablico in spletno povezavo. Gre za eno bolj priljubljenih aplikacij s katero lahko spremljamo učenčevo razumevanje in napredek (formativno spremljanje), hkrati pa ga lahko uporabimo tudi za ocenjevanje znanja, lahko pa tudi kot uvod v novo snov za ugotavljanje predznanja. V času ocenjevanja lahko učitelj nadzoruje učenca na daljavo preko videa, audio ali »screen share« načina. [2]

2 OPIS

Orodje Liveworksheets nam omogoča, da svoje tradicionalne delovne liste za tiskanje (doc, pdf, ppt, jpg...) spremenimo v interaktivne spletne vaje, ki se samodejno ovrednotijo [1]. Učenci lahko delovne liste rešujejo preko spleta in odgovore pošljejo učitelju. Prednost tega je večplastna: predstavlja večjo motivacijo za učence, omogoči njim in učitelju takojšnjo povratno informacijo, učitelju prihrani čas in je prijazen okolju glede na prihranek papirja. Poleg tega interaktivni delovni listi v celoti izkoristijo nove tehnologije, ki se uporabljajo pri izobraževanju: lahko vključujejo zvok, videoposnetke, različne tipe nalog kot so naloge izbirnega tipa, naloge dopolnjevanja in

kratkih odgovorov, naloge povezovanja in urejanja in celo slušne in govorne vaje, ki jih morajo učenci izvajati z mikrofonom.

Delo v aplikaciji zahteva registracijo, ki jo opravite, preden lahko začnete z delom. Osnovna stran ponuja prijavo za učitelja ali prijavo za učenca. Ključne povezave so tri in sicer: iskanje ter uporaba že narejenih interaktivnih učnih listov, izdelava svojih lastnih interaktivnih učnih listov in povezovanje interaktivnih učnih listov v delovne zvezke. Meni *Community* je namenjen urejanju dela za prijavljenega uporabnika in urejanje gradiva za deljenje z učenci.

Učenci dostopajo do gradiva tako, da jim učitelj preprosto pošlje povezavo ali pa učence vpiše v aplikacijo in jim dodeli ustrezne naloge za reševanje. Po reševanju izbranih ali dodeljenih nalog se jim avtomatično izpiše povratna informacija o uspešnosti. Le-ta upošteva samo odgovore, za katera so bila ustvarjena polja, ki jih sistem lahko točkuje, ne zna pa točkovati t. i. prostih odgovorov.

3 IZDELAVA INTERAKTIVNIGA UČNEGA LISTA

S pomočjo orodja lahko zelo enostavno izdelamo svoje lastne interaktivne učne liste, tako da naložimo svoj dokument v aplikacijo Liveworksheet (doc, pdf, jpg ...), ki bo nato pretvorjen v sliko. Nato na učni list samo vnesemo polja s pravimi odgovori. Obstaja tudi nekaj ukazov, ki se jih moramo naučiti za različne tipe nalog, kot so povleci - spusti, povezovanje, slušne vaje, govorne vaje itd.. Vendar je zelo enostavno obvladljivo, v pomoč pa so nam v orodju priloženi tutorial-i ali video priročniki. Seveda pa je potebno omeniti, da lahko v zbirki uporabimo tudi že izdelane interaktivne učne liste, ki zajemajo veliko različnih jezikov in predmetnih področij in so jih bili učitelji pripravljeni dati v skupno rabo in deliti z ostalimi. [1]

3.1 Naložite svoj učni list

Kliknite na *make interactive worksheets* - izdelaj interaktivni učni list na vrhu strani (glavni meni) in kliknite ***get started*** - začni. Nato kliknite *Select file* - Izberi datoteko, *choose the document* - izberi dokument v računalniku in nato kliknite *upload* - naloži.(Slika 1) Datoteka mora biti v formatu doc, docx, pdf, jpg ali png. Omejitev velikosti je 5 MB. Ko se naloži, se bo dokument pojavil na zaslonu in takoj lahko pričnemo urejati in vstavljati besedilna polja v dokument.
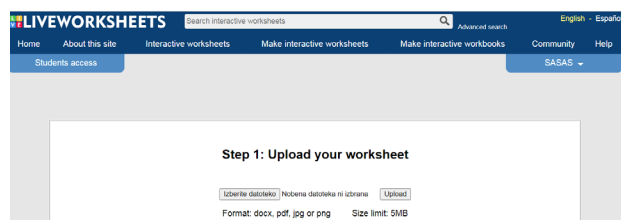
Slika 1: V prvem koraku naložimo svoj učni list (vir:
https://www.liveworksheets.com/lwsmaker/index.asp)

3.2 Izdelava različnih tipov nalog

3.2.1 Vstavljanje pravilnih odgovorov

Na delovnem listu narišete besedilna polja za vstavljanje pravilnih odgovorov tako, da kliknite, pridržite in povlečete do

željene velikosti. Nato v besedilna polja zapišete pravilne odgovore. Če obstaja več možnih odgovorov, vnesete vse, ločene s poševnicami. (Slika 2)

Slika 2: Vstavimo besedilna polja in vanje vpišemo ustrezne odgovore (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.2 Naloga spustnega tipa

Učencem lahko ponudite spustni seznam možnosti, med katerimi lahko izbirajo ustrezno rešitev. V tem primeru narišete besedilno polje in vnesete "choose:", ki mu sledijo možnosti, ločene s poševnicami, pravilni odgovor pa označite z zvezdico. (Slika 3)
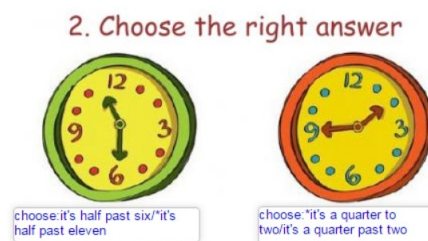
Slika 3: Izdelava vaje spustnega tipa (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.3 Naloga izbirnega tipa

Pri nalogah tega tipa na pravilen odgovor vnesete »select: yes«, na napačen odgovor pa »select: no«. (Slika 4) Če gre za vprašanje z več možnimi odgovori (na primer: "Izberite svojo najljubšo barvo"), vnesete samo "select:".

Slika 4: Izdelava vaje izbirnega tipa (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.4 Naloga povezovanja

V besedilna polja vnesete "join:1", "join:2", "join:3" itd, ki jim sledi isto število odgovorov. (Slika 5) Številke se ne smejo ponavljati.
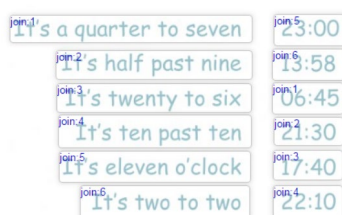
Slika 5: Izdelava vaje povezovanja (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.5 Naloga tipa povleci – spusti

V besedilna polja vnesete "drag - povleci", ki ji sledi številka elementa, ki ga je treba povleči, in "drop - spusti", za njim pa številko ustreznega para. (Slika 6) Številke se ne smejo ponavljati.

Slika 6: Izdelava vaje povleci – spusti (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.6 Naloga slušnega tipa

Da, tako je: interaktivni učni list lahko pripravimo tudi do govorjenja! V besedilna polja vnesete "listen - poslušaj:", ki mu sledi beseda ali poved, ki jo bodo učenci slišali. (Slika 7) S pomočjo sintetizatorja govora boste le še izbrali jezik in slušna naloga za vajo, preverjanje ali ocenjevanje je pripravljena.

Slika 7: Izdelava slušne vaje (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.2.7 Naloga govornega tipa

V besedilna polja vnesete »speak:«, ki mu sledi odgovor. (Slika 8) Nato izberete jezik. Če je možnih več odgovorov, vnesite vse, vendar jih obvezno ločite s poševnicami. Trenutno so govorne vaje delovale le v brskalniku Google Chrome.
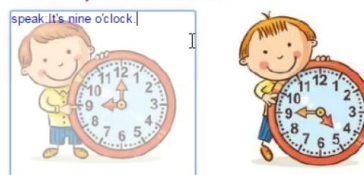
Slika 8: Izdelava govorne vaje (vir:
https://www.liveworksheets.com/lwsmaker/gettingstarted.asp)

3.3 Predogled

Kliknite gumb "preview" za predogled, da si ogledate svoj interaktivni delovni list in ga preverite.

3.4 Shranite učni list

Če ste po predogledu zadovoljni z rezultatom, kliknite gumb za shranjevanje. Nato vnesete naslov učnega lista, uporabniško ime in geslo. Povezava do novega interaktivnega delovnega lista, ki jo lahko pošljete svojim učencem, vam bo takoj na razpolago.

3.5 Skupna raba učnega lista

Če želite, lahko svoj interaktivni delovni list delite z drugimi uporabniki. Vnesti boste morali naslov, jezik, stopnjo, zadevo, starost, opis in vsebino delovnega lista. Te informacije bodo drugim pomagale pri iskanju vašega delovnega lista.

3.6 Posredovanje učnih listov učencem

Obstajata dva načina za pošiljanje učnih listov učencem: Prva, enostavna, je kopiranje povezave učnega lista in pošiljanje le-te po e-pošti, spletni učilnici, socialnih medijih itd. Ko učenci rešijo učni list, svoje odgovore pošljejo učitelju (samodejno se bodo preverili in točkovali, pravilni in nepravilni odgovori bodo nemudoma vidni in obarvani z zeleno in rdečo). (Slika 9) Za to možnost se učencem ni treba registrirati.
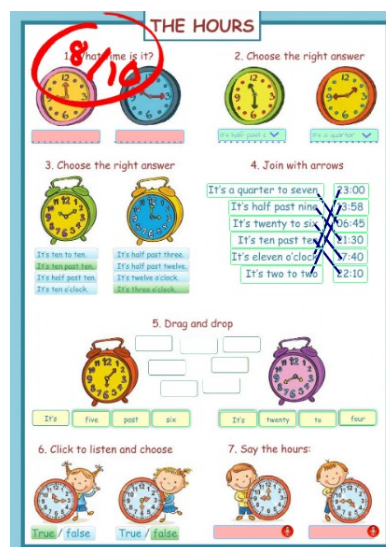
Slika 9: Takojšnja povratna informacije o uspešnosti (vir:
https://www.liveworksheets.com/worksheets/en/English_as_a_Second_Language_(ESL)/Telling_the_time/The_hours_ub184zs)

Druga možnost zahteva več časa za pripravo, vendar je najboljša rešitev v primeru, če nameravate to spletno mesto s svojimi učenci redno uporabljati. Lahko registrirate svoje učence (ali jih povabite, da se prijavijo), sestavite interaktivne delovne zvezke z najljubšimi delovnimi listi in jim dodelite delovne zvezke. S pomočjo te možnosti lahko učenci dostopajo do t.i. *students' zone* z uporabniškim imenom in geslom ter rešujejo vaje v svojih delovnih zvezkih. Vso njihovo delo bo shranjeno, tako da lahko kadar koli preverite njihovo delo in napredek.

3.7 Kam učitelji prejmejo ovrednotene učne liste učencev

Najpreprostejši način je, da učenci, potem ko rešijo učni list, kliknejo ponujeno možnost »Finish - Končaj«, nato izberejo "Pošlji moje odgovore učitelju" in vnesejo vaš e-poštni naslov. Nato boste v svojem e-poštnem sporočilu dobili obvestilo, vse odgovore učencev pa lahko preverite tudi v sami aplikaciji v svojem poštnem predalu.

Bolj zapletena, a še boljša možnost je, da izdelate svoj interaktivni delovni zvezek in vanj dodate svoje najljubše učne liste (svoje ali pa učne liste drugih učiteljev, ki so jih delili v skupno rabo). Nato registrirate svoje učence in jim dodelite delovne zvezke. Kadarkoli lahko preverite njihovo delo, dodelite domačo nalogo ali dodajate komentarje in opombe.

4 ZAKLJUČEK

V času, ko so bile šolske učilnice prazne, smo bili učitelji primorani s pomočjo digitalne tehnologije iskati nove načine za podajanje učne snovi na daljavo, ob tem pa je potrebno poudariti, da je prav poseben izziv predstavljalo preverjanje in ocenjevanje znanja. Liveworksheet je samo ena izmed mnogih možnosti, ki se je izkazala za učinkovito. Glavno prednost vidim v tem, da so se po izjavah učencev in staršev celo zabavali ob reševanju tovrstnih vaj, predvsem pa jim je bilo všeč, da so takoj dobili povratno informacijo o pravilnosti rešenega in svoji uspešnosti. Nemalokrat so ob sprotnem preverjanju učni list reševali večkrat, preden so bili zadovoljni s svojimi rezultati in končni izdelek poslali učitelju. Prav to mi je bil neizpodbiten dokaz za tako željeno angažiranost, samoiniciativnost in motiviranost pri učencih. Seveda se v primeru ocenjevanja med ponujenimi opcijami čas reševanja časovno omeji in tako prepreči večkratno reševanje.

Čeprav sama priprava interaktivnega učnega lista od učitelja zahteva bistveno več vloženega časa, se trud izplača, saj so učenci za tako delo bistveno bolj motivirani in skoncentrirani. Temu primerno je tudi njihovo znanje večje. Menim, da bi bila škoda, da ne bi izmenjevali dobrih praks in tudi v prihodnosti uporabili tehnologije in novih načinov poučevanja in preverjanja znanja, bodisi pri poučevanju na daljavo kot tudi v samem razredu, saj postaja informacijsko-komunikacijska tehnologija v današnjem času vedno bolj nepogrešljiv učni pripomoček, ki predstavlja prednost vsem udeležencem v učnem procesu [3].

VIRI IN LITERATURA

[1] Liveworksheet: https://www.liveworksheets.com/

[2] The Benefits of Online Assessment: https://www.testreach.com/benefits-of-online-assessment-testreach.html

[3] Advantages of using online assessment tools to evaluate students: https://www.creatrixcampus.com/blog/5-advantages-using-online-assessment-tools-evaluate-students

[4] Rutar Ilc, Z., 2003: Pristopi k poučevanju, preverjanju in ocenjevanju. Ljubljana: Zavod republike Slovenije za šolstvo.

[5] Boekaerts, M. 2013. Motivacija in čustva imajo ključno vlogo pri učenju. V Dumont, H. et all. 2013. O naravi učenja: Uporaba raziskav za navdih prakse, 2. izd., Ljubljana, Zavod RS za šolstvo, dostopno na: http://ww.zrss.si/pdf/o-naraviucenja.pdf (24. 8. 2019).

Formativno spremljanje v času izobraževanja na daljavo

Formative assessment in time of distance learning

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POVZETEK

Formativno spremljanje je eno od učinkovitih načinov pouka, ki učencem omogoča, da so soodgovorni za lastno znanje. V preteklem šolskem letu smo zaradi epidemije koronavirusa izobraževanje učencev nadaljevali na daljavo. V prispevku je predstavljena uporaba elementov formativnega spremljanja v obdobju izobraževanja na daljavo na primeru dveh učnih sklopov pri predmetu družba v četrtem razredu ob pomoči različnih računalniških orodij in aplikacij. Rezultat dela po načelih formativnega spremljanja je dober, učenci so dosegli cilje, ki smo si jih zastavili. Poleg dobrih učnih rezultatov pa so učenci dosegli še mnoge cilje, ki krepijo kompetence s področja praktične uporabe IKT.

KLJUČNE BESEDE

Šolanje na daljavo, informacijska tehnologija, Google obrazci, Socrative, Xooltime

ABSTRACT

Formative assessment is one of the effective ways of teaching that allows students to be co-responsible for their own knowledge. In the past school year, due to the coronavirus epidemic, we continued to educate students at a distance learning. The paper presents two cases of formative assessment during distance learning in the subject society in the fourth grade with the help of various computer tools and applications. The result of working according to the principles of formative assessment is good, the students have achieved the goals we set for ourselves. In addition to good learning outcomes, students have achieved many goals that strengthen competencies in the field of practical use of ICT.

KEYWORDS

Distance learning, information technology, Google Forms, Socrative, Xooltime

1 UVOD

Marca 2020 smo vsi izobraževalci v Sloveniji vključno z učenci, dijaki in študenti, ostali doma in se šolali drugače, kot smo bili do sedaj navajeni. Epidemija koronavirusa nas je prisilila, da smo spremenili način poučevanja, učenci pa načine učenja. Prejšnje šolsko leto je naša šola vstopila v razvojno nalogo Uvajanje formativnega spremljanja in inkluzivne paradigme. Gre za projekt, ki traja dve leti. Tako smo tudi v času izobraževanja na daljavo izvajali formativno spremljanje. Prilagoditi smo morali načine vključevanja elementov formativnega spremljanja v pouk, ki je potekal na daljavo.

2 FORMATIVNO SPREMLJANJE

Formativno spremljanje je način pouka, ki sta ga razvila Britanca Paul Black in Dylan William. Pri formativnem spremljanju je učenec tisti, ki izgrajuje svoje znanje, učitelj pa ga pri tem podpira tako, da ves čas ugotavlja, kako napreduje ter pouk prilagaja povratnim informacijam, ki jih od njega pridobi [1].

Formativno spremljanje vključuje pet elementov [1]:

- oblikovanje namenov učenja in kriterijev uspešnosti,
- pridobivanje dokazov o učenju,
- zagotavljanje povratnih informacij (tako od učenca k učitelju kot tudi od učitelja k učencu),
- oblikovanje vprašanj v podporo učenju,
- samovrednotenje ter vrstniško vrednotenje.

2.1 Nameni učenja in kriteriji uspešnosti

Nameni učenja so na takšen način preoblikovani učni cilji iz učnega načrta, da so razumljivi učencu. V učnih načrtih so namreč cilji pogosto zapisani tako, da so razumljivi učiteljem, torej strokovnim delavcem. Oblikovani nameni učenja učencu pomagajo, da razume, kaj se bo učil, mu pomaga osredotočiti se na učno dejavnost in prevzeti odgovornost do lastnega učenja [1]. Kriteriji uspešnosti pa so konkretne trditve, ki so povezane z nameni učenja ter učnimi cilji, ki učencu pomagajo razumeti, v katerem primeru bodo uspešni. Z njihovo pomočjo vedo, ali so dosegli namene učenja.

2.2 Dokazi o učenju

Dokazi so zbirka podatkov, ki jih v procesu učenja dobiva učitelj (ter tudi učenec). V grobem jih delimo v tri skupine: dokazi, ki izhajajo iz pogovorov med poukom, dokazi, ki izhajajo iz

opazovanj ter izdelki kot dokazi [1]. Učenec lahko dokaze zbira tudi v portfoliu, ki omogoča vpogled v njegovo delo. Dokazi se zbirajo v vseh fazah učenja, saj je s tem viden tudi učenčev napredek.

2.3 Povratna informacija

Povratna informacija učencu pove, kako dobro je dosegel cilje ter kaj mora še izboljšati. Učenca spodbuja k razmisleku o tem, na kateri stopnji na poti do svojega cilja je ter kaj vse mora še napraviti, da bo ta cilj dosegel. Povratna informacija mora biti jasna in razumljiva, pravočasna in primerno pogosta, povezana z nameni učenja ter kriteriji uspešnosti, konkretna, specifična in uporabna [1]. Dobro je, da vsebuje tudi predlog, kako izboljšati izdelek. Povratno informacijo lahko učencu podaja učitelj ali pa drug učenec. Prav tako pa so pomembne tudi informacije, ki jih podaja učenec učitelju, saj mu s tem pomaga razumeti učenčeve misli ter potrebe.

2.4 Vprašanja v podporo učenju

Vprašanja učencu pomagajo pri učenju. Vendarle pa moramo paziti, kakšna vprašanja postavljamo, saj morajo biti načrtovana premišljeno ter spodbujati razmišljanje na vseh taksonomskih ravneh. Boljša so odprta vprašanja, saj omogočajo iskanje različnih odgovorov. Pri postavljanju vprašanj pred več učenci se je dobro izogniti dvigovanju rok, saj tak način k razmišljanju spodbudi tudi ostale učence. Prav tako je potrebno učencem zagotoviti dovolj časa za razmislek o odgovoru. Učence je potrebno spodbujati tudi k medvrstniškemu postavljanju vprašanj.

2.5 Samovrednotenje in vrstniško vrednotenje

Samovrednotenje je zmožnost realne presoje lastne uspešnosti [1]. Učenec s pomočjo pregleda dokazov o doseganju namenov učenja presoja, v kolikšni meri jih je dosegel ter o nadaljnjih korakih in morebitnih spremembah načina učenja. Samovrednotenje poteka v vseh fazah učenja. Pri vrstniškem vrednotenju učenci drug drugemu podajajo analizo dosežkov. V tem primeru mora učitelj v razredu zagotoviti zaupanja vredno okolje, v katerem se učenci počutijo varno.

3 IZOBRAŽEVANJE NA DALJAVO

Izobraževanje na daljavo (distance education) je oblika izobraževanja, ko sta učitelj in učenec med poučevanjem prostorsko ločena, komunikacijo med njima in komunikacijo med učenci samimi pa omogočajo različne vrste tehnologij [1]. M. Burns [1] loči 5 modelov izobraževanja na daljavo glede na prevladujočo tehnologijo:

- korespondenčni model (natisnjena besedila),
- avdiomodel (avdiotehnologija, radio),
- televizualni model (videokonferenčni sistemi, televizija),
- na računalniški tehnologiji temelječi multimedijski model (interaktivni videi, CD-ROM-i, interaktivna multimedija),
- na spletu temelječi modeli (online tečaji, online konference, virtualni razredi oz. šole in univerze),
- modeli, temelječi na mobilni tehnologiji (pametni telefoni, tablice, e-bralniki)

Današnje tehnologije za izobraževanje na daljavo omogočajo dve vrsti komunikacije: sinhrono oz. sočasno ter asinhrono oz. časovno neusklajeno komunikacijo učitelja in učenca [1]. V zadnjem času se uporablja pretežno kombinacija obojega, saj nam to omogočajo raznolika spletna okolja, kot so npr. spletne učilnice.

4 FORMATIVNO SPREMLJANJE V ČASU IZOBRAŽEVANJA NA DALJAVO

Izobraževanje na daljavo je v naši šoli po dogovoru potekalo tako, da smo učitelji vsakodnevno pošiljali staršem dokumente, v katerih so bila navodila za šolsko delo tistega dne. Razrednik je tako zbral skupaj vsa navodila ter morebitne priloge, ki jih je v eni elektronski pošti poslal staršem preko modula komunikacija v aplikaciji eAsistent [1]. Učenci so sčasoma postajali vse bolj suvereni pri uporabi IKT, zato so nekateri starši predlagali, da bi se elektronska pošta z navodili pošiljala tudi učencem. Tako so nekateri učitelji vsebine pošiljali še učencem preko eAsistenta za učence. Starši so pohvalili to, da so elektronsko pošto z navodili prejemali tudi sami, saj so tako lahko nadzorovali delo svojega otroka.

Tudi v času izobraževanja na daljavo smo nekateri učitelji pri pouku uporabljali elemente formativnega spremljanja. Predstavljen je primer uporabe formativnega spremljanja pri pouku družbe v 4. razredu pri učnih sklopih domača pokrajina in dejavnosti. Nekaj učne snovi je bilo predelane že v času pred karanteno. Tako smo se že pri pouku v učilnici pogovarjali o namenih učenja.

4.1 Kriteriji uspešnosti

Učencem smo poslali kriterije uspešnosti (slika 1 in slika 2), ki so jim pomagali pri presojanju, kako dobro znajo vsebine obravnavanih sklopov, ki smo jih kasneje tudi ocenili.

CILJI – sklop DOMAČA POKRAJINA	S ✓ označi, kako dobro dosegaš cilje učnega sklopa.		
Znam in zmorem:	☺	😐	☹
1. razložiti, kaj je tloris.			
2. razložiti razliko med načrtom, zemljevidom in letalsko fotografijo.			
3. razložiti, čemu služi merilo.			
4. našteti sestavne dele zemljevida in za vsak sestavni del razložiti njegovo vlogo.			
5. našteti glavne in stranske smeri neba in jih tudi uporabiti.			
6. razložiti, kaj je kompas.			
7. določiti glavne smeri neba s pomočjo sonca in sence.			
8. določiti glavne smeri neba s pomočjo ure.			
9. določiti glavne smeri neba s pomočjo kompasa.			
10. se orientirati v načrtih, skicah in zemljevidih.			
11. razložiti značilnosti podeželskih in mestnih naselij.			
12. razložiti, kako in zakaj se naselja spreminjajo.			
13. našteti vseh sedem naravnih značilnosti pokrajine (naravni pojavi).			
14. opisati vsako od naravnih značilnosti (naravnih pojavov), ki je značilna za našo domačo pokrajino.			
15. razložiti, kaj je relief.			
16. našteti in opisati vseh šest reliefnih oblik.			
17. na primerih razložiti, kako človek vpliva na spreminjanje narave.			

Slika 62: Kriteriji uspešnosti za učni sklop domača pokrajina.

CILJI – sklop DEJAVNOSTI	S ✓ označi, kako dobro dosegaš cilje učnega sklopa.		
Znam in zmorem:	☺	😐	☹
1.	našteti dve glavni skupini dejavnosti.			
2.	našteti, kaj spada med gospodarske in kaj med negospodarske dejavnosti.			
3.	razdeliti gospodarske dejavnosti na tri glavne skupine in opisati, v čem se razlikujejo med seboj.			
4.	opisati posamezne dejavnosti, ki izkoriščajo naravne vire.			
5.	opisati značilnosti obrti, značilnosti industrije ter razliko med njima.			
6.	razložiti, kaj so storitvene dejavnosti in jih opisati.			
7.	na primerih opisati, kako človek vpliva na spreminjanje narave ter kaj to pomeni za naravo (promet, gradnja cest, predorov, zgradb in pristanišč, kamnolomi, odpadki).			

Slika 63: Kriteriji uspešnosti za učni sklop dejavnosti.

4.2 Dokazi o učenju

Učenci so bili občasno naprošeni, da so pošiljali dokaze (slika 3 in slika 4) o svojem učenju preko elektronske pošte, kasneje pa preko spletne učilnice Xooltime, ki jo je v času izrednih razmer razvilo podjetje eŠola d. o. o., pod okriljem aplikacije eAsistent [1].

"Tako, da bi na primer plastenke pomili in potem isto plastenko spet uporabili ali plastično vrečko večkrat uporabil in, da bi kupovali hrano, ki ni večkrat pakirana ali, da bi kupovali baterije, ki jii polnimo in ne tiste ki ji vržemo stran in, ko gremo v trovino vzamemo košaro s sabo, da ne kupujemo plastičnih vreč, da v trgovini na primer za banane ne vzamemo še ene vrečke ampak, da nalepko nalimamo na banane in seveda da hrano čimveč kompostiramo... Pa spomnim se, da sem gledal neko oddajo, ko so v Indiji otroci imeli v šoli vrt in so pri malici in kosilu ostanke hrane metali v vedra in nato na kompost in so imeli svoj kompost in bi bilo fino, če bi tudi mi imeli v šoli kakšen vrtiček in bi tudi bilo manj odpadkov"

"Zmanjašala bi tako, da ne bi več uporabljali plastičnih kozarcev in plastičnega pribora. V trgovini ne bi več uporabljali plastičnih vrečk za enkratno uporabo. Če so nam oblačila premajhna jih podarimo naprej drugim, strgana oblačila pa lahko zašijemo ali iz njih kaj izdelamo. Polomljene ali pokvarjene stvari poskušamo popraviti in ne kupimo takoj novega izdelka. "

"Včasih na sprehod uzamemo vrečko in rokavice za enkratno uporabo , ter pobiramo odpadke, v trgovini se izogibajmo plastičnim vrečkam in plastičnim embalažam in večkrat izberemo trajnostni prevoz."

"Mi varčujemo s steklenicami. Prazne steklenice očistimo, jih potem napovnemo in dobro zapremo. Star papir povežemo z vrvjo in ga odnesemo na skupno zbiralište. Tudi plastiko (npr. kozarčki od jogurta) lahko uporabimo namesto steklenega kozarca za pitje. "

Slika 64: Dokazi o učenju, ki so jih preko aplikacije eAsistent [1] podali učenci na nalogo, naj zapišejo tri izvirne ideje, na kakšen način bi v njihovi družini ali šoli trajnostno ravnali.

Slika 65: Eden izmed dokazov o učenju je bil tudi plakat, ki ga je učenec izdelal s pomočjo znanja, ki ga je pridobil na primeru svojega domačega kraja. Plakat je nato učenec fotografiral in ga naložil v ustrezno objavo v spletno učilnico Xooltime, ki je del eAsistenta [1].

4.3 Povratna informacija

Učenci so v procesu učenja in tudi ob koncu reševali različne naloge (slika 5) preko spletnih aplikacij, preko katerih je posameznik prejel povratno informacijo o svojem učenju (slika 6). Kot zelo uporabna se je izkazala aplikacija Google obrazci oz. Google Forms [1], ki omogoča izdelavo neke vrste kviza. Če v obrazec vnesemo tudi zahtevek za vpis elektronskega naslova, lahko obrazec po pregledu učitelja samodejno pošlje povratno informacijo o pravilnosti rešitev.

Slika 66: Aplikacija Google obrazci oz. Google Forms [1] omogoča tudi vprašanja odprtega tipa, ki jih kasneje pregledamo in ovrednotimo.

Slika 67: Učencu lahko poleg točk pri posameznem odgovoru napišemo tudi povratno informacijo.

Google obrazci oz. Google Forms [1] daje učitelju podrobno sliko o znanju posameznika ter celotnega razreda s pomočjo statističnih podatkov (slika 7).
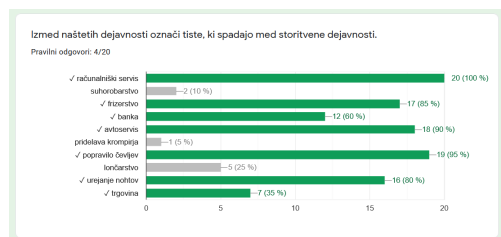
Slika 68: Google obrazci omogočajo tudi odlično statistiko za učitelja.

Dokaze o učenju smo zbirali tudi preko nekaterih drugih aplikacij (slika 8), npr. preko aplikacije Socrative [1]. Kljub temu, da ni prevedena v slovenščino, so jo četrtošolci hitro znali uporabljati brez težav. Prednost te aplikacije je, da ne zahteva registracije učenca, pač pa učenec na začetku le vpiše kodo naloge ter svoje ime.

Slika 69: Povratne informacije od učenca k učitelju smo pridobivali tudi preko aplikacije Socrative [1].

4.4 Vprašanja v podporo učenju

Vprašanja v podporo učenju smo učencem postavljali predvsem preko rednih srečanj preko aplikacije Zoom [1]. Tako so učenci ostali v stiku s sošolci, učiteljem ter učno snovjo. Poleg tega je tak način dela »pomagal« vsem tistim, ki so imeli več težav s tem, da so v času izobraževanja na daljavo poprijeli za šolsko delo. Videokonferenčna srečanja so tako omogočala tudi učencem, da so postavljali vprašanja drug drugemu.

4.5 Samovrednotenje in vrstniško vrednotenje

Samovrednotenje ter vrstniško vrednotenje tega dela učne snovi smo izvedli v tednih v juniju, ko smo se zopet vrnili v šolske klopi. Učenci so na podlagi kriterijev uspešnosti presojali doseganje učnih ciljev. Pri svojem delu so bili več kot uspešni, kar se je pokazalo tudi pri ocenah iz te učne snovi. Učenci so morali povezati teoretično znanje z lastnostmi svojega domačega kraja oz. pokrajine.

5 POVRATNA INFORMACIJA UČENCEV IN STARŠEV

Učenci so bili že vajeni dela po načelih formativnega spremljanja. Poročali so, da jim je všeč, da pri svojem delu uporabljajo različne spletne aplikacije, vendar pa jim uporaba teh (zaenkrat) vzame več časa, kot če bi delali na klasičen način.

Starši so bili veseli, da so njihovi četrtošolci veliko nalog lahko opravili sami. Včasih so imeli le na začetku nekaj dela z njimi, da so jim razložili osnove uporabe določene aplikacije. Všeč jim je bilo tudi, da smo se pogosto slišali in videli preko video klica.

6 ZAKLJUČEK

Glede na to, da bo v prihodnje izobraževanje na daljavo kot kaže ostalo vsaj delno prisotno v našem šolskem vsakdanu, je dobro poznati možnosti, ki nam jih taka oblika izobraževanja ponuja. Formativno spremljanje je zagotovo ena od prioritet, ki bi jo rade šole vpeljale v svoj vsakdan. Na tak način bodo učenci postali in ostali aktivni v izgradnji svojega znanja, prevzeli bodo odgovornost za svoje učenje ter znanje. Elemente formativnega spremljanja je v izobraževanje na daljavo smiselno vpeljevati, vendar premišljeno ter v ustrezni količini. Pogosto se namreč zgodi, da se učenci v »poplavi« vsega izgubijo ter tako hitro izgubijo motivacijo. Na to bomo morali biti učitelji še posebej pozorni.

VIRI

[1] Burns, M. 2011. Distance Education for Teacher Training: Modes, Models, and Methods. Education Development Center. DOI: http://idd.edc.org/sites/idd.edc.org/files/Distance%20Education%20for%20Teacher%20Training%20by%20Mary%20Burns%20EDC.pdf (pridobljeno 10. 8. 2020).

[2] eAsistent https://www.easistent.com/

[3] Google obrazci oz. Google Forms https://www.google.com/intl/sl/forms/about/

[4] Holcar Brunauer, A. idr. 2019. *Formativno spremljanje v podporo učenju.* Priročnik za učitelje in strokovne delavce (7 zvezkov). Zavod Republike Slovenije za šolstvo.

[5] Rupnik Vec, T. idr. 2020. Analiza izobraževanja na daljavo v času epidemije Covid-19 v Sloveniji. Delno poročilo. Zavod Republike Slovenije za šolstvo. DOI: https://www.zrss.si/digitalnaknjiznica/IzobrazevanjeNaDaljavo/2/#zoom=z (pridobljeno 9. 8. 2020)

[6] Socrative https://www.socrative.com/

[7] Zoom https://zoom.us/

Varna mobilnost tudi na daljavo

Safe mobility in time of distance learning

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POVZETEK

V preteklem šolskem letu smo zaradi pojava novega koronavirusa in z njim povezane bolezni COVID-19 praktično čez noč bili primorani spremeniti svoj način poučevanja in se navaditi na šolanje na daljavo. Drugačen način pouka nam je vsem udeleženim, tako učencem, učiteljem kot tudi staršem, obrnil življenje na glavo. Ker pa je šolski kurikulum sestavljen iz obveznega in razširjenega programa, so mnogi učenci v pomanjkanju časa ter težavam pri prilagajanju na drugačen način dela, razumljivo prednost dali obveznemu delu kurikuluma. Učitelji smo tako iskali različne načine za motiviranje učencev. V prispevku je predstavljen primer dobre prakse, kako smo uresničevali cilje razširjenega programa v času šolanja na daljavo. Rezultat skupnega dela je bil video, sestavljen iz posameznih posnetkov, ki smo ga ob koncu šolskega leta predvajali ostalim učencem. Četrtošolci, ki so sodelovali pri izdelavi, so bili na svoje izdelke ponosni, poleg tega pa so se spoznavali z uporabo informacijske tehnologije na koristen način ter interaktivno varnostjo.

KLJUČNE BESEDE

Šolanje na daljavo, razširjeni program, informacijska tehnologija, OpenShot Video Editor

ABSTRACT

In the past school year, due to the emergence of the new coronavirus and the associated disease COVID-19, we were forced to change our teaching methods almost overnight and get used to distance learning. A different way of teaching turned the lives upside down for all participants, students, teachers and parents. However, because the school curriculum consists of a compulsory and extended curriculum, many students, in the lack of time and difficulty in adapting to a different way of working, gave understandable priority to the compulsory part of the curriculum. Teachers were thus looking for different ways to motivate students. The article presents an example of good practice in how we achieved the goals of the extended program during distance learning. The result of the joint work was a video consisting of individual recordings, which we played to other students at the end of the school year. The fourth-graders who took part in the production were proud of their products, and they also learned about the use of information technology in a useful way and interactive security.

KEYWORDS

Distance learning, extended program, information technology, OpenShot Video Editor

1 UVOD

Letošnje šolsko leto je bilo posebno v vseh pomenih te besede. Meseca marca so se učenci namreč namesto v šolskih klopeh začeli izobraževati na daljavo. Izkušnja je bila nova tako za učence kot tudi učitelje. Predvsem od učiteljev je zahtevala popolno reorganizacijo pouka za iskanje najracionalnejše poti za doseganje zastavljenih učnih ciljev. Na daljavo pa se ni izvajal le obvezni program, pač pa tudi razširjeni program osnovne šole, kamor spada tudi poskus »Uvajanje tujega jezika v obveznem programu in preizkušanje koncepta razširjenega programa v osnovni šoli« , znotraj tega pa vsebinski sklop Gibanje in zdravje za dobro psihično in fizično počutje oz. na kratko GZDP, kar zajema tudi teme varne mobilnosti. V prvi polovici šolskega leta smo skupaj z učenci izdelali kar nekaj izdelkov, ki smo jih predstavili ožji in širši okolici, npr. maketo okolice šole s fotografijami nevarnih prometnih točk, letake, s katerimi smo ob pomoči policista voznike v okolici šole opozarjali na problem alkoholiziranosti za volanom … Ko pa smo zaradi pojava novega koronavirusa ostali doma, smo morali plane nekoliko spremeniti. Ni preostalo drugega, kot da smo naše delo prilagodili razmeram in s skupnimi močmi ustvarili video, s pomočjo katerega smo učencem naše šole pokazali, kaj vse smo v letošnjem šolskem letu počeli v okviru varne mobilnosti.

2 RAZŠIRJENI PROGRAM – GIBANJE IN ZDRAVJE ZA DOBRO PSIHIČNO IN FIZIČNO POČUTJE

Program osnovne šole sestavljata obvezni in razširjeni program **Error! Reference source not found.**. Obvezni program obsega obvezne in izbirne predmete, ure oddelčne skupnosti, dneve dejavnosti in šolo v naravi. Razširjeni program obsega neobvezne izbirne predmete, individualno in skupinsko pomoč učencem, dopolnilni in dodatni pouk, interesne dejavnosti, podaljšano bivanje in jutranje varstvo. Šole so dolžne ponuditi

vse organizacijske oblike razširjenega programa, učenci pa se vanje prostovoljno vključujejo **Error! Reference source not found.**.

Razširjeni program osnovne šole se bo iz oblike, kot jo poznamo danes, sčasoma preoblikoval v tri glavna področja **Error! Reference source not found.**:

- Gibanje in zdravje za dobro psihično in fizično počutje (področje A),
- Kultura in tradicija (področje B),
- Vsebine iz življenja in dela osnovne šole (področje C).

Telesna aktivnost, zdrava prehrana, varno okolje in preventivni programi so pomembni dejavniki, ki mladim zagotavljajo optimalen razvoj v času odraščanja. Veliko mladih se namesto za žogo na igriščih podi za žogo na raznih igralnih konzolah, poleg tega se pogosto neredno prehranjujejo s pretežno predelano hrano, premalo pijejo ter zaradi pomanjkanja znanja o tem po nepotrebnem na dolgi rok uničujejo svoje zdravje. V okviru prenovljenega razširjenega programa naj bi učenci spoznali različne vsebine in načine udejanjanja zdravega življenjskega sloga, jih preizkusili, občutili in doživeli **Error! Reference source not found.**.

3 VARNA MOBILNOST

Znotraj področja A (Gibanje in zdravje za dobro psihično in fizično počutje) so naslednji sklopi **Error! Reference source not found.**: gibanje, hrana in prehranjevanje ter zdravje in varnost. V sklop »zdravje in varnost« spada tudi varna mobilnost. V delovnem gradivu Razširjeni program osnovne šole **Error! Reference source not found.** je varna mobilnost definirana kot »sodoben način življenja in dela, katerega sestavni del so prometna kultura, zdrav način življenja, ustrezen odnos do okolja ter ekonomično ravnanje udeležencev v prometu«. Ker se učenci v prometu znajdejo v različnih vlogah (pešci, kolesarji, sopotniki v avtomobilu ali avtobusu …), so vsebine varne mobilnosti namenjene usvajanju znanja in razvijanju različnih kompetenc, ki jih morajo v naštetih vlogah obvladati, da se lahko varno vključujejo v družbo.

4 PRIMER DOBRE PRAKSE

4.1 Varna mobilnost na naši šoli

Vsebinam varne mobilnosti je bilo letno namenjenih 38 ur, torej ena šolska ura tedensko. Ker gre za razširjeni program, je bila ura varne mobilnosti zastavljena tako, da se ni izvajala vsakotedensko po eno uro, pač pa večinoma v t.i. blok urah, torej po dve šolski uri skupaj v nekajtedenskih sklopih, nato pa se nekaj časa ni izvajala. Tako smo izkoristili jesenske in spomladanske mesece, ko smo veliko časa preživeli zunaj in opravljali aktivnosti kar tam. V zimskem času tako vsebin varne mobilnosti nismo izvajali. V okviru teh ur smo jeseni izvedli kar nekaj aktivnosti. V tretjem tednu septembra, torej v Evropskem tednu mobilnosti, smo v sodelovanju z Mestno občino Kranj in društvom Rekreatur za učence od 2. do 5. razreda izpeljali dejavnost Pešbus. Dejavnost poteka v okviru programa Aktivno v šolo. Učitelji smo en teden vsako jutro učence razredne stopnje, ki so to želeli, po predvideni poti peš spremljali v šolo. Pešbus je

»ustavljal« na točno določenih mestih (postajališčih Pešbusa) ter sprejemal svoje potnike, učence. Učenci so prejeli tudi »vozovnico« ter vanjo zbirali žige. Aktivnost smo izpeljali že lansko šolsko leto (v jeseni in spomladi), letos pa smo nabor prog razširili, tako da smo postavili kar tri proge, katerih zadnja postaja je bila naša šola. V dejavnosti je skupno sodelovalo 54 učencev in 9 odraslih spremljevalcev (večinoma učiteljev).

V mesecu oktobru smo sodelovali na likovnem natečaju in pri izvedbi akcije »Otroci za varnost v prometu«, ki ga je organiziral NIJZ OE Kranj. Učenci so narisali risbe, ki se navezujejo na temo »promet in alkohol«, ter jih nato v spremstvu policista delili voznikom, ki so v času ulične akcije pripeljali mimo naše šole.

Oktobra in novembra pa smo se posvetili izdelavi makete naše šole z okolico (slika 1), na kateri smo prikazali prometni režim in nevarne točke. Sprehodili smo se skozi vas ter si ogledali okolico naše šole, fotografirali nevarnejše prometne točke, merilec hitrosti, prehode za pešce … Te fotografije smo potem nalepili na maketo.

Slika 70: Maketa, ki so jo izdelali učenci v okviru varne mobilnosti.

4.2 Varna mobilnost v času šolanja na daljavo

Z aktivnostmi smo nadaljevali v mesecu marcu. Pod šolo smo spremljali promet in šteli posamezna prevozna sredstva, ki so v določenem času pripeljala mimo. Zaradi pojava novega koronavirusa in s tem povezanega šolanja na daljavo, smo z aktivnostmi za nekaj časa prekinili. Nato smo na daljavo izvedli še nekaj aktivnosti: ogled raznih videov, ki so povezana z upadom prometa v času karantene po evropskih in svetovnih mestih, seznanjanje s tem, kako hodijo v šolo otroci drugod po svetu … V zadnjem delu šolskega leta pa smo se preko aplikacije Zoom dogovorili, da bo vsak učenec posnel video, ki je povezan z varnostjo v prometu ali pa s trajnostno mobilnostjo.

4.3 Navodila za izdelavo

Učencem je bilo potrebno podati nekaj navodil za izdelavo videa. To smo storili preko aplikacije Zoom **Error! Reference source not found.**, ki omogoča videokonferenčne klice. Ker so učenci že dobro vedeli, na kaj vse morajo biti udeleženci pozorni, nam tem ni bilo težko najti. Dogovorili smo se, da bomo posneli videe z naslednjo poučno vsebino: trajnostni način prevoza – vlak ali avtobus, vožnja s kolesom po ustreznih prometnih površinah, skupni prevozi, pripenjanje z varnostnim pasom, prečkanje ceste čez prehod za pešce ter vožnja po omejitvah. Ker so v tistem času poudarjali, naj ostanemo doma, smo se dogovorili, da bodo videe

snemali s pomočjo pripomočkov in ne v resničnih situacijah. Situacijo smo izkoristili tudi za pogovor o varnosti na internetu, posnetkih, na katerih so oni sami ter dejstvu, da posnetki, ki jih objavijo v svetovnem spletu, tam tudi za vedno ostanejo.

Slika 71: Učenci so svoje videe posneli s pomočjo igrač, ki jih imajo doma.

Učenci so se o tem, kateri video bodo posneli, odločali glede na igrače, ki so jih imeli doma, npr. skiro, avtomobil, avtobus … (slika 2). Prometno podlago so zgradili s pomočjo lego kock, nekateri so uporabili igralno podlogo, na kateri je cesta ali pa so si pomagali s podlago (slika 3), ki so jo izdelali v eni od nalog, ki so jo imeli v okviru pouka (izdelava družabne igre na temo trajnostne mobilnosti). Snemali so večinoma z mobiteli. Učenci so prejeli še naslednje usmeritve: video naj bo posnet ležeče, izogibajo naj se hitrim premikom, kadar govorijo naj bodo blizu telefona, da se jih bo dobro slišalo ipd.

Slika 72: Učenci so uporabili pripomočke, ki so jih imeli doma (podlaga, ki so jo izdelali za družabno igro na temo trajnostne mobilnosti ter igrače, kot npr. avtomobilčki ter osebe).

4.4 Snemanje in pošiljanje videov, ki so jih ustvarili učenci

Učenci so svoje videe večinoma posneli v MP4 formatu. Zaradi velike velikosti so svoje videe večinoma poslali preko orodja WeTransfer **Error! Reference source not found.**, ki je zelo enostaven za uporabo, omogoča pa pošiljanje večjih datotek (velikost do 2 GB).

4.5 Vmesni kadri

Posamezne videe učencev smo želeli zmontirati v celoto. Za slikovno podlago, v katero smo vključili slike na začetku videa, smo vzeli predlogo iz PowerPointa (slika 4), ki je del paketa Microsoft Office **Error! Reference source not found.**.

Slika 73: Ozadje ob začetku skupnega videa smo naredili s pomočjo predloge v programu Microsoft Powerpoint Error! Reference source not found.**.**

4.6 Montiranje videa v celoto

Za montiranje videov učencev v celoto smo uporabili računalniški program OpenShot Video Editor **Error! Reference source not found.**. Gre za brezplačen program, ki uporabniku omogoča enostavno montažo videov, slik, glasbenega ozadja ter različnih prehodov (slika 5).
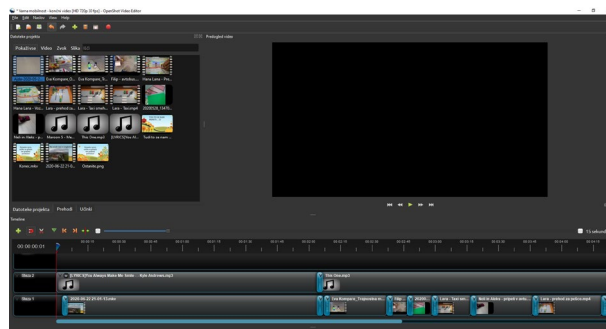
Slika 74: Za montiranje videa smo uporabili računalniški program OpenShot Video Editor Error! Reference source not found.**.**

V končni video so bili vključeni tudi glasba ter prehodi med slikami in posameznimi krajšimi videi.

5 POVRATNA INFORMACIJA UČENCEV

Učenci so po končani nalogi poročali, da jim samo snemanje ni povzročalo težav, prav tako niso imeli težav s pošiljanjem videov. Po njihovem mnenju jim je največ časa vzela priprava scenarija, kako bodo posneli posamezno situacijo. Povedali so, da se sedaj bolj zavedajo, kako pomembno je, kaj snemajo in kje objavljajo svoje video posnetke ter fotografije. Pri snemanju so bili kreativni, znajti so se morali s pripomočki, ki jih imajo doma. Čisto vsi vključeni učenci so bili s svojim izdelkom zelo zadovoljni, želeli bi si več takega načina dela. Predvsem pa so bili ponosni nase, ko so si končni izdelek ogledali še ostali učenci.

6 ZAKLJUČEK

Zaradi trenutne situacije z virusom in boleznijo COVID-19, v kateri se je znašel cel svet, smo se morali vsi prilagoditi. Veliko učiteljev in učencev je bilo na situacijo slabo pripravljenih. Tisti, ki jim je IKT blizu, so imeli s prilagajanjem na situacijo bistveno manj težav. Vendar pa je šlo v tem primeru večinoma za uporabo

tudi takih aplikacij, ki jih sicer v »običajnem« šolanju ne uporabljamo (npr. snemanje videov). V prihodnje se bo zato potrebno izobraziti tudi na teh področjih. Tisti, ki smo se samoiniciativno lotili raziskovanja možnosti, ki nam jih IKT ponuja, smo se v tem času veliko naučili. Glede na to, da kaže, da se situacija z novim koronavirusom še nekaj časa ne bo umirila, se bo potrebno na tak način dela privaditi. Tisti, ki so se vse življenje pripravljeni učiti, s tem ne bodo imeli težav.

VIRI

[1]   Logaj, V. idr. 2018. Razširjeni program osnovne šole. Delovno gradivo. Zavod Republike Slovenije za šolstvo. DOI: https://skupnost.sio.si/pluginfile.php/693888/mod_resourc e/content/1/Kurikularni%20dokument%2011_6.pdf (pridobljeno 4. 8. 2020)

[2]   OpenShot Video Editor https://www.openshot.org/

[3]   Powerpoint (Microsoft Office) https://www.microsoft.com/sl-si/

[4]   Predmetnik osnovne šole. DOI: https://www.gov.si/assets/ministrstva/MIZS/Dokumenti/O snovna-sola/Ucni-nacrti/Predmetnik-OS/Predmetnik-za-osnovno-solo.pdf (pridobljeno 9. 8. 2020)

[5]   WeTranfer https://wetransfer.com/

[6]   Zakon o osnovni šoli. DOI: http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO44 8# (pridobljeno 9. 8. 2020)

[7]   Zoom https://zoom.us/

Razvoj obiskov na Institutu »Jožef Stefan« skozi čas - od odprtih vrat do virtualnega obiska

Development of Jožef Stefan Institute visits through time – from open days to virtual visits

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POVZETEK

Na Institutu »Jožef Stefan« od marca 2008 naprej sistematično organiziramo različne izobraževalne dogodke: dan, teden, večer odprtih vrat ter redne obiske Instituta. Tako se Institut »Jožef Stefan« aktivno vključuje v proces vzpostavljanja učeče se družbe in sodeluje pri razmahu zanimanja otrok, učencev, dijakov, študentov ter odraslih za naravoslovje. S sprejetjem širše rabe virtualnih komunikacijskih orodij v šolah in v podjetjih se v zadnjem času odpirajo tudi nove možnosti za tesnejše sodelovanje s pomočjo virtualnih orodij. Članek obravnava vzpostavitev, rast, razvoj in prenovo omenjenih izobraževalnih dogodkov, skozi dogodke in številke.

KLJUČNE BESEDE

Dan odprtih vrat, izobraževalni dogodki, znanost, izobraževanje, STEM, šolski sistem, sodelovanje

ABSTRACT

At the Jožef Stefan Institute, we have been systematically organizing various educational events since March 2008: a day, a week, an open house and regular visits to the Institute. Thus, the Jožef Stefan Institute is actively involved in the process of establishing a learning society and the spread of interest of children, pupils, students and adults in science. With the adoption of the wider use of virtual communication tools in schools and companies, the Institute is opening up new possibilities for closer cooperation. The article deals with the establishment, growth, development and renovation of the mentioned educational events, through events and numbers.

KEYWORDS

Open day, educational events, science, education, STEM, school system, cooperation

1 UVOD

Na Institutu »Jožef Stefan« že vrsto desetletij, od leta 2008 pa v sistematični in poenoteni obliki k organiziramo tradicionalne dneve Jožefa Stefana, ko praznujemo obletnico rojstva velikega slovenskega znanstvenika, po katerem naš Institut nosi ime. Jožef Stefan se je rodil 24. marca 1835. Dnevi Jožefa Stefana se vsako leto zaključijo v soboto z Dnem odprtih vrat Instituta, ki jih organizira Center za prenos tehnologij in inovacij v sodelovanju z raziskovalnimi odseki na Institutu. Takrat si zainteresirani posamezniki lahko ogledajo zanimivosti, ki jih Institut skriva za svojimi vrati. Marca leta 2020 je bil omenjeni dogodek prestavljen zaradi epidemije Covid19 in se ni izvedel.

Dodatno je konzorcij partnerjev Ustanova Hiša eksperimentov, Institut »Jožef Stefan«, Kemijski inštitut in Tehniški muzej Slovenije sooblikoval projekt »*Noč ima svojo moč*«. V okviru projekta je Center za prenos tehnologij in inovacij na Institutu »Jožef Stefan« organiziral in sodeloval pri aktivnostih v okviru vseevropske akcije Evropska noč raziskovalcev v petek, 28. septembra 2018 in 27.septembra 2019, ko je bil izveden tudi Večer odprtih vrat. Na noč raziskovalcev se širom Evrope široko odprejo vrata organizacij, ki se ukvarjajo z znanostjo in raziskovanjem, da bi predstavile poklic in življenje znanstvenikov širši javnosti.

Z Dnevom odprtih vrat ter izvedbo Večera odprtih vrat (v Noči raziskovalcev) se Institut »Jožef Stefan« že desetletja aktivno vključuje v proces vzpostavljanja učeče se družbe in razmahu zanimanja otrok, učencev, dijakov, študentov ter odraslih za naravoslovje. V nadaljevanju prikazujemo začetek in razvoj skozi številke, ter prehod v novo, informatizirano dobo izobraževalnih dogodkov.

2 DAN ODPRTIH VRAT

2.1 Nov začetek 2008

Dan odprtih vrat na Institutu poteka "od nekdaj" – tako dolgo, da ni mogoče z gotovostjo ugotoviti, kdaj se je ta aktivnost prvič uvedla. Glede na [1] pa je razvidno, da je bil leta 2008 dan odprtih vrat oz. DOV, kot ga imenujemo s kratico, po dolgih letih spet organiziran na soboto in da je bil odziv daleč nad pričakovanji. Tega leta si je prostore instituta ogledalo več kot 700 ljudi, reaktor pa še dodatno več kot 400 ljudi.

Leta 2008 smo obiskovalce prvič povabili, da se ob vsaki polni uri, med 10. in 14. uro zberejo pri vratarju Instituta »Jožef Stefan« na Jamovi cesti 39 na Viču v Ljubljani in si izberejo enouren ogled laboratorijev Instituta. Na voljo je bilo devet različnih predstavitvenih ogledov znotraj treh programov – 1. Program: Snov, robotika; 2. Program: Biotehnologija-kemija-fizika ter 3.program: Znanje, sistemi, materiali in okolje. Obenem je bil ob 11h in 12h z Jamove organiziran prevoz na enoto Instituta v Podgorici - zaradi velikega zanimanja obiskovalcev sta od 11h naprej avtobus in minibus vozila nepretrgoma. Na lokaciji v Podgorici so si obiskovalci lahko ogledali laboratorije v predstavitvah štirih programov: 1. Program: Okolje: Hg laboratorij – geokemija – pospeševalnik; 2. Program Jedrska tehnologija – reaktor TRIGA; 3. Program: Okolje: radiološki del – vroča celica in 4. Program; Jedrski odpadki (ARAO). Zavedali smo se omejitev pri številu obiskovalcev. Zaradi velikosti laboratorijev je bil predviden ogled Instituta v skupinah po največ 15 obiskovalcev. Naenkrat bi tako brez težav lahko v devetih različnih enournih programih sprejeli 135 obiskovalcev, kar se je zdela glede na obisk s prejšnjih let smiselna ocena. Toda obisk je leta 2008 presegel pričakovanja - ob 10h se je na Institutu naenkrat znašlo več kot 250 obiskovalcev in obisk skoraj do konca dneva ni upadel.

Ključnega pomena za izvedbo obiska v tolikšnem obsegu je igral in še vedno igra mrežno razvejan sistem koordinatorjev po raziskovalnih odsekih Instituta. Koordinatorji so tisti, ki s soglasjem vodij svojih enot Instituta obiskovalce toplo sprejmejo v laboratorije, jim jih razkažejo in jih popeljejo v svet znanosti na način, da jim jo čimbolj približajo. Brez njih obiski Instituta ne samo, da bi bili popolnoma drugačni, temveč sploh ne bi bili mogoči. Že desetletje je skupnost koordinatorjev obiskov na Institutu osnova izvedbe obiskov, vseskozi in še vedno deluje na prostovoljni osnovi, saj gre za neplačano delo navdušencev - bila pa je v letih 2008-2010 tako povezana, da so se v šali celo oklicali za ločen odsek Instituta (Slika 1).

Slika 1. Koordinatorji na enem od letnih piknikov, srečanj, na katerih so se med seboj družili in se po napornih prostovoljno izvedenih obiskih Instituta tudi skupaj poveselili.

2.2 Razvoj 2009

Naslednji Dan odprtih vrat je 28. 3. 2009 že minil brez presenečenj in glede na odzive obiskovalcev tudi več kot uspešno. O dnevu odprtih vrat smo šole in gimnazije večkrat obvestili preko Ministrstva za šolstvo, učitelje in njihove aktive pa še posebej preko Zavoda za šolstvo. Naročil večjih šolskih

skupin je bilo manj kot preteklo leto, ker ni bil šolski delovni dan. Kljub temu je prišlo nekaj avtobusov in kombijev.

Podjetja so bila obveščena preko okrožnic TIA in JAPTI ter letakov mreže Enterprise Europe Network. Takoj po objavi so se pričeli vrstiti klici in elektronska sporočila posameznikov iz vse Slovenije.

Dodatno k obveščanju je bilo razdeljenih še 1600 letakov okoliškim prebivalcem na območju Jamove in Reaktorja, obvestili smo tudi medije. Tako smo zajeli precej heterogeno združbo obiskovalcev IJS, od starejših prebivalcev iz soseščine, ki so pogosto poudarjali, da jih je že celo življenje zanimalo, kdaj bo "pri sosedu kaj eksplodiralo", do staršev z otroki, osnovnošolcev, srednješolcev, študentov iz bližnje in daljne okolice Instituta. Obiska se je udeležilo vsaj 11 podjetij iz vse Slovenije, ki jih je zanimalo sodelovanje z IJS, veliko jih je bilo predvsem iz Primorske regije.

Avtobus, ki je na lokacijo »Reaktor« vozil z Jamove ceste vsako polno uro, je bil vseskozi poln, ker pa smo del obiskovalcev zaradi pomankanja prostora na Reaktor poslali s šolskimi avtobusi, so sodelavci z Reaktorja na koncu prijazno ponudili prevoz tudi s svojim kombijem, kar je še en primer povezanosti ekipe na Institutu. Na Reaktor smo prepeljali 3 velike avtobuse obiskovalcev, ki so bili nad možnostjo ogleda Reaktorskega centra navdušeni.

Institut si je na Jamovi ogledalo več kot 600, na Reaktorju pa več kot 250 obiskovalcev (Slika 2). Zahvaljujoč tablam, ki so jih prijazno priredili v delavnicah Instituta, smo z odhodnih mest na parkirišču vsako polno uro pregledno lahko usmerili vsako od devetih skupin ogledov, ki so bili po programu na voljo.

Da bi bili obiskovalci o možnostih ogleda bolje informirani, smo pripravili poseben letak s programi obiska. Kot organizacijsko pomanjkljivost smo identificirali potrebo po velikem plakatu s seznamom odsekov po programih ter prepoznavno znamenje (nalepka, priponka, ...), s čimer bi obiskovalci koordinatorje lažje ločili od množice.

Slika 2: Izvedba obiskov na Institutu je vedno vsebovala mešanico strokovnega pogovora, znanstvenih informacij, ogleda laboratorijev in neobveznega klepeta.

3 IZBOLJŠAVE

V naslednjih letih smo uvedli nekaj izboljšav [2, 3, 4, 5], ki pa niso bistveno spremenile začetne ideje izvedbe. Koordinatorji obiska so dobili svoje značilne puloverje v svetlo modri barvi, da so bili v množici res prepoznavni. Zagotovili smo prazno

parkirišče in na njem znake, izpred katerih so se začenjali ogledi posamičnih skupin in programov. Ponudbo smo kasneje (2013) dopolnili tudi s postavitvijo informacijskega pulta, ki je v prvi vrsti namenjen prestrezanju obiskovalcev ob vstopu ter primernemu preusmerjanju na oglede programov glede na njihov interes. Obenem na informacijskem pultu delimo letake in gradiva o Institutu, projektih instituta ipd., da informacije o aktivnostih IJS lažje dosežejo zainteresirano javnost. Zaradi množičnih obiskov v naslednjih letih smo uvedli tudi t.i. "padalske" obiske, s čimer smo omogočili obisk tudi mnogim, ki so se na oglede Instituta odpravili med polnimi urami, ko so bile skupine načeloma že na obhodih – posebna skupina sodelavcev je poskrbela za to, da se je lahko vsaka večja skupina obiskovalcev pridružila ogledom tudi v vmesnem času. Dodatno smo zagotovili, da so potekali ogledi vseh 27 laboratorijev oz. enot hkrati, s čimer smo precej povečali kapaciteto ogledov ob upoštevanju omejitev 15 oseb na skupino.

Vsako leto novembra smo izvedli pregled odgovornih koordinatorjev po 27 sodelujočih enotah Instituta, zbrali oz. posodobili smo njihove kontaktne podatke ter izvedli informativni sestanek z njimi, kjer smo skupaj pregledali dosežene rezultate preteklega leta ter morebitne težave, ki so ob izvajanju nastajale in način izvedbe obiskov v prihajajočem letu.

Prav tako je bil izveden dodaten sestanek približno mesec dni pred Dnevom odprtih vrat, na katerem smo še posebej pozorno pregledali način organizacije, mesta prevzema, način ukrepanja v posameznih varnostnih in organizacijskih situacijah, do katerih prihaja v primeru dogodkov z več 1000 udeleženci.

Skozi leta se je največji interes kazal za Šolo eksperimentalne kemije in Robotiko, ki smo ju oblikovali v ločena programa, da se ju je lahko udeležilo čim več obiskovalcev, predvsem nadobudnih mladih znanstvenikov iz prve triade ali vrtca.

Čeprav so se in se še vedno koordinatorji obiskov na odsekih trudijo predstaviti problematiko svojih laboratorijev po najboljših močeh, pa je vsa leta ostala nerešena in nenaslovljena tematika kvaliteta predstavitev oz. njihovo poenotenje.

4 DAN ODPRTIH VRAT IN OBISKI SKOZI ŠTEVILKE

4.1 Obdobje 2008-2019

Že kmalu se je pokazalo, da so nekatere tematike za širšo skupino obiskovalcev vsaj na prvi pogled bolj zanimive kot druge. Seveda ob podrobnem pregledu to ni nujno ali sploh ni res, vendar je interes za oglede po posameznih enotah nihal že od samega začetka. Na Sliki 3 vidimo prikaz števila obiskov po posameznih enotah ter odstopanje od povprečnega števila 12 obiskov v obdobju od 30.9.2007 do 30.10.2008 za 331 izvedenih obiskov po enotah v tem obdobju.
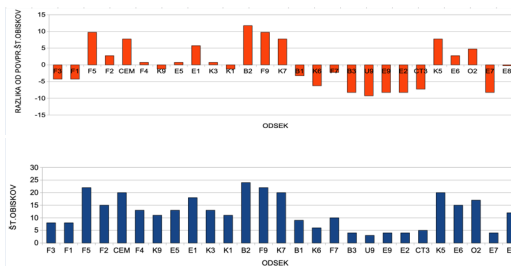
Slika 3. Število obiskov ter odstopanje od povprečja po enotah Instituta v letu 2008 (30.9.2007-30.10.2008)

Število obiskov je nato raslo v dveh zaporednih skokih (Slika 4), vsakemu izmed njih je sledila uvedba neke vrste omejitve števila obiskovalcev, z namenom, da se izvede kot je le mogoče veliko obiskov, vendar v obsegu in obliki, da le ti ne ovirajo tekočega raziskovalno razvojnega dela na Institutu.

V letu 2010 smo zaradi velikega interesa šol za obisk Instituta uvedli teden, namesto dneva odprtih vrat, kar je pomenilo, da nas lahko šole obiščejo v tednu pred Dnevom odprtih vrat vsak dan. Po porastu števila šol, ki so nas obiskale v letu 2011 (65 šol), smo teden odprtih vrat okrnili in omejili število šol, ki so nas lahko obiskale v tem obdobju.
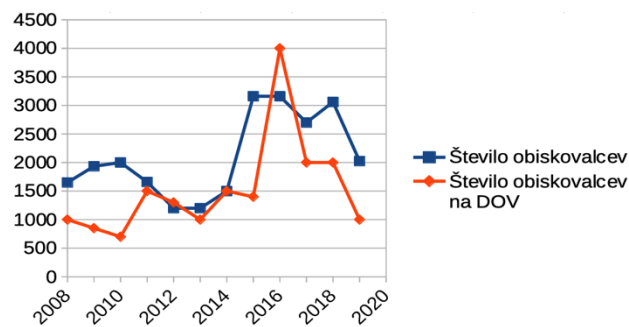
Slika 4. Število obiskovalcev na Institutu v posameznem letu, ločeno za obiskovalce med letom (modra črta) in obiskovalce na Dnevu odprtih vrat (rdeča črta) [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]

Leta 2015 in 2016 je število šol (Slika 5), ki so obiskale Institut ponovno močno naraslo (79 in 83 šol), zato smo v letu 2017 omejili število obiskov na teden, v letu 2019 pa smo preizkušali možnost, da število omejimo na en obisk šole na teden, vendar nam to zaradi velikega povpraševanja ni uspelo.

Glede števila obiskovalcev nimamo podatkov za vsa leta, število obiskovalcev za leta 2009, 2017, 2018 in 2019 so ocene. Vsi ostali podatki so pridobljeni iz letnih poročil Instituta [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16].

Tudi iz števila obiskovalcev je mogoče zaznati enake trende kot pri številu šol, ki so nas obiskale. Vrhovi v letih 2011 ter 2015 in 2016 so bili že obrazloženi, opozoriti pa je potrebno še, da se število obiskovalcev med letom ni zmanjšalo niti z omejitvijo števila šol, zaradi česar smo postali pri oblikovanju skupin za posamezne obiske laboratorijev bolj dosledni pri upoštevanju omejitve velikosti skupine do 15 oseb.
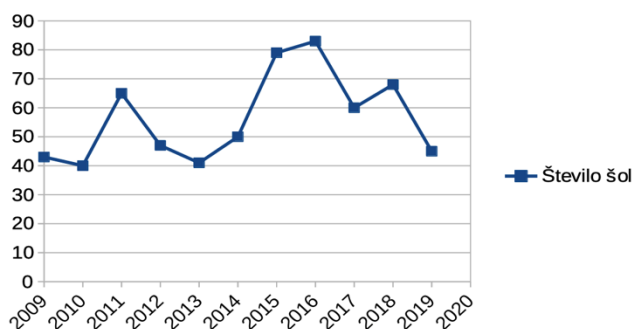
Slika 5. Število šol, ki so obiskale Institut v posameznem letu [6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]
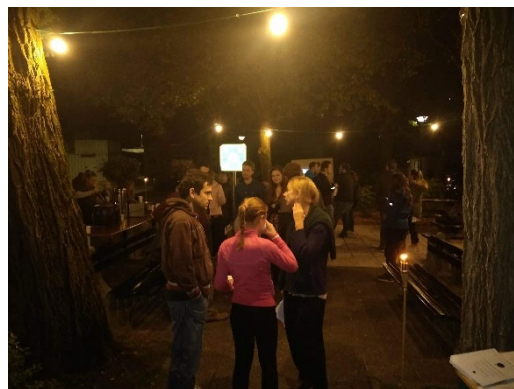
4.2 Večer odprtih vrat

Na noč raziskovalcev se širom Evrope široko odprejo vrata organizacij, ki se ukvarjajo z znanostjo in raziskovanjem, da bi predstavile poklic in življenje znstvenika širši javnosti. V okviru projekta je Center za prenos tehnologij in inovacij na Institutu »Jožef Stefan« organiziral in sodeloval pri aktivnostih v okviru vseevropske akcije Evropska noč raziskovalcev v petek, 28. septembra 2018.

Sodelavci Instituta »Jožef Stefan«, Centra za prenos tehnologij in inovacij smo se že dopoldan podali na pot po Sloveniji z namenom osveščanja o raziskovanju in inovacijah ter družbenih in gospodarskih koristih in kariernih možnostih, ki jih slednja lahko nudita prav vsakomur od nas. Organizirali smo raziskovalne dneve v osnovnih in srednjih šolah ter predavanja in delavnice v domovih za upokojence. S tem smo predstavili možnost uporabe znanosti in raziskovanja v vseh življenjskih obdobjih in pod motom »Znanje je čudovito« prikazali, kako je lahko vsak od nas raziskovalec.

Obiskali smo eno osnovno in dve srednji šoli [17]. Osnovnošolcem in dijakom smo, tudi z njihovo pomočjo, predstavili osnove znanstveno - raziskovalnega dela skozi kemijski test vitamina C in pojasnili osnove podjetništva s poudarkom na pomenu trženja znanja in idej. Predavali smo o intelektualni lastnini ter razpravljali o sodobnem podjetništvu in stanju na trgu. S tem smo spodbujali zanimanje mladih za naravoslovne poklice in zanimanje za raziskave in njihovo uporabo v vsakodnevnem življenju.

Obiskali smo še tri domove za ostarele [17]. Sporočilo obiskov domov za starejše je bilo, da se učimo, izobražujemo in raziskujemo skozi celo življenje in da starejši s svojo modrostjo in življenjskimi izkušnjami doprinesejo dodano vrednost k razvoju naše družbe. Tako pravijo, da moramo vedoželjnost ohraniti skozi celo življenje, da nadgrajujemo naše poznavanje in ozavestimo svet okoli nas in da ne zamremo.

Slika 6: Noč ima svojo moč. Na Večeru odprtih vrat se nam je v soju bakel pridružilo več kot 500 obiskovalcev.

V večernih urah smo v sodelovanju z raziskovalnimi odseki na Institutu organizirali Večer odprtih vrat na Institutu »Jožef Stefan« (Slika 6). Na pobudo promocije znanosti in raziskovanja smo odprli vrata naše največje raziskovalne ustanove in zainteresirani javnosti predstavili različne vidike raziskovalnega dela. Tako so si v petek zvečer obiskovalci v soju bakel in sveč lahko ogledali dosežke in laboratorije številnih raziskovalnih odsekov, dokumentarne filme o raziskovalnem delu, atraktivne in poučne predstave eksperimentov ter se pogovarjali z domačimi in tujimi raziskovalci.

V večeru odprtih vrat se nam je v tej posebni izdaji obiskov na Institutu pridružilo kar 500 obiskovalcev [17].

4.3 Posebno leto 2020

V letu 2020 nas je obiskalo zgolj 5 šol [16], štiri od teh so prišle v mesecih januar in do sredine februarja, ko je Institut že omejil gibanje znotraj organizacije zaradi izbruha Covid-19.

Zaradi uvedbe karantene je bil letos Dan odprtih vrat sprva prestavljen, nato pa odpovedan Upamo, da ga bomo lahko ponovno izvedli že v letu 2021.

Kot prilagoditev na izbruh nalezljive bolezni se na Institutu uvajajo obiski na daljavo.

5 OBISKI NA DALJAVO

V letu 2020 smo izvedli 9 obiskov in gostili 430 obiskovalcev, nato morali dne 27. 2. 2020 prekiniti serijo dodatnih 36 do konca junija načrtovanih obiskov šol [18]. Odpovedati smo morali tudi "Dan odprtih vrat" in »Teden odprtih vrat« med "Štefanovimi dnevi", ki se tradicionalno odvijajo konec marca. V mesecih marec, april in maj tako ni bilo mogoče izvesti nobenega obiska, smo se pa v tem času reorganizirali in začeli izvajati obiske na daljavo. Ideja o virtualnih obiskih se je rodila iz potrebe, da še naprej oblikujemo zavedanje o vrhunski znanosti kot zanimivi in neobhodni sestavini vsake uspešne družbe ter možnosti in nuje, da vsi skupaj hitro osvojimo komunikacijo na daljavo.

Preverili smo interes ter zmožnosti raziskovalcev Instituta za izvedbo obiskov na daljavo. Izvedli smo virtualni sestanek z vsemi koordinatorji, jim pojasnili ter se z njimi pogovorili o novo nastali situaciji ter prosili za mnenja v zvezi z idejo glede virtualne izvedbe obiskov Instituta. Prevladujoče mnenje koordinatorjev je bilo pozitivno, prav tako so se na idejo večinoma pozitivno odzvali vodje enot Instituta. Glavni

pomislek glede smiselnosti prehoda na virtualne obiske se je nanašal na pomanjkanje osebnega stika med raziskovalci Instituta in obiskovalci, kar je dejansko ena izmed pomembnejših komponent obiska. Zato smo se osredotočili na ohranjanje osebnega stika - četudi ta poteka virtualno – in v prihodnje bomo to komponento vzpodbujali in ohranjali kot ključno komponento izvedbe virtualnih obiskov.

Že junija smo izvedli 2 virtualna obiska, nato pa še enega v mesecu avgustu (Slika 7) [19].

Slika 7: V letu 2020 smo se po izbruhu bolezni COVID 19 in z njo povezanih ukrepov preusmerili v izvedbo obiskov na daljavo.

Obiski na daljavo so izvedeni preko prenosa slike in žive besede koordinatorjev obiskov preko virtualnih orodij. Med obiski je vzpostavljen direkten dialog s šolajočo se mladino, saj tako učitelje kot učence spodbujamo, da postavljajo vprašanja o vsem, kar vidijo in slišijo.

Prav tako se izvajajo vnaprej pripravljeni virtualni sprehodi po laboratorijih. Nekateri sprehodi so omogočeni tudi izven časa odprtih vrat, vendar v takem primeru manjka živa beseda gostitelja na Institutu. Menimo, da je prav živ človek na drugi strani virtualne povezave ključnega pomena za uspešnost obiskov, pa tudi za doseganje cilja – čim večje razširjenosti zanimanja mladih za znanost. Predstavitve laboratorijev so tako sicer vnaprej pripravljene, vendar pa kljub fizični oddaljenosti potekajo spontano in se prilagajajo trenutni situaciji, potrebam in interesu udeležencev in njihovim aktivnostim v času obiska.

V novem šolskem letu 2020/21 smo začeli zbirati prijave na obiske s 1.septembrom, prejeli smo že 4 interese in zaključili z načrtovanjem 3 obiskov. Veselimo se nadaljnjih povpraševanj šol in posameznikov, z veseljem bomo ponudili ogled čimveč interesentom, skladno z možnostmi.

V povojih je tudi načrtovanje virtualnega dneva odprtih vrat. V tem trenutku razvijamo različne ideje. Ena izmed njih je možnost vstopa v virtualne sobe, za omejeno količino časa, npr. za 10 minut, pri čemer bi se osredotočali na izvedbo obiskov predvsem za družine in za skupine šol, pa tudi interesentov v domovih za ostarele ali druge skupine, ki bi se nam na ta način lahko pridružile.

Sodeč po pozitivnih odzivih obiskovalcev, jim bo tudi na tak način predstavljeno delo sodelavcev in opreme Instituta še dolgo ostalo v lepem spominu.

Pri tem še naprej ostajamo osredotočeni na organizacijo klasičnih obiskov, ki so se po odzivu šol in šolarjev izkazali za nepogrešljivo doživetje. Obiske na daljavo bi v prihodnje ponujali kot dodatno možnost za premagovanje časovnih, logističnih in drugih ovir za obiske šol.

6   ZAKLJUČEK

Z obiski šol, Tednom in Dnevom odprtih vrat se Institut »Jožef Stefan« že zadnjih 12 let sistematično in izredno proaktivno vključuje v proces vzpostavljanja učeče se družbe in razmahu zanimanja otrok, učencev, dijakov, študentov ter odraslih za naravoslovje. To potrjujejo vtisi obiskovalcev. Posameznike na Institut privabi njihova lastna radovednost o tem, kaj se skriva za vrati Instituta in kako se raziskovalno delo odraža v vsakdanjem življenju. Družine prihajajo na Institut predvsem z namenom ciljno usmerjenega in dolgoročnega načrtovanja poklicne poti otrok ter spodbujanja zanimanja za naravoslovje. Hkrati pa so obiski, Teden in Dan odprtih vrat Instituta "Jožef Stefan" odlična priložnost za podjetja, da si ogledajo laboratorije Instituta in tako dobijo prvi vtis o možnostih vzpostavitve sodelovanja med gospodarstvom in raziskovalci IJS. Kaže tudi, da se s sprejetjem širše rabe virtualnih komunikacijskih orodij v šolah in v podjetjih odpirajo vedno nove možnosti za tesnejše sodelovanje. Te možnosti z navdušenjem sprejemamo.

Z velikim veseljem bomo obiske, dneve, tedne in večere odprtih vrat organizirali še naprej, v prihodnje pa se velja še bolj posvetiti vsebini prikazanih predstavitev in širjenju zavedanja, , da je znanost ena in edina, da je ključ do prihodnosti in da z njo skupaj in enotno dihamo vsi državljani Republike Slovenije.

ZAHVALE

Velika zahvala gre Kristini Žagar Soderžnik – brez njene pomoči, entuziazma in dobre volje obiski na Institutu ne bi zaživeli v taki meri, kot so.

Hvala vsem koordinatorjem obiskov, s katerimi smo sodelovali skozi leta. Mnogi so odšli v tujino ali v industrijo, mnogi so ostali zvesti Institutu. Kjerkoli ste, upam, da še naprej širite ljubezen do znanosti tudi med mladimi.

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Uporaba aplikacije Padlet za učence s posebnimi potrebami pri pouku na daljavo

Using Padlet for pupils with special needs in distance learning

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POVZETEK

V prispevku je prikazan primer uporabe aplikacije Padlet za namene izvajanja dodatne strokovne pomoči učencem s posebnimi potrebami pri pouku na daljavo v času zaprtja vzgojno-izobraževalnih ustanov zaradi razglašene epidemije. Delo z učenci s posebnimi potrebami je že v običajnem šolskem okolju specifično, pri prenosu pouka v virtualna okolja pa je bilo potrebno pri načrtovanju in izvajanju pomoči v digitalno podprtem okolju svoje delo oblikovati še bolj premišljeno.

KLJUČNE BESEDE

Pouk na daljavo, dodatna strokovna pomoč, Padlet

ABSTRACT

The article presents an example of Padlet use for providing additional professional help for pupils with special needs at a distance learning during epidemic. Working with pupils with special needs is already specific in the usual school environment, and when the lessons move to virtual environment, it was necessary to design teachers work even more thoughtfully.

KEYWORDS

Distance learning, additional professional help, Padlet

1 UVOD

Z razglasitvijo izrednih razmer zaradi epidemije covid-19, zaprtjem vzgojno-izobraževalnih ustanov in "preslitvijo" pouka v virtualna okolja se je marsikateri učitelj znašel pred vprašanjem "Kako pripraviti in izvajati pouk na daljavo?" Pred (morda še večjo) zagato smo se znašli tudi učitelji dodatne strokovne pomoči za učence s posebnimi potrebami, saj je narava našega dela specifična – individualno delo "ena na ena". Zato je bilo potrebno v kratkem času dobro pretehtati in ubrati pot, ki bo učencem glede na njim razpoložljivo informacijsko-

komunikacijsko tehnologijo (v nadaljevanju IKT) in veščost njene uporabe v največjo korist.

2 POUK NA DALJAVO

Pouk na daljavo se v veliki meri razlikuje od "klasičnega" pouka, to je pouka v živo, v učilnicah. Razlike so tako na organizacijskem kot tudi na pedagoško-didaktičnem področju. "Učno okolje v tem primeru dobiva popolnoma nove razsežnosti in predstavlja enega izmed temeljev uspešne izvedbe poučevanja in učenja." [3]

Zaradi razglašene epidemije so se vrata vzgojno-izobraževalnih ustanov s 16. 3. 2020 zaprla. V kratkem času so morale šole vzpostaviti ustrezno digitalno podprto učno okolje za izvajanje pouk na daljavo. Vsaka šola je glede na svoje specifike in možnosti pripravila svoj način dela.

Vloga učitelja (in tudi učenca) se pri pouku na daljavo spremeni, saj se več ne osredotoča na razlago snovi, temveč na tako imenovane podporne pogovore, katerih namen je nudenje individualne in dodatne pomoči učencem, motiviranje za izvajanje aktivnosti in tudi nudenje dodatnih učnih izzivov učencem, ki učno vsebino že obvladajo. Zaradi tega je izrednega pomena, da je učitelj ustrezno usposobljen in da v digitalno podprtem učnem okolju pri svojem delu premišljeno uporablja sodobne didaktične pristope. Le na ta način lahko pouk na daljavo izvaja kakovostno [3].

Glavne značilnosti pouka na daljavo najbolj nazorno prikazuje shema (slika 1).

Slika 75: Poučevanje na daljavo [3]

Učitelj mora imeti do obsega dela učencev pri pouku na daljavo realne zahteve, dajati jim miora jasna navodila, primeren

obseg dela in jim posredovati sprotno povratno informacijo. Ob tem pa je potrebno poskrbeti tudi za to, da dosežemo vse oziroma čim več učencev [3]. Ravno slednje je pri učencih s posebnimi potrebami v veliki meri zagotovljeno s strani učiteljev za dodatno strokovno pomoč.

3 DODATNA STROKOVNA POMOČ

Učencem, ki so zaradi določenih primenjkljajev, motenj oziroma ovir usmerjeni kot učenci s posebnimi potrebami, pripada za premočanje težav po [8] dodatna strokovna pomoč.

3.1 Metode in pristopi

Učenci s posebnimi potrebami potrebujejo za optimalen napredek in rezultate prilagojene metode in pristope poučevanja. Pri tem običajno kombiniramo direktno poučevanje (jasno določeni cilji, pravila, specifični koraki, ki se natančno razložijo, demonstracija korakov in povezav med pojmi) s strateškim poučevanjem (učenje strategij reševanja naloge in uporabe znanj pri reševanju problemov) [2]. "Obe metodi terjata modeliranje, demonstracije, povratne informacije, vodeno in samostojno izvajanje vaj ter transfer znanja in naučenih strategij." [4] Učencem s posebnimi potrebami v ta namen s pomočjo drugačnih didaktičnih in metodičnih pristopov, tehnik, pripomočkov in podobno prilagajamo vsebino in organizacijo, pa tudi hitrost napredovanja, cilje in organizacijo vzgojno-izobraževalnega okolja [1].

3.2 Individualizirani program

Za vsakega učenca s posebnimi potrebami strokovna skupina, ki jo za posameznega učenca pred pričetkom šolskega leta imenuje ravnatelj, glede na učenčeve težave, motnje oziroma ovire pripravi individualizirani program.

Z individualiziranim programom se po [8] (36. člen) določijo: (a) cilji in oblike dela na posameznih vzgojno-izobraževalnih področjih; (b) strategije vključevanja učenca s posebnimi potrebami v skupino; (c) potrebne prilagoditve pri preverjanju in ocenjevanju znanja, doseganju standardov in napredovanju; (č) uporaba prilagojene in pomožne izobraževalne tehnologije; (d) izvajanje fizične pomoči; (e) izvajanje tolmačenja v slovenskem znakovnem jeziku; (f) prehajanje med programi in potrebne prilagoditve pri organizaciji; (g) časovna razporeditev pouka; (h) veščine za čim večjo samostojnost v življenju (prilagoditvene spretnosti) in (i) načrt vključitve v zaposlitev.

Za čas pouk na daljavo je zavod za šolstvo izdal priporočila za potek nudenja dodatne strokovne pomoči ter za preverjanje in ocenjevanje znanja v osnovni šoli. Za učence s posebnimi potrebami so tako priporočali, da je pri preverjanju in ocenjevanju znanja v primerih, ko se prilagoditev, zapisanih v individualiziranem programu, pri delu na daljavo ne da v celoti izvesti, priporočljivo dodati spremembe prilagoditev, ki se upoštevajo v času izobraževanja na daljavo.

3.3 Izvajanje dodatne strokovne pomoči na daljavo

Razmere, v katerih smo se marca 2020 zaradi epidemije znašli, so od učiteljev dodatne strokovne pomoči zahtevale veliko mero inovativnosti in iznajdljivosti. V tem času je bilo potrebno nuditi oporo tako staršem kot učencem. S starši smo vzpostavljali in

ohranjali stike na način in preko orodij ter komunikacijskih naprav, ki so jih vajeni oziroma katerih so vešči.

Učencem s posebnimi potrebami je učitelj dodatne strokovne pomoči pomembna oseba na šoli, na katero se lahko obrne, zato je zanje pomembno, da ohranijo stik z osebami, ki jim zaupa. Težave, ki se jim pojavljale v teh razmerah, smo jim pomagali premagovati preko različnih tehnik in strategij ob uporabi IKT. Učencem smo tako pomagali s svetovanjem, razlago (tako učiteljevih navodil, učne snovi kot tudi postopkov uporabe IKT) preko različnih komunikacijskih kanalov in hkrati ohranjali stik z njimi. Navodila za učenje in organizacijo za učenje smo jim učitelji pogosto podprli tudi z različnimi IKT orodji [7], aplikacijami in podobno.

4 APLIKACIJA PADLET

Padlet (nekdanji Wallwisher) je aplikacija oziroma e-storitev, ki omogoča "skupno rabo". Ima obliko table oziroma zida, na katerega lahko pišemo in objavljamo sporočila, pripenjamo različna gradiva, delimo slike ali posnetke [5, 6]. Učenci (in drugi) lahko dostopajo do table preko posredovane povezave ali QR kode.

Padlet podpira vse vrste datotek in je preprost za uporabo, potrebnega je le nekaj osnovnega znanja angleščine. Do aplikacije lahko dostopamo preko spleta na računalniku ali pametnem telefonu. V slednjem primeru si je potrebno prenesti in namestiti aplikacijo na telefon.

Osnovna različica, ki je brezplačna, omogoča omejeno kreiranje različnih tabel, pri čemer so nam na voljo predloge (slika 2). Če želimo različico izboljšati oziroma razširiti, jo lahko glede na svoje želje in potrebe proti doplačilu poljubno nadgradimo.
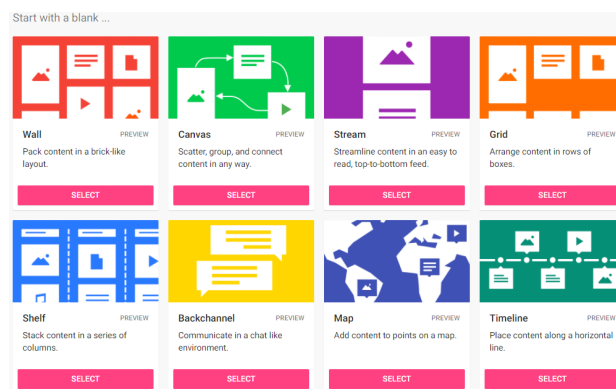

Slika 76: Predloge za kreiranje table

4.1 Uporaba aplikacije pri nudenju dodatne strokovne pomoči na daljavo

Za namene nudenja dodatne strokovne pomoči učencem s posebnimi potrebami na daljavo smo se poslužili aplikacije Padlet, saj se nam je zdela pregledna, preprosta za razumevanje in uporabo in privlačna za učence.

Po uvodnih postopkih za registracijo smo se lotili raziskovanja možnosti, ki jih aplikacija nudi. Kot najbolj pregledno in uporabno, kar je zlasti za učence s posebnimi potrebami zelo pomembno, saj imajo pogosto težave z usmerjanjem pozornosti, orientacijo in organizacijo, se nam je zdelo oblikovanje table s tematskimi sklopi. Te smo poimenovali

glede na predmet oziroma področje, ki so ga posamezne objave/gradiva pokrivala (slika 3).
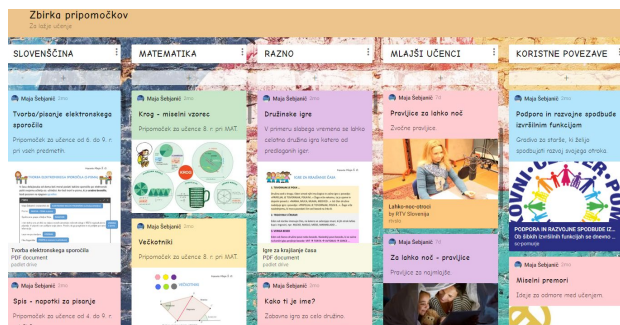
Slika 77: Oblikovana table z gradivi

Za uporabo aplikacije Padlet in oblikovanje table z gradivi smo se odločili, saj smo želeli na enem mestu ponuditi učencem vseh razredov, s katerimi delamo, različne vrste gradiv, ki so jim pri pouku na daljavo in pri izpolnjevanju šolskih obveznosti lahko v pomoč. Na ta način so zlahka in hitro lahko dostopali do nabora gradiv oziroma pripomočkov, kakor jih imenujemo pri našem delu.

4.2 Gradiva za nudenje dodatne strokovne pomoči na daljavo

Pri pripravi gradiv za nudenje dodatne strokovne pomoči smo upoštevali naslednje zahteve: (a) individualizirani program posameznega učenca, vključujoč njegova močna in šibka področja ter učne značilnosti; (b) navodila učečih učiteljev za posamezen teden; (c) diferenciacijo in individualizacijo dela za posameznega učenca (glede na naravo njegovih težav, zmožnosti in podobno); (č) IKT, ki jo ima učenec doma na voljo; (d) dostopnost orodij in aplikacij za pripravo gradiva; (e) uporabnost gradiva za učenca pri izpolnjevanju nalog/obveznosti.

Upoštevaje navedene zahteve smo se najpogosteje poslužili priprave povzetkov učne snovi, s poudarkom na temeljnih pojmih obravnavane učne teme, ki smo jih pripravili v Wordu, shranili v format PDF in objavili na naši tabli Padlet (primer: slika 4).
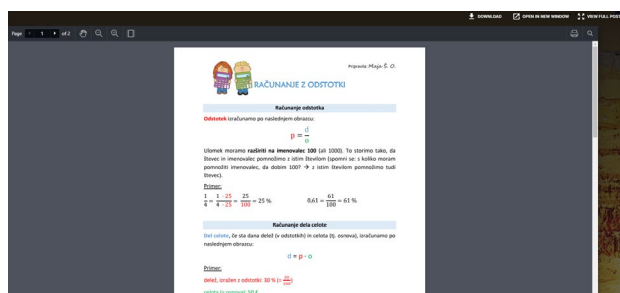
Slika 78: Povzetek učne snovi

Povzetke učne snovi, zlasti pri pouku književnosti, občasno tudi jezika, smo pripravljali tudi v obliki miselnih vzorcev, ki smo jih oblikovali s pomočjo spletne aplikacije Mindomo (primer: slika 5).
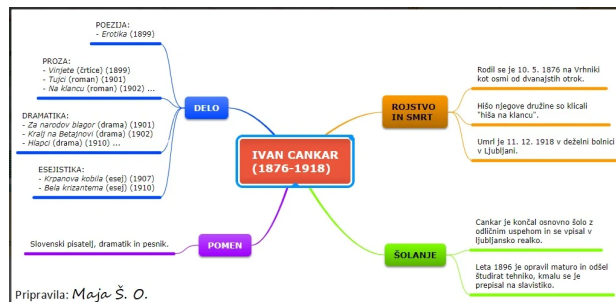
Slika 79: Miselni vzorec

Občasno smo učencem pripenjali sprostitvene aktivnosti in miselne premore, ki smo jih pripredili po spletnih virih in oblikovali v slikarju (primer: slika 6), ali pripeli povezave do različnih posnetkov na spletu. Za mlajše učence so se kot pozitivne obnesle zvočne pravljice, ki so jih lahko poslušali.

Slika 80: Predlog miselnega premora

Učencem (in tudi njihovim staršem) smo povezavo do naše table posredovali na začetku pouka na daljavo in jih pozvali, da naj sproti spremljajo vsebino in gradiva, ki smo jih ves čas sproti posodabljali.

5 ZAKLJUČEK

Čas epidemije je učitelje postavil pred številne nove izzive, vezane zlasti na IKT. Sodobni učitelj mora biti prožen in se na digitalno-tehnološke spremembe odzivati hitro. Imeti mora določena znanja, razvite spretnosti in veščine, tako imenovane digitalne kompetence, da lahko sodobno IKT uporablja preudarno in kompetentno.

Na spletu je dostopno mnogo različnih orodij, aplikacij in storitev, ki so lahko zelo uporabni v izobraževalne namene. Zlasti kot uporabni so se izkazali v času pouk ana daljavo. Tudi sami smo skušali dodatno strokovno pomoč na daljavo izvesti čim učinkoviteje in uporabno za učence. Aplikacija Padlet, ki smo se je pri tem poslužili, nam je omogočala, da smo v kratkem času lahko pripravili za učence pregledno in na videz privlačno tablo, na kateri so zlahka našli gradivo za pomoč pri delu na daljavo. Učenci so bili nad takšnim načinom dela navdušeni, kar je ne nazadje tudi najpomembnejše.

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Oblikovanje učencu prilagojenih e-gradiv

Designing student-friendly e-materials

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POVZETEK

Ustrezna tehnologija in želja po učenju je pripeljala do fenomena učenja preko IKT tehnologij. Sedaj se lahko učenci učijo kitajščine na na prestižni pekinški šoli iz naslonjača svoje dnevne sobe, lahko prisostvujejo pri kemijskih poskusih v nemških laboratorijih ali pa se učijo igranja kitare. Kako bodo pri tem uspešni, pa je odvisno tudi od primerne priprave in prilagajanja učnih gradiv. Čustva pomembno vplivajo na učenje, ne glede na metodo po kateri se učimo. V prispevku smo ob pregledu literature raziskovali v kakšni meri se čustva, počutje in vpletenost učencev upoštevajo pri pripravi e-gradiv in njihovemu prilagajanju. Predstavili smo načine za zaznavanje in prepoznavanje čustev pri e-učenju in se osredotočili na možnosti za prilagajanje učnih gradiv učencem na podlagi le-teh. Iskali smo načine, kako izboljšati izkušnjo e-učenja za učence na način, da bi povečali preglednost napredka učenca in povečali pozitivno izkušnjo e-učenja na način, da bi v učni proces vključili tudi njihovo počutje.

Na podlagi ankete, ki smo jo izvedli z učenci od 6. do 9. razreda osnovne šole, smo zasnovali model za prilagoditev gradiv za e-učenje. Smernice za prilagajanje so bile boljša organizacija, višja motivacija za delo in zmanjševanje občutka preobremenjenosti za delo.

KLJUČNE BESEDE

E-učenje, čustva, učencu prilagojena gradiva, osnovna šola

ABSTRACT

Appropriate technology and a desire to learn has led to the phenomenon of learning through ICT technologies. Now, from the armchair of their living room, students can learn Chinese at a prestigious Beijing school, attend chemical experiments in a German laboratory, or learn to play the guitar. How successful they will be also depends on the appropriate preparation and adaptation of teaching materials. Emotions have a significant impact on learning, regardless of the learning method. In this paper, while reviewing the literature, we explored the extent to which students' emotions, feelings and involvement are considered in the preparation of e-materials and their adaptation. We presented ways to detect and recognize emotions in e-learning and focused on the possibilities of adapting learning materials to students based on them. We looked for ways to improve the e-learning experience for students in a way that would increase the transparency of the students progress and increase the positive e-learning experience in a way that would also include their well-being in the learning process. Based on a survey conducted with students from 6th to 9th grade of primary school, we designed a model for adapting e-learning materials. Guidelines for adjustment were better organization, higher motivation and reduction of work overload feeling.

KEYWORDS

E-learning, emotions, student-friendly materials, primary school

1 UVOD

Učenje je kompleksen proces, pri katerem imajo čustva pomembno vlogo. Čustva vplivajo na motivacijo, pozornost, koncentracijo, zaznavanje, predelavo in pomnjenje informacij, samoregulacijo in številne druge aspekte učenja [1]. Psihologinja Woolfolk ugotavlja, da ja za optimalno učenje potrebno ohraniti ravno pravo raven vzburjenja glede na nalogo, kar pomeni stalno opazovanje učencev in prilagajanje dejavnosti glede na njihove povratne informacije [2]. Raziskava med slovenskimi učitelji ugotavlja, da se le-ti zelo dobro zavedajo pomena čustev pri učenju. Med poučevanjem so tako pozorni na čustva, ki jih učenci izražajo med poukom in jih, preko različnih pristopov, poskušajo tudi uravnavati [3]. Kako pa je s čustvi pri učenju na daljavo? Osredotočili smo se na osnovnošolce in raziskovali, kakšna čustva so doživljali pri učenju na tak način, kako jih sploh prepoznati in kakšne so možnosti za naše upoštevanje le-teh pri pripravi učencu bolj prilagojenih gradiv.

2 UČENJE NA DALJAVO

Učenje na daljavo poznamo že zelo dolgo. Začelo naj bi se že pred sto leti z učenjem preko dopisovanja, in sicer v redko poseljenih državah Avstralije, Nove Zelandije in ZDA [4].

Termin e-učenje navadno uporabljamo za učenje preko spleta, kar ni napačno, toda pomeni še veliko več kot to. Elektronsko oziroma e-učenje je v osnovi definirano kot učenje s pomočjo informacijsko-komunikacijskih tehnologij (IKT) [5]. Nanaša se na uporabo elektronskih medijev v različne izobraževalne namene, od uporabe IKT v klasični učilnici do komunikacije na

daljavo. Pojavlja se v različnih oblikah, kot so: spletno učenje (web based learning), virtualna učilnica, e-komunikacija, računalniško podprta interaktivna komunikacija in podobno.

2.1 E-učenje in klasično učenje

Zaradi določenih specifičnih prednosti, je e-učenje vse bolj prisotno na vseh ravneh izobraževanja, še posebej na visokošolski ravni. Zaradi različnih razlogov, kot so digitalizacija šolstva kot tudi nepredvidljive izredne razmere, se e-učenje vse bolj vpeljuje tudi na osnovnošolsko raven. Oba načina poučevanja imata svoje značilnosti (Tabela 1). Naš fokus je usmerjen predvsem na poudarek v učnem procesu, motivacijo in vlogo učitelja pri poučevanju.

Tabela 5. Primerjava e-učenja in klasičnega učenja [6]

	Klasično izobraževanje	E-izobraževanje
Učni proces	Izobraževanje poteka s sodelovanjem celotnega razreda. Skupinsko ali individualno delo je redko.	Večina učnega procesa se izvaja v skupinah ali individualno.
Vsebina	Učne ure so usmerjene po učnem načrtu.	Učenec sodeluje pri določanju vsebine. Izobraževanje je osnovano na več različnih virih informacij, kot sta svetovni splet in spletni eksperti (angl. *net-experts*).
Poudarek v procesu izobraževanja	Učenci se učijo »kaj« in ne »kako«. Poudarek je na opravljenosti vsebinskih kvot in nalog, manj pa na poizvedovanju in reševanju problemov.	Učenci se bolj učijo »kako« in manj »kaj«. Poudarek je na raziskavah, ki zajemajo iskanje in zbiranje podatkov iz svetovnega spleta. Izobraževanje je bolj povezano z resničnim svetom, vsebine pa so bogatejše s snovjo v različnih formatih.
Motivacija	Motivacija učencev je nizka, vsebina pa jim je tuja.	Motivacija učencev je visoka zaradi vključenosti v zadeve, ki so jim blizu in zaradi uporabe tehnologije.
Vloga učitelja	Učitelj je avtoriteta.	Učitelj usmerja učence k informaciji.
Lokacija učenja	Izobraževanje poteka v učilnicah šole.	Izobraževanje poteka kjerkoli.
Struktura učne ure	Učitelj določi strukturo učne ure in razdelitev časa.	Struktura učne ure je pogojena z dinamiko skupine.

Raziskave na področju primerjave klasičnega učenja in e-učenja kažejo različne rezultate. Nekatere ugotavljajo, da med danima načinoma učenja ni pomembnih razlik [7]. Ameriška primerjava med študenti glede motivacije/zanimanja za delo in ocen pri prvem preizkusu znanja navaja več prednosti pri klasični metodi učenja. Študentje, ki so se izobraževali po identičnem programu preko e-učenja, so sicer kazali več zanimanja za delo in posledično imeli več motivacije za delo, a so se izkazali s slabšimi ocenami prvega izpita kot študenti, ki so se izobraževali preko klasičnih predavanj [8]. Nekatere študije pa poročajo o več prednostih učenja na daljavo [9].

2.2 Čustva pri klasičnem in e-učenju

Raziskave kažejo, da ni pomembnih razlik pri izražanju akademskih čustev med klasičnim učenjem in e-učenjem. Na splošno so rezultati raziskav v e-okoljih vzporedni z rezultati v tradicionalnih učilnicah, kar kaže na to, da so čustva v spletnih učnih okoljih v primerjavi s klasičnimi učilnicami podobna [10]. Zato lahko čustva v e-okoljih raziskujemo po identičnih paradigmah.

2.3 Prednosti e-učenja

Prednosti e-učenja, v ospredju učenja preko spleta [11]:

- možnost večperspektivnega prikaza snovi (interaktivni način učenja),
- poljubnosti prostora (posameznik se lahko uči na katerikoli lokaciji želi),
- poljubnost hitrosti (posameznik izbira kako hitro oziroma počasi jemlje snov),
- poljubnost časa (posameznik izbere čas učenja).

Prav tako zmanjša stroške izobraževanja. Zmanjšanje stroškov je posledica različnih dejavnikov: ni izgubljenega časa na poti do izobraževalnega središča, ni potnih stroškov, ni stroškov povezanih z učilnicami, omogoča pridobivanje znanja po potrebi. Podatki so stalno posodobljeni. Zaradi hitrega tehnološkega razvoja znanje prej zastara. Strokovne knjige postanejo zastarele že kmalu po izdaji. Spletna gradiva imajo v primerjavi s knjigami veliko prednost, saj jih je mogoče sproti posodabljati [12].

2.4 Izzivi e-učenja

Kot slabost e-učenja šteje to, da je e-učenje v večini primerov formalno naravnano in z manj priložnostmi za neformalno izobraževanje. E-izobraževanje je pogosto učenje v zamudi, posameznik navadno ne dobi takojšnje povratne informacije, ko jo potrebuje, ampak šele kasneje v časovnem presledku. Če je veliko posredovanja preko spleta, iz strani učitelja in učenca ni vključenih veliko čustev, zato je tudi motivacija za učenje lahko slabša. E-učenci morajo biti zato veliko bolj samostojni, motivirani in zanesljivi kot tradicionalni učenci [8]. V klasični učilnici ima učitelj direkten vpogled v počutje učencev, saj lahko jasno prepoznava, kdaj so učenci aktivni/manj aktivni, doživljajo pozitivna oz. negativna čustva in na podlagi tega prilagaja pouk. Pri e-učenju pa se ta vidik pogosto zanemarja, saj je težko dosegljiv in merljiv. Raziskovalci zato opozarjajo, da so čustva zelo pomembna, če ne še bolj, tudi pri e-učenju in jih je potrebno upoštevati, kako in na kakšen način, pa bo potrebno podrobneje raziskati [13], [14].

Raziskovanja aspekta vključevanja učencev pri e-učenju smo se lotili tudi mi.

2.5 Sistemi, ki prilagajajo gradiva

Obstaja že veliko sistemov, ki na podlagi različnih dejavnikov prilagajajo gradiva svojim uporabnikom. Na podlagi predznanja, časovnega okvirja in starosti se prilagaja zahtevnost, obširnost in količina gradiv.

Raziskovalci so oblikovali tudi gradiva na podlagi učnih stilov posameznika [7] in pričeli s študijami, kako prilagajati učna gradiva glede na počutje učencev [15].

3 ČUSTVA IN UČENJE

3.1 Akademska čustva

Akademska čustva so povezana s čustvi, ki jih učenci doživljajo med učenjem. Feldman Barrett in Russell delita akademska čustva na pozitivna/negativna ter na čustva, ki aktivirajo in de-aktivirajo posameznika med učenjem (Tabela 2) [15].

Pozitivna čustva so tista, ki jih učenci doživljajo kot prijetna in pri njih vzbujajo veselje do učenja, spodbujajo motivacijo, aktivnost in zbranost, večajo kritičnost in fleksibilnost mišljenja. Negativna čustva so tista, ki jih učenci doživljajo kot neprijetna

in praviloma zavirajo proces učenja, demotivirajo, zmanjšujejo stopnjo pozornosti in motivacije za učenje.

Tabela 2. Akademska čustva po Feldman Barrett, Russell in Pekrun

Pekrun [15] deli čustva na štiri področja. Čustva, ki jih učenci doživljajo ob dosežkih, uspehih oz. neuspehih (veselje, upanje, ponos/sram, anksioznost). Epistemološka čustva so tista, ki jih sprožajo kognitivni problemi ob učenju, predvsem pri novih in neznanih nalogah (radovednost, zmedenost, frustracije ob ovirah, presenečenje…). Temeljna čustva so tista, ki se vežejo na teme in snovi, ki so predstavljene med poukom, povezane z interesi učencev (zanimanje, nezanimanje). Socialna čustva so vezana na odnose z učitelji in sošolci (sočutje, ljubezen, zavist, jeza…). Pri poučevanju je pomembno, da jih učitelj pozna in upošteva tako pri učenju, kot tudi pri pripravi in oblikovanju gradiv.

4 PRILAGAJANJE E-GRADIV GLEDE NA POČUTJE

4.1 Raziskave

Več raziskav na tem področju se je pričelo v letu 2011 z uvedbo t.i. projekta ALICE (Adaptive Learning via Intuitive/Interactive, Collaborative and Emotional systems). Cilj programa je bil oblikovati inovativno prilagojeno okolje za e-učenje, ki je interaktivno in se prilagaja učenčevim čustvom, spodbuja njegovo opolnomočenje, gradi socialno identiteto in zagotavlja pristno učno izkušnjo [16].

4.2 Emotivni sistem e-učenja

Velik izziv e-učenja je, kako čim bolje zaznavati in prepoznavati počutje učencev, da bi na podlagi teh spoznanj lahko prilagajali učenje, kot to počnejo učitelji v klasični učilnici.

Feidakis in Daradoumis [17] sta oblikovala t. i. inteligentni emotivni sistem za e-učenje, ki izboljšuje učno izkušnjo učencem in spodbuja tudi razvoj učenčevih socialnih in čustvenih kompetenc. Navajata tri stopnje sistema, ki so bolj podrobno opisani v nadaljevanju.

1. stopnja: zaznavanje in prepoznavanje čustev

Opredelitev treh načinov za merjenje čustev:

• psihološki (subjektivno poročilo učenca z uporabo verbalnih ali slikovnih lestvic oz. vprašalniki itd.),

• fiziološka (uporaba senzorjev za zajemanje biometričnih signalov: EMG, EKG…),

• vedenjski (opazovanje ali zajem motorično-vedenjskih aktivnosti, kot so obrazni izrazi, intonacija glasu, telesna drža, analiza vnosa besedila …).

2. stopnja: vrednotenje čustev

A – pred nalogo (subjektivno poročilo učenca). Če je učenec žalosten oz. utrujen, se sistem praviloma izogne novi snovi.

B – med nalogo (subjektivno poročilo učenca). Učenci določajo vrsto in intenzivnost čustev, ki jih doživljajo.

C – analiza počutja po nalogi (analiza preko vnesenega teksta učenca ali preko subjektivnega poročila učenca).

D – evalvacija počutja učenca (na podlagi dobljenih podatkov se učencu določi njegovo počutje: žalost, dolgočasje, utrujenost, zmedenost …).

Povratna informacija

Pomemben del sistema je, na podlagi pridobljenih informacij in podanih algoritmov, avtomatsko oblikovanje primerne povratne informacije učencu, da pri učenju spodbudi čim večjo čustveno varnost in vztrajnost pri delu. Sistem se lahko odzove bodisi s paralelno-empatičnim (npr. »to je bilo pa stresno, poskusimo nekaj drugega«) ali reaktivno-empatičnim odgovorom (»Izberi si naslednji izziv…«) ali pa predlaga spremembo nalog (npr. sprememba zaporedja nalog).

5 IDEJNA ZASNOVA UČENCU PRILAGOJENEGA E-GRADIVA

Zaradi izrednih razmer smo osnovne šole v šolskem letu 2019/20 od marca do maja izvajale celoten pouk na daljavo. Ker je pouk večinoma potekal preko spleta, lahko govorimo o e-učenju ali celo spletnemu učenju. V zelo kratkem časovnem obdobju je bilo potrebno prilagoditi gradiva spletnemu načinu dela, kar vsekakor ni bilo enostavno. Pri tem smo se srečevali s številnimi izzivi. Eden izmed teh je bil, kako vzdrževati motivacijo učencev za delo in njihovo vztrajnost, prav tako pa tudi kako pomagati učitelju, da bi lažje spremljal učence pri delu.

Učencem smo želeli učna gradiva čim bolj približati, tako z vidika dejavnosti in načina dela, kot tudi preveriti njihovo doživljanje ob delu in gradiva prilagajati še iz tega vidika. Po enem mesecu e-učenja smo izvedli spletno anketo o delu na daljavo, na podlagi katere smo zbrali prevladujoča čustva učencev, ki so bila temelj za oblikovanje poskusnega sistema gradiv po metodi Feidakis in Daradoumis [17].

6 PRILAGAJANJE E-GRADIV

Oblikovanje gradiv je potekalo v treh stopnjah in sicer: analiza stanja učenja na daljavo in prepoznavanje prevladujočih počutij učencev ob tem, posodobitev interaktivnih gradiv na podlagi prepoznanih prevladujočih občutij ter oblikovanje smernic za konstruktivne povratne informacije.

6.1 Analiza e-učenja

Za namen naše raziskave smo uporabili psihološki način merjenja čustev, čustva učencev smo ugotavljali preko subjektivnega poročila z uporabo lestvic v obliki spletne ankete.

S spletno anketo o e-učenju smo želeli izvedeti mnenje učencev o zahtevnosti dela, izvedeti kako uspešni se počutijo pri delu in njihovo počutje ob učenju na tak način. V anketi je sodelovalo 222 učencev od 6. do 9. razreda.

Analiza ankete

Ugotovili smo, da je 94 % učencev za dostop do gradiv uporabljalo splet, pri čemer lahko govorimo o spletnem učenju. 70 % učencev je ocenilo, da delo z e-napravami obvladajo, samo 5 % učencev je ocenilo, da pri tem potrebujejo pomoč. Večina (90 %) učencev je naloge opravljala sama, brez pomoči staršev ali drugih. Velika večina učencev pravi, da so, po njihovem mnenju, uspeli opraviti vse naloge (81 %). Kot glavne razloge za nedokončanje vseh nalog so učenci navajali predvsem pomanjkanje organizacije, motivacije in preobremenjenost (Slika 81).
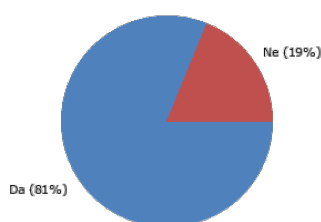
Slika 81: Ali si uspel/a narediti vse do sedaj zahtevane naloge? (n = 207)

Prepoznavanje prevladujočih počutij učencev

Učenci so večinoma poročali o pozitivnih čustvih (Slika 82). Pod drugo pa so navajali brezvoljnost, strah, tesnobo, osamljenost, nevtralnost in podobno.
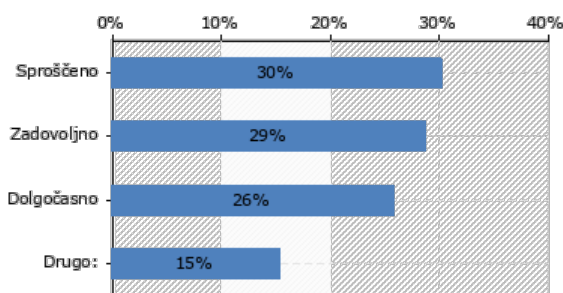
Slika 82: Večino časa se počutim (n = 209)

Na podlagi pridobljenih podatkov smo zbrali prevladujoča, kontrastna čustva in jih razdelili v tri sklope glede na vrednost in aktivacijo, in sicer:

- pozitivna – visoka aktivnost (zadovoljstvo, veselje, radovednost),

- pozitivna/negativna - nizka aktivnost (sproščenost, dolgočasje),

- negativna – visoka aktivnost (strah, tesnoba).

6.2 Prilagajanje gradiv

Začetno stanje

Osnovna oblika gradiv, ki smo jih pripravljali za učence, je bila pripravljena v obliki PDF. Naloge s cilji so bile pripravljene za 1 teden in razdeljene po predmetnih področjih. Učenci so naloge izpolnjevali po lastni organizacijski shemi in ob tem pisali dnevnik opravljenih nalog. Po končani nalogi so dodali svojo samooceno v obliki trostopenjske slikovne lestvice (Slika 3).

Slika 3: Primer naloge za matematiko

Ta sistem dela je odlično deloval za 80 % učencev, ki so naloge redno opravljali (Slika 81), za ostalih 20 % učencev pa smo iskali druge rešitve, tudi v prilagoditvi gradiv.

Prenos gradiv v Google Slides

Za prilagoditev gradiv smo uporabili Googlovo orodje Google Slides. Orodj je brezplačno in podprto v vseh operacijskih sistemih. Omogoča spletno ustvarjanje in urejanje predstavitev, deljenje preko povezav in urejanje z drugimi udeleženci [18]. Gradivo smo prilagodili na podlagi treh najpogostejših težav, ki so jih učenci navajali v anketi kot glavne razloge, da niso dokončali vseh nalog.

Organizacija

Oblikovali smo tedenski urnik, v katerega smo preko povezav umestili vse naloge, ki so bile razdeljene na 45 minutne sklope po predmetih (Slika 4).

Slika 4: Tedenski urnik s povezavo

Motivacija

Motivacijo lahko povečamo preko višje participacije posameznika, spodbujanja radovednosti in preko dajanja večje možnosti odločanja/izbire. Aktivnost lahko učenem povečamo tudi z raznolikostjo, presenetljivimi dejavnostmi in kratkimi fizičnimi aktivnostmi [2]. Zato smo ob zaključku vsakega sklopa nalog določenega predmeta ohranili 3-stopenjsko samooceno opravljenih nalog in dodali možnost za opombe. Na koncu smo dodali še 4 možnosti, ki jih učenec izbere glede na vrednost (pozitivna/negativna) in aktivacijsko pozicijo trenutnega počutja (visoka/nizka):

- pozitivna – visoka aktivnost: »Grem na naslednji predmet/nalogo«,

- pozitivna/negativna – <u>nizka aktivnost</u>: «Potrebujem izziv«,
- <u>negativna – visoka aktivnost</u>: «Vaje sproščanja/Kontakt učitelja«.

Slika 5: Več možnosti izbire glede na trenutno počutje učenca

Vaje sproščanja, miselni in športni izzivi so povezave na spletne posnetke/vaje in na sklop vaj izdelan prav tako v Google Slide orodju.

Preobremenjenost

Za lažjo prilagajanje težavnosti smo v osnovnem urniku označili tiste ure predmetov, za katere učitelji ocenjujejo, da so bolj zahtevni (Slika 6). Na tak način učenci lažje izbirajo tiste dejavnosti, ki bolj ustrezajo njihovemu trenutnemu razpoloženju.

Slika 6: Z zvezdico označene, po mnenju učitelja, bolj zahtevne naloge

Evalvacija počutja učenca

Ob zaključku delovnega dneva oz. po izpolnitvi zadanih nalog učenec odgovori na vprašanje o njegovem počutju tekom delovnega procesa, ki učitelju nudi pomembno informacijo o njegovem počutju (Slika 7).

Slika 7: Evalvacija počutja učenca

6.3 Oblikovanje povratne informacije

Predvidevali smo, da ima vsak učenec svoje Google Slide e-gradivo, kar mu daje možnost, da vnaša samoocene narejenih nalog in drugih opomb direktno v dokument, kar prihrani veliko časa. To daje tudi učitelju možnost, da sproti spremlja napredek učenca in predvsem oblikuje konstruktivne povratne informacije - dnevne, tedenske ali ob zaključku sklopa določene snovi, kar ključno poveča motivacijo učencev za delo.

Povratna informacija je sestavljena iz učenčeve uspešnosti pri delu (npr. št. pravilnih odgovorov), njegove motivacije/prizadevanja za delo in empatične spodbude v obliki poudarjanja močnih točk, izpostavitve določenega čustva ali nudenja potrebne pomoči.

7 DISKUSIJA

Dodana vrednost prispevka je v iskanju rešitev, kako spletno učenje čim bolj približati klasičnemu učenju, predvsem v smislu socialne in psihološke podpore posamezniku, ki so jo učenci vajeni v klasičnem razredu.

To smo storili preko vpeljevanja sprememb v spletno učenje na področju organizacije in preglednosti nad nalogami; z vpeljevanjem več izbir pri delu smo želeli dvigniti motivacijo za delo, preko označevanja težavnosti nalog vplivati na manjši občutek preobremenjenosti. Za lažje oblikovanje povratnih informacij učitelja učencu, pa smo dodali še evalvacijo počutja učenca.

Sam sistem od učitelja terja zelo veliko časa in energije, kar je velika pomanjkljivost, za katero bomo iskali boljše rešitve, predvsem v uporabi drugih spletnih platform. Naš sistem smo oblikovali v orodju Google Slide, ena izmed možnosti je tudi uporaba aplikacije Microsoft Teams v okolju Microsoft 365, ki pa je za uporabo malce zahtevnejša. Nadaljnje delo bo usmerjeno tudi v iskanje bolj optimalnih tehničnih rešitev.

8 ZAKLJUČEK

V prispevku smo iskali načine, kako izboljšati izkušnjo e-učenja za učence na način, da bi povečali preglednost napredka učenca, povečali njihovo motivacijo in jih podprli v učenju in predvsem v učni proces vključili tudi počutje učencev.

V izvedeni anketi med osnovnošolci so učenci navedli tri glavne razloge, zakaj pri e-učenju niso bili uspešni in sicer težave z organizacijo, motivacijo in preobremenjenost. Te trije vidiki so bili izhodišče za preoblikovanje že obstoječih e-gradiv s spletnim orodjem Google Slides.

Na podlagi literature in lastnih izkušenj smo tako zasnovali model za prilagoditev gradiv za e-učenje, s katerim želimo učenem omogočiti boljšo organizacijo, višjo motivacijo za delo in zmanjševati občutek preobremenjenosti za delo. Prav tako pa pomagati učitelju k večji preglednosti učenčevega dela. V kakšni meri smo bili pri tem uspešni, bo pokazala uporaba in nadaljnje študije.

Pomanjkljivosti takega modela vidimo v tem, da je za samo oblikovanje potrebno zelo veliko časa. Če želi imeti učitelj pregled nad delom posameznega učenca, mora izpolnjevati vsak svoj dokument, kar poveča obremenjenost učitelja tako pri pripravi, kot tudi pri pregledovanju gradiv. V vsakem primeru pa mora povratno informacijo še vedno oblikovati za vsakega posameznega učenca posebej. Smernice, da bi tudi povratne informacije računalniško prilagajali s pomočjo algoritmov, v teoriji prinašajo zelo veliko prednosti, v praksi pa je iskren človeški stik, četudi preko spleta, še vedno nenadomestljiv.

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Spremljanje srčnega utripa s pomočjo IKT pri predmetu šport

Monitoring the heart rate with the help of ICT in P. E. Lessons

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POVZETEK

Sodoben način poučevanja prav gotovo zajema tudi uporabo informacijsko-komunikacijske tehnologije (IKT). To je način poučevanja, kjer se uporabljajo vsa sodobna orodja in obvladovanje le-teh, je ena pomembnejših kompetenc 21. stoletja. Uporaba IKT je ena izmed dodatnih možnosti učitelja za drugačen, bolj inovativen didaktičen pristop k poučevanju določenih vsebin. Inovativni pouk je način poučevanja, pri katerem učitelj učence usmerja, da le-ti z raziskovanjem, ustvarjalnostjo in uporabo IKT pridejo do spoznanj o učni snovi in pri tem nadgrajujejo/izpopolnjujejo svoje znanje. V prispevku je predstavljena uporaba IKT pri predmetu šport. Učenke so svoj srčni utrip spremljale s pomočjo merilca srčnega utripa, mobilne aplikacije in ročnega merjenja.

KLJUČNE BESEDE

IKT, merilec srčnega utripa, šport, srčni utrip

ABSTRACT

The modern way of teaching certainly includes the use of information and communication technology (ICT). Mastering the way of teaching, where all modern tools are used, is one of the most important competencies of the 21st century. The use of ICT provides the teacher additional possibilities for a different, more innovative didactic approach to teaching certain contents. Innovative teaching is a way of teaching in which the teacher directs students to gain knowledge about the subject matter through research, creativity and the use of ICT, whilst upgrading / improving their knowledge. The paper presents the use of ICT in P.E. lessons. Pupils monitored their heart rate with the help of a heart rate monitor, a mobile application and manual measurement.

KEYWORDS

ICT, heart rate sensors, sport, heart rate

1 UVOD

Živimo v obdobju, ko so družbene, gospodarske, izobraževalne in vzgojne potrebe čedalje večje, zato je toliko bolj pomembna uvedba informacijsko-komunikacijske tehnologije (IKT) v vse segmente našega življenja. Družbeni razvoj tako teži k razvijanju in razširjanju visoke tehnologije. Danes uporabljajo računalnike in druge informacijsko-komunikacijske tehnologije ljudje v vseh delovnih okoljih na vseh področjih. Tako je seveda pomembno in neizogibno IKT uvesti v čim večji meri tudi v predšolsko in osnovnošolsko izobraževanje. Če se bo učence že v osnovni šoli navajalo na različne IKT, bodo le-ti kot odrasli lažje razvili ustrezne veščine za prilagajanje na vse novosti. Zato je potrebno izobraževanje otrok v vrtcih in osnovnih šolah prilagoditi času in prostoru, v katerem živijo, jih izobraževati in vzgajati tako, da bodo lahko obvladovali hiter razvoj tehnologije v družbi [1].

Spremembe, ki jih je s seboj prinesla IKT, niso zaobšle niti izobraževanja. Ross je že leta 1982 zapisal, da se izobraževalni sistem spreminja skladno z družbenimi, zgodovinskimi in ekonomskimi dejavniki, ki vključujejo tudi tehnološke spremembe. Tako je IKT v izobraževalni sistem prinesla številne spremembe, ki jih morajo udeleženci znati izkoristiti, da bi bil njihov učinek optimalen. V slovenskih osnovnih šolah je bila informacijska tehnologija prvič predstavljena v začetku osemdesetih let prejšnjega stoletja. Na nacionalni ravni se je načrtno začela uvajati šele v sredini devetdesetih let dvajsetega stoletja, s projektom RO – računalniško opismenjevanje, ki je za začetek poskrbel za osnovno računalniško opremo in izobraževanje za uporabo le-te na slovenskih šolah. Cilj projekta je bil izvesti široko računalniško izobraževanje za učitelje in ravnatelje, opremiti vse osnovne in srednje šole z IKT in programsko opremo ter omogočiti raziskovanje in razvoj uporabe računalnikov v šolah, s tem pa ustvariti sodobnejši, aktivnejši pouk ter sodobno vodenje in poslovanje šole [1].

2 KAJ JE INFROMACIJSKO-KOMUNIKACIJSKA TEHNOLOGIJA (IKT)?

Informacijsko-komunikacijska tehnologija (v nadaljevanju IKT) je skupen izraz različnih računalniških, informacijskih in komunikacijskih naprav, ki so postale naš vsakdanji spremljevalec [2]. Tehnološki napredek je zajel tudi področje šolstva, zato so se bile šole primorane informatizirati. IKT je

postal nepogrešljiv pripomoček pri učenju in poučevanju. Glavni cilji vključevanja IKT v pouk so informacijska pismenost, nove spretnosti in bogatejše izkušnje. Za ustrezno in smiselno rabo IKT pri pouku je odgovoren usposobljen učitelj. Tehnologija omogoča učiteljem, da pouk načrtujejo bolj učinkovito, od učencev pa zahteva, da so pri pouku aktivni in motivirani [3].

Enotne definicije, ki bi natančno opredelila IKT ni, vsem pa je skupno to, da se v opredelitvi omenja beseda komunikacija. V literaturi je mogoče zaslediti več opredelitev IKT.

3 UPORABA IKT PRI POUČEVANJU

Računalnik oz. IKT danes že imata svoje mesto v našem izobraževalnem sistemu in poučevanju nasploh, v nekaterih šolah bolj, v drugih manj uspešno. Veliko je govora o možnostih sodobnejšega in kvalitetnejšega pouka in poučevanja, ki jih tehnologija omogoča, o možnostih prehoda od pouka, ki temelji na pomnjenju velike količine podatkov, k reševanju praktičnih problemov, ki zahtevajo od učenca kreativno mišljenje in konec koncev tudi takšno znanje. Pomembne so didaktične oblike in metode dela ter zavedanje, na kateri stopnji znanja so učenci in učitelji pri uporabi IKT pri pouku, da bi lahko učence miselno in motivacijsko razgibali in se predvsem izognili morebitnim negativnim učinkom na učni načrt. Uporaba IKT pri pouku je ob ustrezni opremi odvisna seveda od učitelja. Učiteljevi odzivi na različne pristope k uporabi IKT so odvisni namreč od njihovega individualnega znanja, lastnega prepričanja in pristopa k poučevanju (npr. občasna uporaba projektorja pripelje do hitre navade na takšen način dela). Če učitelj pogosto uporablja določeno opremo ali pristop, se le-ta izkaže za uspešno izhodišče pri uvajanju bolj učinkovitega vključevanja IKT v pouk. Zato je zelo pomembna učiteljeva samozavest in prepričanje v lastne sposobnosti na področju uporabe IKT. Bolj samozavestni in sposobni učitelji so hitro pripravljeni sprejeti nove učne pristope (npr. predstavitev s pomočjo računalnika in projektorja), medtem ko manj samozavestni redkeje pristopijo k uporabi IKT. Učitelji z bolje razvitimi osebnimi sposobnostmi za uporabo IKT tako seveda lažje razumejo potencial, ki ga nudi IKT, in so tudi bolj odločni za uporabo pri poučevanju. In prav zato je pomembna usposobljenost učiteljev za uporabo računalnika oz. IKT. Da učitelji lažje in bolj jasno odločajo o tem, kako in kdaj jim lahko IKT pomaga pri poučevanju, je pomembno, da poznajo strojno in programsko opremo, ki jim je v šoli na voljo za uporabo. Za učinkovito izrabo IKT je zato zelo pomembno, da poznamo razpoložljivo strojno in programsko opremo [1].

Tišler [1] v svojem delu pravi, da šole v svojih učnih načrtih po navadi ne predvidevajo, kako IKT vključiti v pouk, saj se po navadi načrtuje le razvijanje učenčevih sposobnosti za rabo IKT pri predmetu računalništva. Vzrok temu je lahko pomanjkanje opreme za uporabo IKT ali premajhna pripravljenost za uporabo le-te. Najbolj uporabne se posebne učilnice, opremljene z več računalniki (računalniške učilnice), na katerih lahko hkrati delajo vsi učenci v učilnici. Zato je seveda ustrezna opremljenost šolskih prostorov nujna, saj lahko le tako učitelji učinkoviteje načrtujejo in uporabljajo IKT na različnih predmetnih področjih. Vsa oprema, ki je na šoli, pa nujno ne zadošča za smotrno in kvalitetno uporabo računalnika pri pouku, zato je pomembno, da se pri pouku ne uporablja zastarele opreme, ki prepogosto zataji, kar lahko kar hitro pripelje do zastoja učne ure. Med strojno opremo lahko štejemo naslednje: osebni računalnik, prenosni računalnik, omrežna računalniška postaja, LCD projektor, skener, digitalna kamera, digitalni fotoaparat, interaktivna tabla … Pri predmetu šport lahko učitelji uporabijo različno opremo: prenosni računalnik, kamera, LCD projektor, merilci srčnega utripa … Skoraj bolj pomembno od poznavanja strojne opreme pa je, da pozna učitelj vrsto in način uporabe programske opreme, ki mu je na voljo in se uporablja za posamezne predmete. Prav tako je pomembno, da se učitelj sam, npr. na spletu, pozanima o možnih novih, boljših didaktičnih programih in predlaga nabavo le-teh, kar pa pomeni, da mora biti seznanjen z načini zagotavljanja ustrezne programske opreme in zato vključen v načrtovanje nabave nove opreme za uporabo IKT. Ob poznavanju strojne in programske opreme, ki je na voljo, je pomembno načrtovanje za poučevanje predmeta. Tukaj je potrebno jasno razločevati med načrtovanjem vključevanja IKT v pouk za dosego ciljev pri drugih predmetih in na drugi strani med načrtovanjem razvijanja učenčevih sposobnosti na področju IKT. Učinkovita izraba IKT se bo tako odražala v izboljšanju poznavanja posameznega predmeta in tudi na učiteljevih razlagah snovi.

3.1 PREDNOSTI IN SLABOSTI IKT

Tako kot vse stvari ima tudi uporaba IKT svoje prednosti in slabosti.

Himmelsbach [4] je v svojem članku predstavil pet prednosti in pet slabosti uporabe IKT pri pouku;

Prednosti uporabe IKT pri pouku

- Uporaba IKT omogoča več eksperimentiranja in takojšnjo pridobitev povratnih informacij.
- Uporaba IKT pomaga pri vključevanju vseh učencev (polna udeležba).
- Pouk z uporabo IKT pripomočkov je bolj zabaven in učinkovit.
- Z uporabo IKT v razredu imajo učenci takojšen dostop do aktualnih informacij, ki lahko dopolnijo njihovo učno izkušnjo.
- Živimo v digitalnem svetu, zato je uporaba IKT postala življenjska veščina.

Slabosti uporabe IKT pri pouku

- IKT je lahko v učilnici moteča.
- Uporaba IKT lahko zmanjša socialno interakcijo učencev.
- Uporaba IKT naprav lahko spodbuja goljufanje v razredu in pri preverjanju znanja.
- Učenci nimajo enakega dostopa do tehnoloških virov.
- Viri, ki jih učenci najdejo na spletu, velikokrat niso zanesljivi.

4 SMERNICE ZA UPORABO IKT PRI PREDMETU ŠPORT

Športna vzgoja/predmet šport je učni predmet, pri katerem učitelj, poleg gibalnega znanja in sprostitve učencev zasleduje, tudi veliko število vzgojnih ciljev in ciljev, vezanih na razvoj temeljnih gibalnih sposobnosti oz. gibalne učinkovitosti

učencev. To je predmet, pri katerem moramo znati izvesti dejavnost učinkovito in varno, da bomo tudi kasneje v življenju to lahko redno in varno počeli. Športni pedagog uporablja IKT v procesu poučevanja z namenom, da učno vsebino ali cilj lažje in bolje ponazori, osmisli, utemelji, izboljša razumevanje, izboljša kakovost demonstracije, spodbudi učence k razmišljanju in dejavnosti, pripomore h kakovosti procesa učenja. IKT je pri tem pripomoček oz. orodje, ki pomaga pri pridobivanju znanja [5].

Učni načrt predmeta šport uporabo informacijsko komunikacijske tehnologije navaja v Splošnih izhodiščih, ki jim sledi učitelj športa.

Markun Puhan [5] navaja, da je IKT v tretjem vzgojno izobraževalnem obdobju omenjena pri naslednjih učnih sklopih:

- Pri učnem sklopu Splošna kondicijska priprava: Ugotavljanje zakonitosti športne vadbe - izbor nalog, intenzivnost vadbe in trajanje obremenitve glede na različne cilje, tudi z uporabo IKT (merilniki srčne frekvence, porabe energije, števila korakov).
- Pri učnem sklopu Ugotavljanje in spremljanje gibalnih sposobnosti ter telesnih značilnosti: Pri obravnavanju značilnosti biološkega razvoja učenci za spremljanje svojega telesnega in gibalnega razvoja ter vrednotenje sprememb uporabljajo tudi informacijsko-komunikacijske tehnologije.
- Pri Splošnih teoretičnih vsebinah: Odzivanje srčno-žilnega in dihalnega sistema na povečan napor pri športni vadbi (merjenje srčnega utripa… načrtovanje vadbe, pomen največje porabe kisika).

4.1 DODATNI DIDAKTIČNI NAPOTKI ZA UPORABO IKT PRI PREDMETU ŠPORT

Markun Puhan [5] navaja naslednje dodatne didaktične napotke za uporabo IKT pri predmetu šport:

Pomembno je, da si učitelj prej odgovori na vprašanje kaj želi pri določeni uri z učenci doseči, šele nato pa kaj bo delal in katere pripomočke bo a to uporabil (rekvizite, delovne liste, IKT)

Učitelj naj presodi kdaj in katero sodobno tehnologijo bo uporabil v procesu poučevanja; IKT sama po sebi namreč nima dodane vrednosti. Je le orodje, kot svinčnik, zvezek, žoga, blazina… ki učencem/dijakom pomaga pri učenju)

Učenci so lahko na področju rokovanja z IKT znajo več od učitelja. V tem primeru naj jim učitelj omogoči, da izkažejo svoje znanje, sam pa naj bo pozoren na cilje, za katere želi, da jih učenci usvojijo.

S pomočjo IKT lahko učenec ali dijak sprejema informacije vzporedno po več kanalih npr. poleg slušnega in kinestetičnega še po vidnem kanalu, kar predstavlja pomembno dodano vrednost. Informacije in povratne informacije so tako natančnejše, razumljivejše in zato učinkovitejše.

5 SRČNI UTRIP

Srce se med svojim delovanjem razteza in krči. Pri raztezanju se napolni s krvjo, pri krčenju pa kri potisne po žilah. Pri tem se kri iz njegove leve polovice pretoči skozi aorto v glavne arterije. Ker je pretok krvi pri krčenju srca velik, se v arterijskih žilah (ali žilah utripalnicah) zazna pulzni val, ki se otipa s prstnimi blazinicami, ko se žilo pritisne ob tršo podlago (kost ali mišico). Včasih se

tako utripanje žil opazi s prostim očesom kot nihanje kože. Temu utripanju pravimo srčni utrip ali pulz. Normalen srčni utrip odraslega netreniranega človeka (pri otrocih ta podatek ni merodajen) je od 60 do 100 udarcev na minuto čez dan, medtem ko je ponoči veliko nižji (lahko tudi le okoli 40 utr./min.). Na eni strani imamo maksimalni srčni utrip (maksimalno število utripov v minuti), na katerega načeloma ne moremo kaj dosti vplivati, saj je slednji odvisen predvsem od starosti in dednih zasnov. Mlado srce lahko doseže tudi do 200 udarcev v minuti, z leti ta vrednost pada. Na drugi strani imamo srčni utrip v mirovanju, na katerega lahko vplivamo in ga s pomočjo treningov dolgoročno znižujemo. Srce utripa v mirovanju počasi, med obremenitvijo pa se pulz pospeši, da zadosti potrebi po večjem pretoku, predvsem skozi obremenjene mišice. Med obremenitvijo – telesno pa tudi psihično, se utrip pospeši, v mladosti bolj kot v starosti. Utrip lahko spremenijo nekatera fiziološka stanja (npr. nosečnost), pa tudi bolezni. Najpomembnejšo fiziološko spremembo utripa dosežemo z redno telesno aktivnostjo, ki lahko precej upočasni pulz, tudi do vrednosti pod 40/min v mirovanju. Oseba, ki ima tako nizek pulz v mirovanju, ima veliko rezervo, ki jo lahko izrabi med obremenitvijo [6].

6 PRIMER SPREMLJANJA SRČNEGA UTRIPA S POMOČJO IKT PRI PREDMETU ŠPORT

Spremljanje srčnega utripa s pomočjo IKT smo izvedli v 6. razredu pri rednih urah predmeta šport v sklopu splošne kondicijske priprave. Pri uri je sodelovalo 12 učenk.

Z navodili in opisom poteka ure/meritev so bile učenke seznanjene že na prejšnji uri. Vsaka je meritve izvajala na način, ki ji je bil določen:

- 1 učenka - s pomočjo ure Polar V800, ki omogoča merjenje srčnega utripa,
- 5 učenk - ročno, na notranji strani zapestja, proti palcu (a. radialis) - 30 sekund in
- 6 učenk - s pomočjo mobilne aplikacije Srčni Utrip Plus

Meritve srčnega utripa so se izvajale po naslednjem zaporedju:

- srčni utrip v mirovanju (na začetku ure so se vse učenke za 5 minut usedle na klop ter povsem umirile),
- srčni utrip po ogrevanju,
- med vadbo in
- na koncu šolske ure v mirovanju (5 minut sedenja).

Izmerjene rezultate so si učenke sproti zapisovale na osebni karton. Rezultate smo na naslednji uri analizirali in primerjali med seboj. Na prenosnem računalniku smo si ogledali tudi spreminjanje srčnega utripa pri učenki, ki je celo šolsko uro nosila uro Polar V800 (Slika 1).
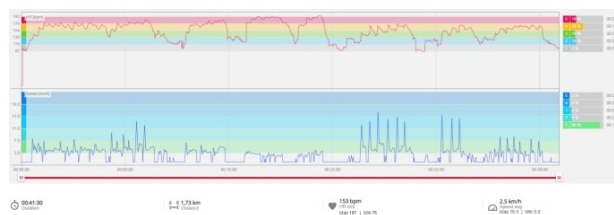
Slika 1. Spreminjanje srčnega utripa pri učenki

7 SKLEP

Uporaba IKT je sigurno ena izmed dodatnih možnosti učitelja za drugačen oz. bolj inovativen didaktičen pristop k poučevanju določenih vsebin. Inovativni pouk je način poučevanja, pri katerem učitelj učence usmerja, da le-ti z raziskovanjem, ustvarjalnostjo in uporabo IKT pridejo do spoznanj o učni snovi in pri tem nadgrajujejo/izpopolnjujejo svoje znanje. Učitelj mora biti pri uporabi IKT pozoren, da njegovo vnašanje v pouk ni prekomerno in le takrat, kadar je to smiselno. Uporaba IKT naj ne bo za vsako ceno in vsekakor ne namesto praktičnega dela pouka. Predvsem naj bodo sredstva IKT praktičnemu pouku športne vzgoje v pomoč in dopolnitev.

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Pouk angleščine na daljavo s spletnim orodjem BookWidgets

Distance English language teaching using the BookWidgets online tool

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POVZETEK

Leto 2020 je z epidemijo SARS-CoV-2 šolskemu sistemu v Sloveniji prineslo situacijo brez precendensa: karanteno, zaprtje izobraževalnih ustanov in pouk na daljavo. Zlasti osnovne šole so se morale zato čez noč prilagoditi novim razmeram in pripraviti vse potrebno, da je pouk na daljavo stekel karseda nemoteno navkljub številnim težavam, ki so se ob tem pokazale. Učitelji so morali prilagoditi metode dela in v priprave na pouk integrirati spletna orodja, ki bi omogočila tako napredek učencev pri doseganju učnih ciljev, kot zbiranje dokazov o učenju, dajanje povratne informacije in komunikacijo z učenci. Prispevek opisuje primer pouka angleščine na daljavo z uporabo Bookwidgets, spletnega orodja, ki uri pouka da interaktivno noto in učitelja opolnomoči, da ustvari interaktivne naloge, jih deli z učenci in jim po reševanju omogoči povratno informacijo. V zaključku se prispevek osredotoča na analizo prednosti in slabosti orodja BookWidgets v smislu SWOT analize.

KLJUČNE BESEDE

Pouk na daljavo, IKT, BookWidgets, tuji jezik angleščina

ABSTRACT

With the outbreak of the SARS-CoV-2 epidemic, the year 2020 caused an unprecedented situation in the Slovenian school system: quarantine, educational institution lockdown and distance learning. Primary schools in particular had to adapt to the new situation overnight and measures had to be taken to ensure the learning processes would continue as seamlessly as possible in spite of the many problems that arose from the situation. Teachers had to make a shift in their methods of teaching and incorporate in their lesson plans online tools that would allow for collecting evidence of learning, giving students feedback and communicating with them. This paper presents a case of English language distance learning by means of BookWidgets, an online tool, that makes learning interactive and empowers the teacher to create interactive activities, share them with their students and give them feedback on their work. In conclusion, the paper focuses on advantages and disadvantages of using BookWidgets in the form of a short SWOT analysis.

KEYWORDS

Distance learning, ICT, BookWidgets, EFL

1 UVOD

Šolsko leto 2019/20 je poučevanju v Sloveniji postreglo z velikim izzivom. Ko je decembra 2019 v kitajskem mestu Wuhan prišlo do izbruha okužb z virusom SARS-CoV-2 (v nadaljevanju: koronavirus), ki se je hitro razširil onkraj meja Kitajske, je bilo le vprašanje časa, kdaj bo prvi primer okužbe zabeležila tudi Slovenija. A posledic – tudi za slovensko šolstvo – v takšni meri, kot so se pojavile v tednih po prvih zabeleženih okužbah na naših tleh, verjetno številni niso pričakovali.

V obdobju od 4. marca 2020, ko je bila slovenska javnost obveščena o prvem zabeleženem primeru koronavirusa, ni preteklo veliko časa, ko je bilo potrebno slovenski izobraževalni sistem tako rekoč čez noč postaviti na glavo na način, da je še vedno ostal – vsaj razmeroma – funkcionalen. Tako je bila v četrtek, 12. marca 2020, ob 18. uri razglašena epidemija ter s tem naznanilo, da se s 16. marcem 2020 zapirajo vse vzgojno-izobraževalne institucije v državi. Takoj v petek in tekom vikenda, ki je sledil, so predvsem številne šole intenzivno iskale načine, kako s poukom kar najbolj optimalno nadaljevati od 16. marca 2020 dalje. To je bil začetek obdobja brez precedensa: pouk na daljavo za vse vzgojno-izobraževalne ustanove.

2 POUK NA DALJAVO – SODOBNI IZZIV

2.1 Organizacija pouka na daljavo z danes na jutri: osnovnošolski primer

Po četrtkovi večerni razglasitvi epidemije je bila v Osnovni šoli Toma Brejca Kamnik takoj naslednji dan aktivirana delovna skupina za načrtovanje pouka na daljavo. Člani delovne skupine smo intenzivno premlevali možnosti, kako učencem še naprej zagotoviti obiskovanje pouka in kakovostno izobraževanje. Hkrati smo moči uperili v to, kako o aktualnem dogajanju hitro in učinkovito obvestiti ključne deležnike vzgojno-izobraževalnih procesov na šoli: učitelje, učence in njihove starše.

Medtem ko so učiteljice 1. in 2. razreda sklenile, da se bodo za izvajanje aktivnosti v okviru pouka na daljavo povezale neposredno z učenci oz. njihovimi starši, smo v delovni skupini po tehtnem premisleku sklenili, da bomo vzpostavili izobraževalno okolje v oblaku na platformi GoogleDocs. Za učence od 3.–9. razreda smo pripravili dostop do delovnih map in se z učiteljskim zborom dogovorili, da učitelji v mape nalagajo gradiva v obliki pdf datotek en dan vnaprej.

V šolskih dneh, ki so sledili, izzivov za učitelje ni manjkalo. Pri pouku na daljavo smo se srečevali s težavami, ki jih zaradi hitre spremembe načina izvajanja pouka ni bilo možno v celoti predvideti vnaprej, med drugim:

- Kako pomagati učencem brez ustrezne IKT opreme?
- Kako pomagati učencem s slabo internetno povezavo?
- Kako pomagati učencem, ki pri učenju na daljavo zaradi različnih razlogov niso imeli učinkovite podpore domačega okolja?
- Kako vzpostaviti enostavno, hitro, predvsem pa učinkovito komunikacijo z učenci?
- Kako vzpostaviti stik z neodzivnimi učenci in jih vzpodbuditi k delu?
- Kako učinkovito pomagati učencem s posebnimi potrebami?
- Kako motivirati za delo šibkejše učence?
- Kako diferencirati pouk na daljavo tako, da so dejavnosti v izziv tudi zmožnejšim učencem?
- Kako izbrati aktivnosti, ki naredijo pouk privlačen in zanimiv?
- Kako učencem nuditi dobro razlago nove snovi?

Pouk, ki je v celoti podprt z IKT in v katerem ni neposrednega fizične prisotnosti učitelja in učencev, je tako čez noč zahteval veliko mero iznajdljivosti v IKT segmentu sodobnih pristopov v poučevanju.

2.2 Sodobni pristopi v poučevanju angleščine in IKT

V času pouka na daljavo smo se učitelji ukvarjali s skupno dilemo: na spletu obstaja nebroj idej, aplikacij in digitalnih gradiv za delo na daljavo; toda kako za svoje skupine učencev izbrati najučinkovitejše? Takšne, ki bodo učinkovito razvijale jezikovne zmožnosti in hkrati dopuščale povratne informacije v smeri učitelj–učenec in obratno. Vzporedno s tem smo iskali načine, kako iz učnih načrtov izluščiti in prilagoditi bistvene vsebine tako, da bodo učenci pri pouku na daljavo uspešni skladno s svojimi zmožnostmi in bodo napredovali? Dodaten izziv je hkrati bil ugotavljanje in spremljanje (ne)napredka posameznega učenca?

Učni načrt za angleščino [1] opredeljuje IKT kot pomemben podporni element pri pouku angleščine, saj učitelju »omogoča uvajanje raznolikih oblik in metod dela v pouk ter pripravo in prilagoditev besedil, nalog in drugih gradiv za doseganje različnih ciljev,« učenci pa ob IKT podpori radi sodelujejo in se lotevajo nalog, kar je pomemben motivacijski element. IKT pri pouku angleščine med drugim spodbuja sporazumevalno in medkulturno zmožnost, splošno razgledanost in sodelovalno ustvarjalnost.

Sodobni pristopi kot ključno v procesu poučevanja na daljavo zahtevajo od učitelja več časa za kvalitetno načrtovanje pouka. Barton [2] povzema, da neuspeh pri učencih izvira tudi iz tega, da »skrbijo za učne stile, ne pa tudi za učence in učenje samo« ter izpostavi, da se je potrebno osredotočiti na personalizirano učenje. »Vsi učenci morajo vedeti, zakaj in kako se učijo, in biti opolnomočeni, da vzamejo učenje v svoje roke.«

Načrtovanje pouka poteka tako na zavedni kot na nezavedni ravni, pri čemer mora učitelj še posebej upoštevati:

- znanja, ki so pomembna za učence,
- jasno postavljene cilje, ki naj jih učenci usvojijo,
- konkretno začrtane poti do zastavljenih ciljev,
- nabor dejavnosti, ki jih bo implementiral v pouk ter frekvenco implementacije le-teh,
- konkretno, nedvoumno in jedrnato podajanje navodil za izvedbo izbranih dejavnosti,
- načine diferenciacije pri pouku na daljavo,
- načine pridobivanja in vzdrževanja pozornosti učencev,
- vzpostavitev stika z učenci, ki spodbuja dobro počutje učencev in motivira za delo,
- pridobivanje dokazov o učenju in posledično spremljanje napredka učencev,
- vzpodbujanje sodelovalnega učenja in medvrstniške pomoči na daljavo,
- načine za kvalitetno preverjanje in ocenjevanje znanja.

Poleg tega je, podobno kot pri klasičnem pouku, tudi pri pouku na daljavo pomembno, da učencem jasno opredelimo namen učenja in s tem pri njih dvignemo raven zavesti o tem, kaj in zakaj se učijo ter kdaj so pri učenju uspešni (kriteriji uspešnosti). Prav ta dvig zavesti, t. j. ko učenci vedo, kdaj nekaj znajo, je lahko pri njih ključen motivacijski dejavnik.

3 SPLETNA ORODJA IN POUK NA DALJAVO

3.1 Morje možnosti

Z uvedbo pouka na daljavo smo učitelji ne glede na pretekle izkušnje bili primorani razmišljati o uvedbi novih načinov dela z učenci. Številni smo se lotili raziskovanja raznoraznih spletnih orodij, ki omogočajo bodisi uporabo že pripravljenih gradiv, bodisi izdelavo novih, hkrati pa – kar smo hitro ugotovili, da je nujno – tudi neko obliko komunikacijskega kanala z učenci, preko katerega smo preverjali, ali učenci opravljajo naloge in kako uspešno.

Razvoj IKT sodobnemu učitelju ponuja številna didaktična spletna orodja, mnoga od teh z integriranim formativnim spremljanjem napredka učencev. Učitelji (in delno tudi učenci) imamo v bogatem naboru teh orodij med drugimi na voljo npr.:

- Wordwall (spletni kvizi na igriv način),
- Kahoot (spletni kviz s točkovanjem in možnostjo časovne omejitve reševanja),
- Socrative (spletni kvizi),

- ActivePresenter (orodje za pripravo razlage snovi za učence),

- Padlet (spletna oglasna deska, npr. za objavo izdelkov učencev),

- Jamboard (razlaga snovi s pomočjo spletne table),

- MovieMaker (orodje za montažo video posnetkov),

- Interactive Worksheets (orodje za predelavo klasičnih učnih listov v interaktivno obliko),

- GoFormative (izdelava nalog za učence na osnovi povratne informacije in formativnega spremljanja),

- Canva (orodje za pripravo vizualnih gradiv, npr. plakatov),

- BookWidgets (orodje za pripravo raznovrstnih spletnih vaj z možnostjo spremljanja napredka in neposredne povratne informacije učencu),

- okolja v oblaku kot so GoogleDocs, MS Office 365 idr.

3.2 Prava izbira?

Precej večji izziv kot samo iskanje, raziskovanje in preizkušanje orodij učitelju predstavlja odločitev o uporabi posameznih orodij za svoje skupine učencev. Učitelj na osnovi izkušenj in poznavanja skupin svojih učencev ter na osnovi karakteristik posameznikov v skupinah presodi:

- Katera orodja so za učence glede na značilnosti skupine (starostna stopnja, predhodna znanja uporabe IKT, ipd.) primerna?

- Kdaj v učnem procesu bodo posamezna izbrana orodja prišla v poštev (npr. ugotavljanje predznanja, obravnava nove snovi, preverjanje znanja, ocenjevanje znanja ipd.)?

- Kako pogosto bodo posamezna orodja uporabljena, da se učni proces z njimi ne zasiti in bi posledično pri učencih upadla motivacija za delo?

Uvajanje IKT v pouk zahteva tudi tehten premislek o pedagogiki 1:1. Ta zahteva »temeljito načrtovanje in zavedanje, da ne gre za tehnologijo, ampak za spremembo pedagoške paradigme. Ena od poti, kako uresničiti novo pedagoško paradigmo, je prav gotovo smiselno didaktično vključevanje sodobnih tehnologij v poučevanje, učenje in vrednotenje.« [3]

V času izvajanja pouka na daljavo je bila ena od odkritih možnosti za spremljanje napredka učencev spletno orodje BookWidgets. V nadaljevanju prispevka je predstavljen primer uporabe tega orodja pri pouku angleščine na daljavo v 5. in 6. razredu.

4 BOOKWIDGETS

BookWidgets (v nadaljevanju: BW) je v angleškem jeziku zasnovano spletno orodje, ki uri pouka da interaktivno noto. Učitelju omogoča, da s pomočjo več kot 40 predlog ustvari interaktivne naloge v smislu vaj, kvizov, iger ipd. in jih deli z učenci, ki jih nato rešijo na svojih elektronskih napravah (npr. tablica, telefon, računalnik, iBooks).

Nadalje BW učencem lahko dá takojšnjo povratno informacijo o njihovem dosežku in napredku, saj je preverjanje rešitev številnih nalog lahko prednastavljena – en klik in učenec

lahko preveri svoj dosežek. Učitelj tako prihrani pri času, ki bi ga sicer v klasični situaciji v razredu porabil za pregled pravilnosti rešitev nalog.

V ozadju BW učitelju ponuja možnost spremljave napredka učencev v realnem času (angl. realtime tracking) ne glede na to, ali učenci delajo na daljavo ali v šoli. Tako lahko učitelj na eni strani hitro identificira učence, ki potrebujejo dodatno vodenje ali pomoč, na drugi strani pa tudi tiste, ki morda potrebujejo dodatne izzive.

Ker se sodobni učenci večinoma že v domačem okolju pogosto srečujejo z uporabo IKT naprav, jih delo z BW – za razliko od klasičnih metod in oblik dela – posledično še dodatno motivira.

4.1 Prijava v orodje BW

Pred pričetkom dela v BW se mora uporabnik prijaviti na spletnem naslovu https://www.bookwidgets.com/. To lahko stori tako, da ustvari račun ali se prijavi z že obstoječim računom, npr. Googlovim ali Microsoftovim (Slika 1).

Slika 1. Okno za prijavo v orodje BW.

Po prvi prijavi učitelj izbere svojo vlogo (npr. OŠ, SŠ, višješolsko izobraževanje), orodje pa ga nato vodi skozi enostaven postopek izdelave gradiva. V meniju Podpora in navodila (angl. Support & Tutorials) so uporabniku tudi kasneje na voljo dodatne razlage, kako uspešno pripraviti gradiva za učence (Slika 2). Začetno 30-dnevno obdobje uporabe BW je brezplačno, kasneje pa je uporaba plačljiva.

Slika 2. Podpora uporabniku v orodju BW.

4.2 Izbira gradiva

Delo z orodjem BW je zelo intuitivno, pospremljeno s primeri rabe in sprotnimi napotki. Učitelj najprej izbere izdelavo novega

gradiva (angl. widget). Pri tem lahko izbira med različnimi predlogami (Slika 3). Predloge so pregledno razdeljene v skupine:

- preverjanje (in ocenjevanje),

- igre,

- slike in videoposnetki,

- predloge za področje matematike,

- umeščanje zunanjih aplikacij (npr. pdf datoteka, GoogleMaps, iskalnik Wikipedia idr.),

- razno.

Po izbiri vrste gradiva učitelj začne z vnosom navodil za delo in nalog. Za iztočnico lahko uporabi klasični učni list in ga prilagodi s pomočjo orodja BW. V nadaljevanju so predstavljeni nekateri primeri gradiv.
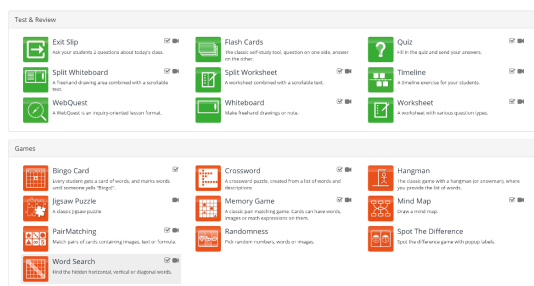
Slika 3. Del predlog za delo z BW.

4.3 Primeri BW gradiv

Za izdelavo BW gradiv najprej izberemo polje *Create a widget*. Nato med predlogami izberemo želeno možnost in v meniju, ki ga orodje odpre, izberemo *Questions*. Da dodamo navodila za reševanje oz. posamezna vprašanja izberemo možnost *Add question* (Slika 4), nakar lahko izbiramo med različnimi tipi nalog, npr.:

- osnovno prosto besedilo (če npr. od učenca zahtevamo, da si neko besedilo samo prebere),

- naloga izbirnega tipa, kjer je pravilen samo en odgovor (angl. multiple choice),

- naloga z več možnimi pravilnimi odgovori,

- naloga, kjer učenec vpiše svoj odgovor na kratko (npr. kratki odgovori na vprašanja),

- naloga, kjer učenec vpiše svoj odgovor na dolgo (npr. krajši spis, pismo ipd.),

- naloga dopolnjevanja vrzeli (angl. gap fill),

- naloga vnosa danih besed v besedilo (angl. drag and drop),

- naloga izbire rešitev v tabeli (npr. bralna naloga po principu drži / ne drži / ni v besedilu),

- naloga označevanja delov slike,

- naloga avdio odgovora (npr. učenec na vprašanje odgovori ustno tako, da svoj odgovor posname s svojo napravo),

- naloga slikovnega odgovora (npr. učenec na vprašanje odgovori s sliko, ki jo posname s svojo napravo),

- naloga povezovanja (npr. povezovanje besed ali povedi, povezovanje besed in slik ipd.),

- naloga razvrščanja besed ali slik v ustrezne skupine.
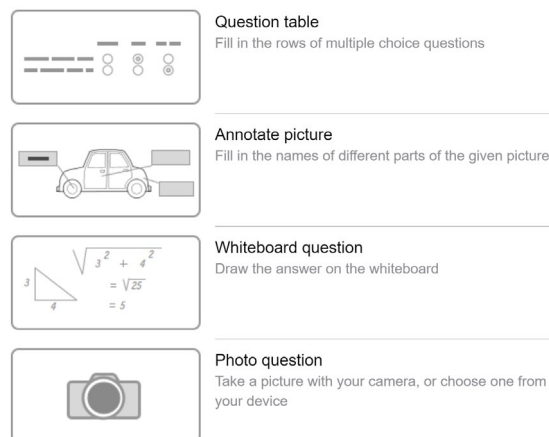
Slika 4. Nekateri tipi nalog v orodju BW.

Vsaki nalogi lahko po želji dodamo tudi slikovno ali zvočno predlogo, kar je pri pouku angleščine v osnovni šoli pogosto zelo uporabno, če ne celo nujno.

V nadaljevanju so predstavljeni trije postopki priprave nalog, ki so bile uporabljene v času pouka na daljavo za učence 5. in 6. razreda.

PRIMER 1: Slušna naloga z dopolnjevanjem besedila povzeta po učbeniškem gradivu *Touchstone 6* (6. razred)

Vnos navodila (*Question*):

Oglej si sliko in besedilo. Nato poslušaj (1-2x) telefonski pogovor in ga dopolni. Povleci ustrezne besede na ustrezna mesta.

Vnos besedila (*Text*) – pri vnosu besedila z oglatimi oklepaji <<>> označimo nabor besed, ki jih učenci lahko vstavijo v besedilo. Po želji dodamo še distraktorje:

MAKING SUGGESTIONS

Mr Robinson: Hello 862330.

Jill: Good <<afternoon>>, Mr Robinson. This is Jill <<speaking>>. Can I speak to Roy?

Mr Robinson: Yes. Just a <<minute>>. Roy! Jill's on the <<phone>>.

Jill: Hi, Roy, it's Jill.

Roy: Hi, Jill.

Jill: What are <<you>> doing?

Roy: I'm drawing <<posters>> for the School Festival.

Jill: Oh, I see.

Roy: And you?

Jill: I'm <<reading>> a magazine. There's a new film on at the Odeon <<Cinema>>. Let's see it together.

Roy: Well, what is it?

Jill: It's the new James Bond.

Roy: Oh, I'd <<love>> to go, but not today. I really can't <<afford>> the time. Why don't we go on <<Sunday>>?

Jill: All right. <<Let's>> go on Sunday then.

Vnos zvočnega posnetka (*Audio*) – dodamo zvočni posnetek (npr. v formatu mp3), ki spremlja nalogo.

Vnos slikovnega gradiva (*Image*) – dodamo sliko (npr. v formatu jpg), ki spremlja nalogo.

Učenčev pogled: že med izdelavo naloge ali po vnosu vseh elementov naloge lahko s klikom na *Preview* preverimo, kakšen bo učenčev pogled (Slika 5).

Slika 5. Slušna naloga z dopolnjevanjem besedila – učenčev pogled.

PRIMER 2: Naloga besedišča in pravopisa – dopolnjevanje praznih polj z ustreznimi besedami na slikovni podlagi učbeniškega gradiva *My Sails II NEW* (5. razred)

Vnos navodila (*Question*):

V okvirčke vpiši manjkajoče besede za dele teles teh živali:

Vnos slikovne podlage (*Background Picture*) – dodamo ustrezno slikovno podlago.

Vnos polj in pripadajočih rešitev (*Input Fields*) – vpišemo iskane besede (kjer je več možnih rešitev, to označimo z znakom ##) in določimo pozicijo praznega polja na slikovni podlagi:

beak

whisker##whiskers

wing##wings

mane

paw##paws

Učenčev pogled (Slika 6).

V okvirčke vpiši manjkajoče besede za dele teles teh živali:
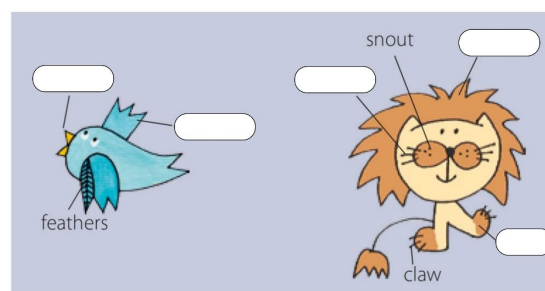
Slika 6. Naloga besedišča in pravopisa – učenčev pogled.

PRIMER 3: Slovnična naloga, Present Simple, povzeto po učnem gradivu *Grammar Two* (6. razred)

Vnos navodila (*Question*):

Dopolni besedilo o sinjih kitih z glagoli v oklepajih v obliki PRESENT SIMPLE. Razmisli: kdaj glagol dobi končnico -s? Pazi tudi na pravopis.

Vnos besedila (*Text*):

The blue whale <<is>> (be) the largest animal in the world. It <<weighs>> (weigh) 150 tonnes and <<grows>> (grow) 30 metres long. Baby blue whales <<drink>> (drink) 600 litres of their mother's milk every day. Blue whales <<live>> (live) in the sea, but they <<come>> (come) to the surface every 15 minutes. When a whale <<breathes>> (breathe), it <<blows>> (blow) water into the air. There <<are>> (be) 83 kinds of whale. They all <<have>> (have) different songs. Some people <<hunt>> (hunt) whales to get meat and oil.

Vnos slikovnega gradiva (*Image*) – dodamo sliko, ki spremlja nalogo.

Učenčev pogled (Slika 7).

Slika 7. Slovnična naloga, Present Simple – učenčev pogled.

4.4 Vključitev učencev

Pred samo vključitvijo učencev v učni proces z orodjem BW, lahko učitelj izbere še nekatere druge možnosti kot so:

- lokalizacija, t. j. prevod določenih delov gradiva,

- pošiljanje rešitev učitelju (da ali ne),

- časovna omejitev reševanja,

- skrivanje prikaza rešitev po zaključku reševanja,

- kratka povratna informacija učencu po zaključku reševanja idr.

Ko je gradivo pripravljeno, ga učitelj lahko deli tako, da izbere možnost *Share*, ki omogoča:
- delitev gradiva z učenci preko spletne povezave,
- delitev gradiva z učenci preko QR kode in
- tudi delitev gradiva z drugimi učitelji uporabniki orodja BW tako, da učitelj prejemnik lahko prejeto gradivo po svoje prilagodi in ga preko svojega računa deli s svojimi učenci.

Učenci, ki se udeležijo pri delu s pripravljenim gradivom, rešujejo naloge na svojih napravah in po reševanju lahko prejmejo takojšnjo povratno informacijo tako, da se prikaže njihov dosežek in pravilne rešitve. Če učitelj želi, lahko to možnost tudi onemogoči (npr. v izogib temu, da bi učenci, ki so naloge že rešili, rešitve nemara posredovali tistim, ki k reševanju nalog še niso pristopili). Pri nalogah, kjer to ni možno (npr. daljši pisni odgovori, naloge, pri katerih ni možno vnaprej predvideti enoznačnih odgovorov ipd.) pa učitelj lahko v orodju nastavi možnost, da učenci posredujejo svojo rešitev, pri čemer dodajo svoj e-poštni naslov. Ko učitelj pregleda njihovo rešitev in jo točkuje, učencu preko e-pošte lahko poda povratno informacijo.

4.5 Povratne informacije in spremljanje napredka učencev

Med reševanjem posameznih gradiv učitelj v orodju v meniju *Grades & Reporting* lahko spremlja delo učencev. Učitelj v prvem delu menija za spremljanje napredka učencev dobi uvid, katere naloge v gradivu so učenci bolj in katere manj uspešno reševali (Slika 8).

1	Glagolom dodaj končnico -s. UPOŠTEVAJ PRAVOPISNA PRAVILA, ki smo se jih učili!	92%
2	Besedilo dopolni z danimi glagoli v obliki PRESENT SIMPLE. Če je pri polju znak (+), uporabi trdilno obliko. Če je pri polju znak (-), uporabi nikalno obliko.	69%
3	Natančno beri in dopolni povedi z besedami: do, does, don't, doesn't.	89%
4	Oglej si slike 1-8 in povleci ustrezne povedi na mesta 1-8.	95%
5	Preberi trditve in označi ali držijo (TRUE) ali ne držijo (FALSE).	89%
6	Glagolom dodaj končnico -ing. UPOŠTEVAJ PRAVOPISNA PRAVILA, ki smo se jih učili!	78%
7	Dopolni poved v obliki PRESENT CONTINUOUS, uporabi glagole iz oklepajev. Nato poved zapiši še v nikalni in vprašalni obliki.	62%
8	Kaj delata Dominic in Mark? Dopolni povedi. Uporabi dane glagolske besede zveze v obliki PRESENT CONTINUOUS (primer 1 je že rešen). PAZI NA PRAVOPIS!	56%
9	Dopolni odgovore na vprašanja. Uporabi slike iz prejšnje naloge (primer za sliko 1 je že rešen):	88%

Slika 8. Pregled uspešnosti reševanja po posameznih nalogah.

V drugem delu menija za spremljavo učitelj spremlja dosežke posameznih učencev. Vidi lahko, katere naloge je posamezni učenec reševal zelo uspešno, uspešno ali neuspešno, kar je prikazano z zeleno, rumeno in rdečo barvo (Slika 9).

S klikom na posameznega učenca se učitelju odprejo učenčeve rešitve, ki so že popravljene in točkovane. Učitelj tako samo še preleti naloge in upošteva, če je kje treba še dodatno upoštevati kakšno pravilno rešitev, ki je učitelj ni dodal ali predvidel vnaprej. Učitelj lahko v glavi gradiva ali pri posameznih nalogah doda komentarje, nato pa gradivo vrne učencu preko e-pošte, ki jo učenec mora vpisati pred zaključkom reševanja (opozorimo jih, da so pri vpisu natančni). Učenec popravljeno in komentirano gradivo prejme kot pdf priponko na svoj e-poštni naslov.

Ažbe	26. 5. 2020 13:27:58	93 / 100	12	11	17	8	10	11	5	5	14
Bor	26. 5. 2020 10:22:59	92 / 100	12	8	14	8	10	11	9	5	15
crt	26. 5. 2020 11:21:40	62 / 100	11	3	9	8	8	7	2	1	13
Dženana	26. 5. 2020 17:35:13	65 / 100	11	4	16	6	8	11	0	0	9
Eva	29. 5. 2020 15:11:41	94 / 100	12	9	17	8	10	11	4	4	14
Ivona	26. 5. 2020 08:38:39	93 / 100	8	8	17	8	10	11	6	5	16
Jaka	26. 5. 2020 09:53:35	77 / 100	10	3	12	8	6	10	9	4	15
jonna	26. 5. 2020 12:55:31	74 / 100	10	8	14	6	8	2	0		16
Jošt	26. 5. 2020 12:08:18	93 / 100	8	8	17	8	10	10	6	5	16
Julija	27. 5. 2020 21:12:22	74 / 100	11	10	14	8	10	0	0		13
katarina	26. 5. 2020 09:24:52	87 / 100	12	8	17	8	6	11	5	5	15

Slika 9. Pregled uspešnosti reševanja po učencih.

5 REFLEKSIJA

Vsaka metoda in oblika dela, ki jo pri pouku na novo vpeljujemo, si zasluži temeljito refleksijo, saj le tako lahko ugotovimo, ali je bil nov način dela učinkovit ter kako ga lahko še izboljšamo. To je še toliko bolj pomembno, ko gre za pouk na daljavo v razmerah, kot so se v Sloveniji pojavile v obdobju marec–junij 2020. Refleksijo lahko izvedemo podobno kot podjetja, ki se pri strateškem načrtovanju poslovanja rada poslužujejo t. i. SWOT analiz (S = strengths, slov. prednosti; W = weaknesses, slov. slabosti; O = opportunities, slov. priložnosti; T = threats, slov. nevarnosti). Razmislek o teh kategorijah je nanizan v Tabeli 1.

Tabela 1. Razmislek o orodju BW v SWOT obliki.

S prednosti		• integracija IKT v pouk, kar motivira učence za delo, • izboljšana dinamika pouka, • prihranek pri učiteljevem dragocenem času (zlasti če gre za pouk na daljavo v času karantene), ki ga lahko učitelj nato nameni za motiviranje in pomoč učencem, • stroškovni prihranek za šolo, saj so gradiva digitalna in se prihrani pri stroških tiskanja, obremenitev okolja je manjša, • enostavnost uporabe in bogat nabor tipov nalog za različna predmetna področja, • spremljanje napredka učencev, • neposredna povratna informacija pri tipih nalog, ki omogočajo samopreverjanje, • kompatibilnost z napravami z različnimi operacijskimi sistemi, • možnost integracije v določena učna okolja (npr. GoogleClassroom, Moodle, Canvas).

W	slabosti	• nekatere predloge in tipi nalog preverjajo znanja na (naj)nižjih taksonomskih stopnjah,
		• pri uporabi z velikim številom učencev lahko postane dajanje povratnih informacij zamudno, zlasti ko gre za naloge, pri katerih v ospredju ni samopreverjanje,
		• odgovori se na lokalnem računalniku (npr. v računalniški učilnici) shranijo; če bi BW naloge z isto povezavo reševali dve skupini učencev, je potrebno uporabljati brskalnik brez sledenja zgodovine ali pa moramo odgovore prve skupine predhodno izbrisati,
		• pri pouku na daljavo učitelj nima nadzora nad tem, ali učenci naloge opravljajo samostojno, kar je zlasti pomembno, če moramo na daljavo z učenci opraviti tudi ocenjevanje znanja,
		• orodje ni kompatibilno za integracijo z slovenskim spletnim učim okoljem Xooltime (eAsistent),
		• orodje je po preteku promocijskega obdobja plačljivo.
O	priložnosti	• ostajamo v koraku s časom in učenci ter tako sledimo smernicam sodobnih pristopov v poučevanju,
		• BW je orodje, ki se ob ustrezni in premišljeni uporabi izkaže za zelo koristnega v kontekstu pouka na daljavo.
T	nevarnosti	• paziti moramo, da orodje uporabimo na način, ki zadosti potrebam različnih učencev,
		• paziti moramo, da orodja ne uporabljamo prepogosto, saj lahko izgubi svoj čar.

6 ZAKLJUČEK

Za marsikoga, ki je aktivno udeležen v slovenskem (zlasti osnovnošolskem) izobraževalnem sistemu, so bile nove izkušnje, ki jih je s seboj prinesla epidemija koronavirusa, neprecenljive. Številni učitelji s(m)o odkrivali nove sfere modernih pristopov k poučevanju, učenci in njihovi starši so zagrizli v kislo jabolko pouka na daljavo, vodstva šol pa so se ukvarjala z novonastalimi težavami, ki jih ob začetku šolskega leta ni predvidel nihče.

Prihodnost ni tako gotova, kot bi si želeli. Trenutno se šole ukvarjajo z izvedbo pouka v šolskem letu 2020/21 z določenimi omejitvami, da pouka na daljavo več ne bo, pa ni garancije. Niti ni potrebna, saj mora po poti, ki smo jo učitelji prehodili v obdobju marec–junij 2020, v nas ostati zavest, da pouk na daljavo lahko je, tudi ko ga uradno ni. Moderni pristopi v poučevanju že in še bodo to narekovali, zato je nujno, da se učitelji stalno strokovno izpopolnjujemo tudi v tej smeri. Ko bomo znali v klasični pouk vpletati sodobne tehnologije, kvalitetno presoditi katere so v posameznih primerih kakovostne in uspešne, učencem postavljati jasne cilje in jim jasno dati vedeti, kdaj so uspešni, takrat bomo poučevanju v prihodnje zagotovili gotovo prihodnost.

VIRI

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Pozitivni in negativni vidiki igrifikacije v izobraževanju

Positive and negative aspects of gamification in education

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POVZETEK

Prispevek opisuje igrifikacijo v izobraževanju tako s pozitivnega kot negativnega vidika. Igrifikacija pomeni uporabo elementov, ki se pojavljajo v igrah in sicer v neigralnih kontekstih. V prispevku so predstavljene osnove igrafikacije in njeni elementi. Z uvedbo igricikacije v nek specifičen proces lahko vplivamo na vedenje ljudi v tem procesu. Igrafikacije se je zaradi številnih pozitivnih učinkov začela uporabljati na številnih področjih. Eden izmed njih je tudi področje izobraževanja. S pravilno uporabo igrafikacije se lahko poveča angažiranost, motiviranost, učinkovitost in uspešnost študentov v izobraževanju. Vendar uvedba igraifkaicje v izobraževanje sama po sebi še ne zagotavlja uspeha. V prispevku so prikazani številni izsledki raziskav. S tem želimo čim bolj objektivno prikazati področje igrifikacije tako s pozitivnega kot negativnega vidika.

KLJUČNE BESEDE

Izobraževanje, igrifikacija, elementi igrifikacije

ABSTRACT

The paper describes gamification in education from a positive and negative perspective. Gamification means using elements that can be found in games in non-gaming contexts. The paper presents the basics of gamification and elements of gamification. By introducing gamification into a specific process, we can influence the behavior of people in that process. Gamification is used in many fields due to its many positive effects. One of them is also the field of education. Proper use of gamification can increase the engagement, motivation, efficiency, and effectiveness of students in education. However, the use of gamification in education does not guarantee success. The paper presents several research findings. We want to show the field of gamification as objectively as possible, both from a positive and an opposing point of view.

KEYWORDS

Education, gamification, elements of gamification

1 UVOD

Živimo v času interneta, pametnih telefonov, tablic in druge informacijsko-komunikacijske tehnologije. Omenjene tehnologije so omogočile nasluten razmah dejavnosti, ki so del celotne človeške zgodovino - igre. Značilnost iger je, da se jih ljudje udeležujejo in igrajo brez prisile in z veseljem. Industrija video iger se močno razvija in nenehno pridobiva nove uporabnike [1], njen tržni delež v industriji zabave raste in postaja glavni vir zabave [2]. Da bi igre pritegnile in ohranile igralce se v industriji iger poslužujejo določenih tehnik in metod znane pod imenom igrifikacija (angl. gamification). Igrifikacija pomeni uporabo elementov, ki se pojavljajo v igrah. Najbolj značilni elementi igrifikacije so točke, značke, lestvice, napredovanje, statusi, nivoji, nagrade in drugo. Namen igrifikacije je izboljšati sodelovanje med uporabniki, povečati motiviranost in uspešnost pri opravljanju določenih nalog in sicer z vključevanjem elementov iger in drugih elementov, ki naredijo neko nalogo bolj privlačno [3]. Igrifikacija se je izkazala za učinkovito in uporabno na številnih področjih. Nekatera izmed teh so finance in finančna pismenost [4], kadrovski management [5], informacijska pismenost [6], management informacijskih tehnologij [7], management sprememb [8], management tveganj [9], marketing [10], računalništvo [11], turizem [12], visoko šolstvo [13] in drugo. Eno izmed področij, kjer se igrifikacija največ uporablja je izobraževanje. Raziskave o igrifikaciji na področju izobraževanja omenjajo številne pozitivne vplive na udeležence kot so povečana motiviranost, angažiranost, učinkovitost in uspešnost. Obstajajo pa tudi negativne lastnosti, ki so lahko posledica igrifikacije in njene nepravilne uvedbe v izobraževanje. V nadaljevanju so predstavljene osnove igrifikacije in igrifikacije v izobraževanju.

2 IGRIFIKACIJA

Večji trend znanstvenega in raziskovalnega proučevanja igrifikacija lahko zasledimo v letu 2010 in naprej. Igrifikacijo oz. njen pomen lahko definiramo kot uporabo elementov iger in njenih značilnosti v dejavnostih, ki niso igre [14]. Seznam elementov igrifikacije, ki jih je mogoče uporabiti v praksi [15]: točke: številčne enote, ki merijo napredek (točkovanje); značke: vizualne ikone, ki kažejo dosežke (trofeje); lestvice: prikaz vrstnega reda udeležencev (uvrstitve); napredovanje: mejniki, ki kažejo napredek (napredovanje); status: prikaz določenih dosežkov (naslov, rang); stopnje: vse bolj zahtevna okolja

(stopnje); nagrade: oprijemljivi, zaželeni predmeti (spodbude, nagrade; darila, …) in vloge: vloge igralca (razred, značaj, …).

Omenjene elemente lahko uporabimo z namenom vplivanja na vedenje posameznika ali skupine v nekem procesu. Poleg tega lahko s pomočjo igrifikacije naredimo določene nalog bolj zanimive in s tem povečamo verjetnost dokončanja neke naloge. Tega so se v industriji iger začeli zavedati že zelo zgodaj in ni naključje, da industrija iger postaja eden izmed glavnih virov zabave. Poslovna skupina Obstajajo ocene, da je bil leta 2019 trg igrifikacije vreden okoli 6 milijard dolarjev [16]. Igrifikacija se je zaradi svojih lastnosti zelo uveljavila na številnih področjih, predvsem pa v izobraževanju. Z vključevanjem igrifikacije v izobraževanje lahko dokazano povečamo motiviranosti, učinkovitosti in uspešnost posameznikov v nekem izobraževanju.

3 IGRIFIKACIJA V IZOBRAŽEVANJU

Igre imajo pomemben pozitiven vpliv na razvoj motoričnih sposobnosti, kreativnosti, gibanja in so potrebne za celoten fizični razvoj posameznika [17]. V svetovnem merilu se tedensko porabi več kot tri milijarde ur za igranje video in/ali računalniških iger in skoraj tretjina študentov igra tri ali več ur video in računalniških iger na povprečen šolski dan [18]. Za spodbujanje učencev, dijakov in študentov se že dalj časa uporabljajo različni zunanji vzvodi in mehanizmi kot so bralne značke, različne nagrade (materialne in nematerialne), različne častna mesta, dekanove liste in drugo [19]. Omenjeni avtorji so mnenja, da je namen takšnih nagrad dodatno motivirati osebe za učenje oz. študij. Raziskava o vplivu elementov igrifikacije na motivacijo študentov, da obstajajo razlike med posameznimi elementi igrifikacije [20]. Tako je med posameznimi študenti pet najbolj zaželenih elementov: (1) pridobivanje dodatnih točk za prisotnost na predavanjih in vajah, (2) sodelovanje s sovrstniki in skupinsko delo, (3) pridobivanje dodatnih točk za aktivno sodelovanje na predavanjih in vajah, (4) pridobivanje dodatnih točk za opravljanje domačih, seminarskih in drugih nalog in (5) nagrade za uspeh v obliki bonus točk. Pet najmanj zaželenih elementov igrifikacije pa predstavljajo elementi kot so (1) kazni za zamujanje časovnih rokov oddaje, (2) kazni za neuspešno opravljanje obveznosti (npr. minus točke, idr.), (3) nagrade zgolj iz naključne sreče (npr. na podlagi žreba, idr.), (4) razvrščanje v lestvice z anonimnimi udeleženci (npr. indeks in ocene) in (5) razvrščanje v lestvice z vidnimi udeleženci (npr. tekmovanje s sovrstniki). Izobraževanje podprto z igrifikacijo ima nekatere skupne lastnosti z določenimi teorijami učenja, ki priporočajo hitre in pozitivne povratne informacije, kratke naloge in postopne izzive prilagojene znanju in veščinam udeležencem izobraževanja [21]. Usklajenost med zahtevnostjo nalog in dejanskim znanjem udeležencem lahko pri udeležencih povzroči stanje velike motiviranosti in angažiranosti, ki ga strokovno imenujemo stanje toka (angl. flow). Na Sliki 1 lahko vidimo mentalni model oz. stanje igralca/izobraževanca glede na njegov nivo sposobnosti in nivo izziva/naloge.

Stanje toka lahko opredelimo kot optimalno izkušnjo za katero sta značilna popolna osredotočenost in angažiranost pri neki aktivnosti [23]. Tok pri udeležencih sprožijo štirje elementi, ki jih lahko najdemo v igrah [24]: jasni cilji in pravila, povratne informacije in prostovoljno sodelovanje. Omenjene elemente bi bilo smiselno v čim večji meri uporabiti v izobraževalnih procesih, saj bi s takšnim načinom dela lahko bistveno bolj

povečali zadovoljstvo, motiviranost in angažiranost uporabnikov. Dejavnosti in procesi podprti z elementi igrifikacije imajo tri glavne učinke na udeležence: motivacijski, psihološki (sprememba občutkov o dejavnosti med in po njej) in vedenjski (sprememba vedenja po igrificirani dejavnosti) [25].
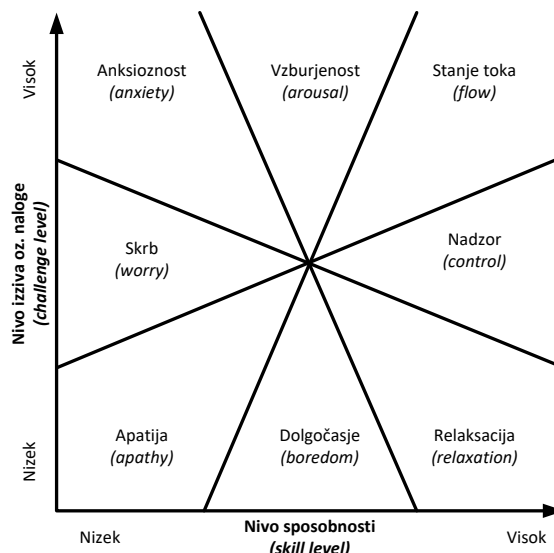
Slika 1: Mentalno stanja igralca/izobraževanca glede na njegov nivo sposobnosti in nivo izziva/naloge (prirejeno po [22]).

4 POZITIVNI VIDIKI IGRIFIKACIJE

Igrifikacija pomeni uporabo elementov iger (točke, nagrade, lestvice, …), ki se lahko uporabijo v izobraževanju za doseganje pozitivnih učinkov pri učencih [26] in z namenom narediti izobraževanje prijetno oziroma zabavno, kot so zabavne in prijetne video igre [2]. Uporaba elementov iger v izobraževanju ima številne prednosti in se je pokazala za uspešno v izobraževalnih okoljih [27]. Zaradi svojih pozitivnih lastnosti se je igrifikacija v izobraževanju zelo uveljavila. Raziskave s področja igrifikacije v izobraževanju poročajo o številnih pozitivnih rezultatih. V nadaljevanju so nekateri izmed njih: [28] uporaba prikaza dosežkov pri učencih; [29] uporba izzivov, nivojev, nagrad, časovnih pritiskov, točk in mini iger; [30] uporaba znač; [31] uporaba točk, prikaza dosežkov in nagrad pri učencih; [32] uporaba nagrad; [33] uporaba znač za doseganje nekaterih pozitivnih učinkov; [34] omenja različne elemente igrifikacije; [35] pozitivni učinki na kratkoročne dejavnosti podprte z igrifikacijo.

S pomočjo uporabe igrifikacije pri študentih, le ti postanejo bolj motivirani za delo ter, da lahko določene naloge opravljajo z večjim zadovoljstvom [36]. Prednost uporabe igrifikacije na področju izobraževanja se kaže v takojšnji povratni informaciji (v primeru, da so sistemi podprti z informacijsko-komunikacijsko tehnologijo), ki je značilna za video in računalniške igre [26]. Rezultati raziskave o opravljanju nalog, ki so podprte z igrifikacijo povečuje motivacijo študentov in njihovo medsebojno sodelovanje [37].

Uvedba elementov igrifikacije v izobraževalni proces pa še ne pomeni, da bodo udeleženci izobraževanja ustrezno motivirani, angažirani in bolj učinkoviti. Rezultati nekaterih

empiričnih raziskav o različnih elementih igrifikacije izvedenih v izobraževalnih ustanovah so tudi mešani [37]. Nekatere od teh so: [38] uporaba točk in napredka; [39] uporaba značk in lestvic; [40] uporaba nivojev, izzivov, značk in lestvic; [35] mešani učinki pri različnih učencih.

Opazimo lahko, da se pri pozitivnih in mešanih učinkih pojavljajo podobni elementih igrifikacije. Iz tega lahko sklepamo, da ni problem v elementih iger temveč v načinu njihovega posredovanja, izvedbe procesa ali drugih faktorjev. Različne aktivnosti so primerne za samo določene udeležence in morajo biti realizirane na različne načine. Vedno bolj se poudarjajo potrebe po personalizaciji izobraževanja in po raziskavah o razumevanju učinkov igrifikacije na individualni ravni posameznika [41]. Glede na potencial, ki ga ima igrifikacija bi bilo smiselno prilagoditi elemente igrifikacije posamezniku, kar pa zahteva poznavanje in uskladitev osebnostnih lastnosti in elementov igrifikacije.

5 NEGATIVNI VIDIKI IGRIFIKACIJE

Kot vse stvari in storitve ima tudi igrifikacija v izobraževanju določene pomanjkljivosti. Za dobro razumevanje učinkov igrifikacije v izobraževanju je potrebno dobro razumeti posamezen izobraževalni model, ki je podprt z elementi igrifikacije [2]. Negativno stran študij o igrifikaciji predstavlja tudi omenjen vzorec empiričnih študij, kar je posledica metodoloških težav, kot so pomanjkanje primerjalnih skupin, kratkih časovnih rokov raziskav in drugo [25]. Pomanjkanje analiz uporabniških profilov, neustrezne metode oblikovanja in preveč preprosta uvedba igrifikacije lahko privede do neustreznih rezultatov uvedbe igrifikacije v izobraževanju [3].

Socialno primerjanje običajno pripelje do tekmovanja, s tem pa se posamezniki zavedo pomanjkanja svojih spretnosti v primerjavi z ostalimi udeleženci [42]. Tekmovanje in medsebojno primerjanje lahko zmanjša sodelovanje in reševanje problemov ter lahko pripelje do raznih oblik goljufanja [43]. Nekateri avtorji [44] so pripravili pregled literature o igrifikaciji na področju izobraževanja in predstavili seznam kritičnih točk, ki lahko zmanjšajo notranjo motivacijo študentov. Poleg tega omenjeni avtorji navajajo, da igrifikacija ni primerna za vsako izobraževalno okolje ter da je izredno težko doseči uravnoteženost med nalogami in znanjem. V določenih raziskavah poročajo o nerazumevanju pravil, kar lahko posledično zmanjša uspešnost izobraževanja [45]. Avtorja [46] poročata o nezanimivo postavljenem sistemu bonusov oz. nagrad. Različni avtorji [40] poročajo, da udeleženci v njihovem eksperimentalnem izobraževalnem procesu podprtem z igrifikacijo niso dobro sprejeli takšnega sistema, ker so menili, da sistem ni prijeten in da je izguba časa. Dogaja se, da študenti sčasoma izgubijo zanimanje za izobraževanje podprto z igrifikacijo, ker ni dovolj zanimivo [47]. Pri določenih aktivnostih v izobraževanju se lahko dogaja, da so študenti bolj osredotočeni na elemente igrifikacije kot na samo učno snov in pridobivanje znanja [48]. Avtorji [35] v svoji raziskavi ugotavljajo in poročajo o nekaterih pomanjkljivostih igrifikacije. Prva ugotovitev je v obliki priporočila inštruktorjem oz. učiteljem, da se isti elementi igrifikacije ne uporabljajo dlje časa. Druga pomembna ugotovitev je, da igrifikacija ni najbolj primerna za učence oz. študente, ki majo slabše učne dosežke.

Pri uvedbi igrifikacije v izobraževanje se pojavljajo še druga vprašanja kot so: (1) profiliranje uporabnikov in njihov odziv; (2) kako primerno obremeniti študente glede njihovega znanja in sposobnosti; (3) kulturne razlike v dojemanju igrifikacije; (4) individualne in kolektivne spremenljivke in drugo. Poleg omenjenih vprašanj se je potrebno zavedeti, da igrifikacja pri študentih lahko sproži tudi neželena vedenja kot so goljufanje, upad zanimanja za neko nalogo, slabša kakovost izdelkov, skrb za zasebnost in drugo.

6 ZAKLJUČEK

Industrija iger je v porastu in igre (predvsem video in računalniške) postajajo glavni vir zabave. Kljub temu pa niso vse igre komercialno uspešne, saj so uporabniki tisti, ki se na prostovoljni osnovi odločajo ali bodo igre igrali ali ne. Razlogov za neuspešnost neke igre je lahko več od nezanimivosti, prevelike zahtevnosti, nepravilne uporabe elementov iger in drugih faktorjev. Podobno je tudi z igrifikacijo v izobraževanju. Vpeljava elementov igrifikacije v izobraževanje še ne zadostuje, da postane takšno izobraževanje tudi zanimivo za uporabnike.

Večina raziskav s področja igrifikacije v izobraževanju je bila v preteklosti osredotočena na pozitivne učinke kot so povečana motivacija, angažiranost, učinkovitost in uspešnost (učencev, dijakov ali študentov). Pomanjkljivo pa so bili raziskani negativni vplivi, ki jih lahko ima igrifikacija v izobraževanju. Za uspešno vpeljavo elementov igrifikacije v izobraževalni proces moramo podrobno razumeti elemente igfifikacije, ki lahko vplivajo na uporabnika. Obstajajo številni faktorji in njihovi medsebojni vplivi, kot so kulturno okolje, osebnost posameznika, starost, spol, razlike med individualnim in skupinskim delom, razumevanje vplivov posameznih elementov igrifikacije in drugo. O uspešni uvedbi igrifikacije v izobraževanje se lahko veliko naučimo tudi od nekaterih dobrih komercialnih poizkusov, ki so prestali test časa in kritičnost uporabnikov. Nekatere izmed bolj znanih spletnih izobraževalnih platform so Duolingo, Khan Academy, Moodle, Lumosity, Neuro Nation in drugi. Za uspešno uvedbo igrifikacije moramo razumeti in vedeti kateri elementi so udeležencem v izobraževalnem procesu pomembni. Igrifikacija se veliko bolje obnese če se njeni elementi odražajo tudi realnosti (npr.: dodatne točke za vaje, ustna pohvala, …). Doseganje virtualnih točk, ki v realnem svetu nimajo pomena, postane dolgočasno in nezanimivo.

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Vpeljava, dobre prakse in spoznanja poučevanja ter učenja na daljavo na Osnovni šoli Preska

Introduction of distance teaching and learning, examples of good practice and insights in Preska primary school

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POVZETEK

V prispevku so opisani načini vpeljave poučevanja in učenja na daljavo na Osnovni šoli Preska. Predstavljena so spoznanja na ravni šole, učitelja in učenca, ki zajemajo metode ter predvsem tiste dejavnosti in pripomočke, ki so se izkazali za koristne. V obdobju zaprtja šol so v šolskem prostoru svoje mesto dobile marsikatere nove in presenetljive prakse. Iznajdljivost in fleksibilnost pod okriljem digitalne kompetence sta tako na strani učitelja kot učenca postali najpomembnejši vrlini. Prispevek vsebuje nekatere ideje, dobre prakse, metode in orodja za delo na daljavo v obdobju, ki je poleg novitet prineslo predvsem potrebo po še temeljitejši refleksiji učiteljevega in učenčevega dela ter napredka.

KLJUČNE BESEDE

Osnovna šola, digitalizacija pouka, poučevanje in učenje na daljavo, metode in orodja

ABSTRACT

The article presents ways of introduction of distance teaching and learning in Preska Primary School. It shows insights of the whole school as well as individual students and teachers, which involve methods and the most efficient activities and tools. During lockdown, the online school environment has produced several new and surprising methods. Suddenly ingenuity and flexibility became the most important virtues supported by digital competence for both teachers and students. The article presents some of the ideas, examples of good practice, methods and tools for distance teaching in the time when, apart from all the novelties brought about, the need to reflect in depth in connection to the work and progress of both teachers and students has become apparent.

KEYWORDS

Primary school, digitalization in education, distance teaching and learning, methods and tools

1 UVOD

Izobraževanje na daljavo je v preteklih desetletjih mnogokrat pomenilo le alternativo, saj se doslej še nismo srečali z okoliščinami, v katerih je postalo tako rekoč nujno potrebno in skorajda edina opcija. Pred skoraj dvema desetletjema je Ivan Gerlič v zborniku strokovne konference E-izobraževanje doživeti in izpeljati izobraževanje na daljavo opisal kot obliko posrednega oz. indirektnega izobraževanja, kjer sta učitelj in učenec med seboj fizično ali tudi časovno ločena, kjer učitelj sproti preverja učni uspeh udeleženca in kjer se učno gradivo posreduje na daljavo s pomočjo medijev v tiskani ali elektronski obliki [1]. Tedaj je e-izobraževanje pomenilo nadgradnjo oz. poučevanje in učenje v koraku s časom. Prehod v e-izobraževanje je bil v času zaprtja šol nagel, zato je bilo tistim, ki so se z njim do tedaj že seznanili, mnogo prihranjenega. Niko Schlamberger je v prispevku Pismo strankam – Predlogi za dvig digitalnih kompetenc izpostavil problem nujnosti dviga digitalne pismenosti. Po njegovem mnenju sta družba in država glede tega premalo ozaveščeni, saj se pomembnosti dviga digitalnih kompetenc zavedajo le posamezniki in nekatere institucije [2]. Njegove ugotovitve so se v obdobju e-izobraževanja potrdile in skrbi izkazale za upravičene.

Na OŠ Preska smo se v času, ko se je v državi zaostrovala epidemiološka slika in se je slutilo zaprtje šol, že intenzivno ukvarjali s pripravami na prihajajoče obdobje. Kot povsod drugod je bilo naenkrat zelo malo časa za načrtovanje, zato smo se naslonili na tisto, kar lahko nemudoma ponudimo in kar so naši učenci ter sodelavci že (vsaj delno) poznali.

V času zaprtja šol je pouk na daljavo na razredni stopnji večinoma potekal po elektronski pošti in s pomočjo videokonferenc, saj smo menili, da je za to starostno obdobje to najustreznejši način. Razredničarka je z učenci komunicirala preko staršev, brez sodelovanja katerih najbrž delovanje ne bi bilo uspešno. Za komunikacijo so uporabljali svoje elektronske naslove.

Za učence predmetne stopnje smo menili, da lahko učenje na daljavo v veliki meri spremljajo povsem samostojno. Kmalu smo si zadali cilj, da bomo obdobje šolanja na daljavo izkoristili za

računalniško opismenjevanje in poiskali načine, ki bi nas pripeljali do želenih rezultatov. Naša prizadevanja so predstavljena v nadaljevanju.

2 PODPORA UČITELJEM

2.1 Organizacijska podpora učiteljem

Za vzpostavitev in nemoten potek poučevanja na daljavo je vseskozi skrbela računalničarka, na katero smo se učitelji lahko po pomoč obrnili katerikoli dan in skorajda katerokoli uro. V dnevih pred zaprtjem šol nas je pozvala, naj se (ponovno) seznanimo s spletno učilnico Moodle in nam v primeru težav nudila pomoč.

Učitelji, ki spletne učilnice še niso uporabljali, so imeli možnost individualnega izobraževanja.

Na OŠ Preska učitelji v domačem okolju tudi za službene namene uporabljamo lastne računalnike in ostalo opremo. Računalničarka je zato naredila poizvedbo, v kakšnem stanju so naše naprave. V najkrajšem možnem času smo s skupnimi močmi poskušali odpraviti večino težav in nadomestiti nedelujoče ali zastarele naprave z razpoložljivimi iz šole. Poskrbeli smo, da smo učitelje opremili s komponentami, za katere smo menili, da bodo pri poučevanju na daljavo potrebne (mikrofon, zvočniki, kamera …).

2.2 Sodelovanje med učitelji

Četudi je sodelovanje potekalo v fizični odsotnosti, je bilo konstantno in konstruktivno. Na pobudo računalničarke smo se učitelji vsak dan od ponedeljka do petka ob 10. uri dopoldne srečevali preko videokonferenc, ki smo jih poimenovali Odmor s kavo. Na začetku smo uporabljali Zoom, kasneje pa po priporočilih Googlovo aplikacijo Meet. Sprva smo imeli nekaj začetniških težav, a smo jih kmalu uspešno odpravili (prikaz slike, upravljanje s kamero, nadzor nad glasnostjo in aktivnostjo mikrofona, deljenje zaslona …). Ažurno in sinhrono smo spremljali delo učencev, iskali rešitve in odpravljali težave. Videokonferenc smo se večinoma udeleževali vsi pedagoški delavci, če le nismo imeli takrat napovedanih video srečanj z učenci. Redno sta sodelovala tudi ravnatelj in pomočnik ravnatelja, ki sta po potrebi dodatno pojasnjevala informacije, ki sta jih sicer posredovala po elektronski pošti.

2.2.1 Medgeneracijska pomoč med učitelji

Posebej velja omeniti, da je bila v teh časih vidnejša vrzel med starejšimi in mlajšimi učitelji, ki se je nanašala predvsem na znanje pri uporabi komunikacijske tehnologije. Nekateri mlajši predstavniki so starejšim kolegom pomagali pri usvajanju računalniških spretnosti, uporabi aplikacij in urejanju ter uporabi e-učilnice. Pomoč je bodisi potekala telefonsko bodisi preko organiziranih videokonferenc, ki jih je sklical učitelj, ki je določeno področje dobro poznal. Pripravljenost in dostopnost mlajših učiteljev je bila tu ključnega pomena in še eno spoznanje več, kako lahko tak pristop k delu pripomore k uspešnemu delovanju znotraj kolektiva. Mlajši učitelji so uporabljali in kolegom posredovali veščine digitalne tehnologije ter na ta način tudi sami obnovili marsikatero znanje. Tako se je tudi pri njih samih ohranilo, kar bi se v poplavi novosti sicer lahko z leti izgubilo. Vsako tako znanje se bo tako s strani mlajših kot starejših učiteljev zagotovo s pridom uporabljalo v prihodnosti.

3 PODPORA UČENCEM

3.1 Organizacijska podpora učencem

V tednu pred zaprtjem šol smo se učitelji večkrat sestali in v dogovoru z vodstvom šole naredili načrt delovanja za čas, ko bi morali znanje posredovati s pomočjo elektronske tehnologije. Pretehtali smo možnosti in vsak pri sebi preverili razpoložljivost potrebnih naprav ter lastno zmožnost njihove uporabe. V dogovoru z računalničarko smo po potrebi posamezne težave individualno reševali.

Razredniki so razredne ure in ostale razpoložljive trenutke posvetili pogovoru in pripravi na obdobje izobraževanja na daljavo. Učence so uvodno seznanili s spletno učilnico Moodle, ki jo je večina učencev že poznala, saj so jo učitelji že več let uporabljali kot učinkovit pripomoček za popestritev in utrjevanje učnih vsebin.

V vsakem razredu smo v dveh dneh izpeljali izobraževanje, ki ga je vodila računalničarka in je trajalo eno šolsko uro. Namenjeno je bilo upravljanju in delu z e-učilnico Moodle. Poleg tega so vsi učenci predmetne stopnje dobili svoj šolski elektronski naslov, s pomočjo katerega so komunicirali z učitelji.

3.1.1 Pomoč pri zagotovitvi računalnikov

Šola je v času pred zaprtjem in v času le-tega večkrat pri učencih in njihovih starših poizvedovala o razpoložljivosti komunikacijske tehnologije in jih pozvala, naj sporočijo, če menijo, da so naprave, ki jih imajo doma, neustrezne ali nedelujoče. Za poizvedbo smo uporabili več možnih kanalov (razredne ure, individualne razgovore, govorilne ure, družabna omrežja, elektronsko pošto, sistem LoPolis …).

Na šoli smo skupaj z Občino Medvode, Civilno zaščito in s pomočjo donatorjev (Rotary Club in založba Rokus Klett) uspeli skupaj zagotoviti 21 računalnikov.

3.2 Spletna učilnica Moodle

Z uporabo spletne učilnice Moodle smo na OŠ Preska začeli pred približno desetimi leti. V tem času jo je uporabljalo nekaj učiteljev predmetne stopnje, zato so jo vsaj v grobem že spoznali mnogi učenci. Dostopna je na spletni strani OŠ Preska, ki deluje na lastnem strežniku. Prav slednje je vseskozi bistveno pripomoglo k nemotenemu delovanju spletne učilnice in neovirani komunikaciji med učenci in učitelji. Mnoga druga spletna okolja so se namreč srečevala s preobremenjenostjo, ki ji je botroval naval ob zaprtju šol.

Moodle omogoča vnašanje besedil, nalaganje dokumentov, dodajanje spletnih povezav in uporabo različnih integriranih orodij, zato je tako rekoč solidno zastavljen in brezplačen pripomoček za poučevanje in učenje na daljavo.

Učitelji predmetne stopnje smo učilnico po presoji vsakega posameznega učitelja razdelili po predmetih ali posameznih učiteljih, pri čemer pa smo se ušteli. Po zaključku poučevanja na daljavo smo spoznali, da smo na začetku lahkomiselno verjeli, da se bomo v šole vrnili po 14 dneh, kot se je sprva načrtovalo. V bodoče bomo stremeli k enotnosti pri oblikovanju spletnih učilnic, kar bo predvsem učencem zagotovilo večjo preglednost.

3.3 Videokonference

Tako kot smo učitelji komunicirali med seboj, smo seveda želeli komunicirati tudi z učenci. Prej omenjeni Odmori s kavo so nam

pod preprostim in šaljivim imenom omogočali tudi soočanje s tehnologijo, ki je prej sploh nismo uporabljali ali pa je večinoma nismo dobro poznali. Na začetku je bila to aplikacija Zoom, kasneje pa Google Meet, ki smo jo večinoma uporabljali tudi v stiku z učenci. Videokonference so se izkazale za koristne predvsem pri individualnem delu z učenci, kot npr. pri delu z učenci s posebnimi potrebami, učenci tujci, pri zagovoru bralne značke ... Na ravni celotnega oddelka so se učenci srečevali predvsem z razredniki, na t. i. videokonferenčnih razrednih urah, ki so v času zaprtja šol nudile prepotreben stik s sošolci in razrednikom. Kot manj učinkovite pa so se videokonference izkazale za namen razlage nove snovi, na kar je vplivalo mnogo dejavnikov. Tako kot učitelji so se tudi učenci soočali z novitetami, ki so jim povzročale marsikatero preglavico. Razlago nove snovi smo učitelji velikokrat raje ponudili s pomočjo vseh vrst video in zvočnih posnetkov, preko videokonferenc pa smo zagotovili možnost dodatne razlage snovi.

Omeniti velja, da smo bili mnogi učitelji preko videokonferenc učencem vselej na voljo in da jim je to zavedanje veliko pomenilo. Na naši šoli je namreč veliko otrok, ki v svojem okolju nimajo veliko družbe, zato jim je naša dostopnost obdobje izolacije olajšala.

4 NEKATERA ORODJA ZA USPEŠNO DELO NA DALJAVO

4.1 YouTube

Portal YouTube je že leta na prvem mestu po priljubljenosti med spletišči, ki ponujajo ogled in nalaganje videoposnetkov. Mnogi učitelji smo ustvarili svoj kanal, na katerem so lahko učenci našli najrazličnejše gradivo, ki smo jim ga pripravili. Pri pouku slovenskega jezika so npr. lahko dobili razlago nove snovi, interpretacijo poezije, glasno branje odlomka iz berila ipd. Portal učenci dobro poznajo in uporabljajo tudi v prostem času, zato jim je bilo tokrat prihranjeno seznanjanje z novimi orodji.

4.2 GoFormative

Brezplačna aplikacija nam omogoča izdelavo kvizov, vprašalnikov ali testov, ki so nam lahko v pomoč pri preverjanju in ocenjevanju znanja. Vnašamo lahko že narejene teste, oblikujemo naloge/vprašanja in jih točkujemo. Način pridobitve povratne informacije je tako zelo enostaven in hiter.

Reševanje takšnih testov je sicer zahtevalo veliko dodatne razlage in zavedanja pomembnosti natančnosti ter upoštevanja pravil, a je bilo učencem kljub temu vznemirljivo in zanimivo. Slabost brezplačne različice GoFormative je v tem, da dovoljuje nalaganje relativno majhnega števila posameznih strani (do 20 strani).

4.3 Screencast-o-Matic

Orodje je v omejeni različici prav tako dostopno brezplačno in omogoča snemanje zvoka ob sliki/predstavitvi. Za ozadje si lahko izberemo sliko ali pa drsnice, ob katerih razlagamo ali utrjujemo snov. Program ponudi shranjevanje videoposnetka na računalnik, tega pa lahko kasneje naložimo npr. na YouTube. Program je še posebej uporaben za delo z učenci s posebnimi potrebami. Učencu, ki ima denimo disleksijo, lahko učitelj ob predvajanju besedila glasno bere.

4.4 Quizizz

Quizizz je pripomoček, ki so ga učenci zelo dobro sprejeli, a je bolj kot ne namenjen le zabavi in popestritvi ob utrjevanju snovi. Omogoča izdelavo preprostih kvizov in je prav tako brezplačen.

5 UGOTOVITVE, SPOZNANJA IN NAČRTI

Po zaključku obdobja poučevanja in učenja na daljavo smo dodobra pregledali rezultate dela in pretehtali možnosti za izboljšanje stanja. Temeljna ugotovitev je bila, da so bile nekatere stvari zastavljene preveč ambiciozno, kar pomeni, da smo si predstavljali, da jih učenci poznajo veliko bolje, kot se je kasneje izkazalo. Verjetno smo v poplavi materiala in orodij, ki smo jih v dobri veri želeli ponuditi učencem, nehote povzročili tudi zbeganost in stisko ob zahtevah po obvladovanju računalniških spretnosti. Za naslednje šolsko leto smo si zadali cilj, da predvsem učenci predmetne stopnje še dodatno nadgradijo in okrepijo računalniško znanje. Ob zaključku pouka za šolsko leto 2019/2020 smo naredili načrt za delo predvsem z učenci od 6. do 9. razreda. Vanj smo vpeli vse učitelje predmetne stopnje, ki bodo na ta način tudi sami obnovili znanje za morebiten ponoven prehod k poučevanju in učenju na daljavo.

V veliko pomoč pri oceni stanja in načrtovanju izboljšanja nam je bila anketa, ki smo jo proti koncu obdobja poučevanja in učenja na daljavo posredovali učencem in staršem. Izpolnilo jo je skoraj 50 odstotkov staršev in okoli 25 odstotkov učencev. Spraševali smo jih o opremljenosti in dostopu do komunikacijske tehnologije, obvladovanju dela z njo, kateri način dela jim najbolj ustreza, kolikšna je stopnja samostojnosti učencev in uspešnost reševanja nalog, ali so navodila s strani učitelja razumljiva ipd. Rezultate smo analizirali in jih predstavili pedagoškemu osebju in staršem.

6 ZAKLJUČEK

Četudi je bil prehod k izobraževanju na daljavo nenaden, smo se na to za marsikoga neznano pot podali dokaj uspešno. Mnogi učitelji smo s trudom znova dokazali, da smo lahko kos novim in zahtevnim nalogam. Težave smo reševali timsko in se zavedali, da naša neomajnost pomeni kakovost za najpomembnejše deležnike učnega procesa - naše učence. Proti digitalni pismenosti smo s pomočjo medgeneracijskega sodelovanja uspešno vodili starejše kolege, ki so se prvič srečali z marsikatero noviteto. Učencem smo nudili pomoč preko videokonferenc in spletne učilnice, kjer smo jim predstavili različna internetna orodja za učinkovito delo na daljavo.

O uspešnosti našega delovanja pričajo rezultati ankete, ki smo jo posredovali staršem in učencem. Zadovoljni smo, da so predvsem učenci naše udejstvovanje znali prepoznati kot dobro in v njem videli sprejemljivo opcijo. Po vrnitvi v šolske klopi smo se posvetili področjem, za katera smo menili, da so bila v času dela na daljavo manj uspešna. Tem spoznanjem in izkušnjam bomo pri načrtovanju podobnih dejavnosti v bodoče namenili največ pozornosti

VIRI

[1] Geder, M. et al. 2003. *E-izobraževanje doživeti in izpeljati: zbornik strokovne konference*. Maribor. Doba.

[2]   Schlamberger, N. 2018. *Pismo strankam – Predlogi za dvig digitalnih kompetenc*. Slovensko društvo Informatika. Objavljeno na: http://www.dlib.si/details/URN:NBN:SI:DOC-BVH4L8Z5/?euapi=1&query=%27keywords%3dniko+schlamberger%27&sortDir=ASC&sort=date&pageSize=25 (15. 9. 2020)

Od besede do besedila s pomočjo IKT

From one word to a text with the help of ICT

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POVZETEK

V preteklem šolskem letu smo v marcu čez noč prešli iz dela v razredu, ki smo ga bili vajeni tako učitelji kot tudi učenci, na delo na daljavo. Delo se je nadaljevalo s pomočjo informacijsko-komunikacijske tehnologije, učitelji pa so morali najti drugačne poti do ciljev, kot so si jih zastavili ob začetku šolskega leta. V pričujočem prispevku so predstavljeni koraki od spoznavanja posamezne besede v tujem jeziku do tvorbe celotnega besedila in nekaj orodij, ki so jih učenci uporabljali v obdobju dela na daljavo. V sklopu spletnih nalog so učenci razvijali tako slušne in bralne kot tudi govorne in pisne spretnosti.

KLJUČNE BESEDE

Pouk tujega jezika, IKT, aplikacije

ABSTRACT

In the past school year, in March, we moved virtually overnight from classroom work, which both students and teachers were accustomed to, to distance education. The work continued with the help of information and communication technology, and teachers had to find different paths to the goals they had set at the beginning of the school year. The paper presents the steps from learning a single word in a foreign language to creating a full text and some of the applications used by students during distance learning. As part of these tasks, students develop both listening and reading skills, as well as speaking and writing skills.

KEYWORDS

Foreign language teaching, ICT, applications

1 UVOD

Zaradi zaprtja šol so učitelji morali poiskati nove poti do učencev in s tem tudi do znanja. Situacija je tako učence kot učitelje prisilila v komunikacijo preko računalnikov ali drugih mobilnih naprav. S tem pa je tudi zahtevala določena znanja in kompetence. Pri pouku tujega jezika smo se poslužili komunikacije preko šolske elektronske pošte in spletnih učilnic.

Oboje so učenci že poznali. V nadaljevanju bo predstavljen način dela na daljavo pri obveznem izbirnem predmetu nemščina.

2 OBVEZNI IZBIRNI PREDMET NEMŠČINA

Že v uvodnih besedah učnega načrta za obvezni izbirni predmet nemščina je poudarjeno, da imajo tuji jeziki pomembno vlogo pri vzgoji in izobraževanju. Nemščina kot tuj jezik je pomembna za intelektualno rast posameznika, za oblikovanje samopodobe in samozavesti ter za vključevanje v družbi. [1] V splošnih ciljih predmeta je zapisano [1], da je temeljni cilj pouka vzpodbuditi zanimanje za drugo in drugačno. Pouk je usmerjen k učencu in njegovemu razvoju in postopni samostojnosti. [1] V sklopu doseganja operativnih ciljev učenci razvijajo in poglabljajo jezikovno znanje ter jezikovne sposobnosti (slušno in bralno razumevanje, ustno in pisno sporočanje), postopoma se seznanijo z jezikovnimi normami, konvencijami in funkcijami. [1] Sprva je poudarek na reprodukciji, kasneje pa na produktivnem poglabljanju v tematske sklope. [1]

Pri poučevanju tujega jezika imamo torej v mislih posameznika, ki pri učenju tujega jezika na različne načine spoznava novo besedišče. Svoje jezikovne sposobnosti poglablja na področju slušnega in bralnega razumevanja ter pisnega in bralnega sporočanja, s čimer pa postane pozoren tudi na lasten jezik in lastno kulturo.

2.1 Nemščina in IKT

Uporaba informacijske in komunikacijske tehnologije je v učnem načrtu za obvezni predmet nemščina omenjena v razdelku »Medpredmetno povezovanje«. Sposobnost pridobivanja, vrednotenja in uporabe informacij pa je tesno povezana z znanjem informacijskih tehnologij, ki ga učenci pridobijo na področju računalništva in informatike. [1] Ker se je od izdaje učnega načrta v letu 2001 marsikaj spremenilo, se je potrebno zavedati prednosti in slabosti, ki jih tehnologija prinaša in slednjo znati uporabiti na načine, da z varno in pravilno uporabo tehnologije, ki je učencem na razpolago tudi pri učenju tujega jezika, najdejo orodja, ki jim pomagajo priti do cilja.

2.2 Priprava gradiv

Kot sta ugotovila Petroman in Petroman [2], je načrtovanje in priprava gradiv pri delu na daljavo pravi izziv ne glede vrsto izobraževalnega zavoda. Pri pripravi gradiv za delo na daljavo mora učitelj upoštevati jezikovno predznanje učencev in jih usmerjati k temu, da čim bolj samostojno dosegajo cilje učnega

načrta, pri tem pa razvijajo jezikovne sposobnosti na vseh ravneh. Pomembno je, da učence pri tem vodimo po korakih in jim hkrati omogočimo, da delo opravijo v svojem ritmu in glede na svoje predznanje. Tako upoštevamo načela diferenciacije in individualizacije.

Učni sklop, ki smo ga v času dela na daljavo obravnavali v osmem razredu pri izbirnem predmetu nemščina, je bil človeško telo. Cilj, ki so ga učenci morali doseči po predelanem učnem sklopu, pa je bil zmožnost samostojnega poročanja o počutju in tvorba pogovora pri zdravniku.

2.3 Digitalne kompetence

Pri delu na daljavo so učenci morali biti digitalno pismeni – obvladati so morali različna področja digitalnih kompetenc, kot so: informacijska pismenost, komuniciranje in sodelovanje, izdelovanje digitalnih vsebin, varnost in reševanje problemov. [3] Pri delu na daljavo so učenci te digitalne kompetence nujno potrebovali, da so lahko dosegali zastavljene cilje.

3 KORAKI DO CILJA

3.1 Začetki dela na daljavo

Ko smo zakorakali v prvi teden dela na daljavo, smo najprej hoteli doseči čim več učencev. Ker so učenci delo v spletnih učilnicah že poznali, so nekateri tudi hitro našli prve informacije. Drugim pa je bilo treba posredovati osnovna navodila za vstop v elektronsko pošto in spletne učilnice. Ko je bilo to urejeno, so učenci v spletni učilnici našli predvsem navodila za ponavljanje že predelane snovi in navodila za urejanje dostopov do e-gradiv.

3.2 Spoznavanje besedišča

V drugem tednu pouka na daljavo so bili učenci v spletne učilnice že prijavljeni in smo lahko pričeli z novo učno temo. V uvodnem delu so se učenci seznanili z besediščem, ki ga potrebujejo za poročanje o počutju in pogovor pri zdravniku. Pri tem so si lahko pomagali z različnimi spletnimi orodji (kot npr. s spletnim slovarjem PONS, ki so ga že poznali), pa tudi z učbenikom in delovnim zvezkom. S pomočjo i-učbenika [4] so novo besedišče, ki je bilo v učbeniku podprto s slikovnim gradivom, tudi slišali, saj je v i-učbeniku možno pri branju spremljati še zvočne zapise in s tem vaditi tudi izgovorjavo. Kot osnovno orodje za doseganje tega cilja so učenci uporabili učbenik, saj jim je znan in so ga vajeni. Temu so dodali še njegovo spletno različico. Slika 1 prikazuje stran v učbeniku, na kateri je besedišče zapisano. Besede so zapisane v ednini in množini, s klikom na zvočnik pa so učenci vadili še izgovorjavo.

Čeprav smo v šoli i-učbenik uporabljali že od začetka šolskega leta in so bili učenci z dostopom do e-gradiv seznanjeni, se je izkazalo, da mnogi e-gradiv do začetka dela na daljavo niso koristili. Ob začetku dela na daljavo pa so si uredili dostop do e-gradiv.

Za utrjevanje novega besedišča so učenci uporabljali različna spletna orodja. Nove besede so ponavljali s pomočjo nalog na naslednjih spletnih straneh:

- LearningApps.org: https://learningapps.org [5],

- Arnesove interaktivne vaje: https://interaktivne-vaje.si/nemscina/wortschatz/korperteile.html, [6],
- Quizlet: https://quizlet.com/375343493/flashcards [7],
- Quizizz: https://quizizz.com/admin/quiz/5c9b78369f82cb001a41747d/körperteile [8].
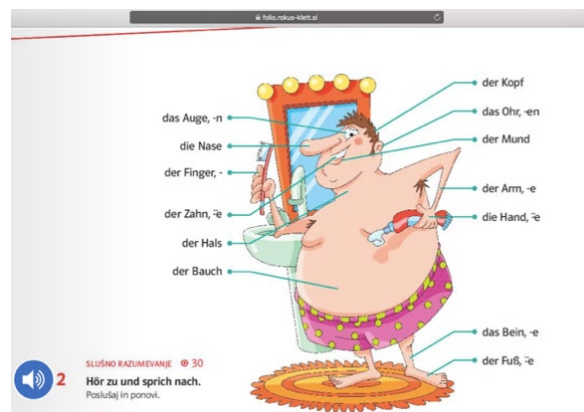
Slika 1. V i-učbeniku so učenci spoznali zapis in izgovorjavo novega besedišča. [4]

Spletnih strani, ki omogočajo spoznavanje in ponavljanje besedišča, je veliko. Prednost takšnih vaj je, da jih učenci lahko ponovijo večkrat, pri interaktivnih vajah pa lahko izbirajo med lažjimi in težjimi nalogami, mnoge imajo tudi možnost uporabe zvočnega posnetka. Med lažje naloge spadajo naloge prepoznavanja in povezovanja. Ko to znanje usvojijo, pa si izberejo še naloge, pri katerih je potrebno besede zapisati samostojno. Ker pri reševanju spletnih nalog učitelj procesa ne more neposredno preverjati, so morali učenci v dokaz pošiljati slike svojega dela (zaslonske slike) oz. so reševali naloge z zapisovanjem besed v delovni zvezek.

Pri izbiri nalog je bilo potrebno upoštevati učenčevo predznanje in učne cilje. Zato so na začetku prednjačile naloge, kot so iskanje parov in igra spomin, ki jih je občasno podpiral tudi zvočni zapis. Tako so učenci vadili najprej bralno in slušno razumevanje, čemur so dodali še izgovorjavo. Pozneje so nadaljevali z vajami zapisovanja besed, ki so jih reševali tudi v delovnem zvezku. Pravilnost zapisa določene besede so lahko preverili s pomočjo rešitev na spletu, zaslonsko sliko opravljenega dela pa so poslali učitelju v dokaz. Tako se je krog (spoznavanje → učenje → uporaba znanja → ponavljanje in utrjevanje) zaključil z evalvacijo znanja, saj so rešitve morali preveriti in napake popraviti s pisalom druge barve.

Vsako izmed naštetih orodij pa ima seveda svoje prednosti in slabosti. Prednost i-učbenika je zagotovo ta, da so ga učenci že poznali. Prav zato so vedeli, kaj pomenijo posamezna oznake, kje najti slovar in razlago slovnice. Tudi delovni zvezek je v elektronski obliki, a so učenci rešitve zapisovali v svoje tiskane delovne zvezke in jih nato pregledali ter napake označili z drugo barvo. V tem primeru se je slabost dela na daljavo pokazala v tem, da med samim delom učitelj ni mogel spremljati zapisa v delovnem zvezku in nuditi dodatne razlage, če je bila potrebna.

Aplikacijo LearningApps so učenci uporabljali predvsem v prvi fazi učenja, saj so pri mnogih nalogah možnosti že dane in

jih morajo le prepoznati. Lahko pa so v aplikaciji izbirali tudi zahtevnejše naloge, ki so zahtevale samostojen zapis (npr. zapis besed v množini).

Prednost Quizlet-a je ta, da lahko besedišče poljubno oblikujemo sami. Uporabimo lahko predpripravljen kviz in ga spremenimo glede na cilje, ki jih želimo doseči. Quizlet omogoča tudi različne vaje iz spoznavanja besed. Učenci so besede spoznali najprej s pomočjo slik, nato pa so morali prepoznati poimenovanje delov telesa na sliki. V nadaljevanju so morali dele telesa na sliki zapisati, zapisati so morali še slišane besede in se preizkusiti v testu. Besedišče pa so lahko vadili tudi s pomočjo dveh iger – iskanja parov in zapisa prevoda. Aplikacija je tako nudila nabor nalog različnih težavnostnih stopenj, ki so razvijale tako slušno kot tudi bralno razumevanje in pisno sporočanje.

Podobno velja za interaktivne vaje, kjer so imeli učenci na razpolago zbirko naslovov z nalogami različnih težavnostnih stopenj. Te so učenci že poznali, saj so jih pogosto uporabljali v preteklih letih. Pri reševanju teh nalog pa so učenci delali samostojno, za dokaz je služila le ekranska slika.

Quizizz so uporabljali predvsem za reševanje že vnaprej priravljenih kvizov, v katere so se morali vpisati z imenom, da sem lahko sledila njihovemu delu in napredku. Podoben kviz so rešili tudi v Arnesovi spletni učilnici. Izkazalo se je, da pri Quizizz-u radi sodelujejo, ker ga doživljajo kot bolj sproščeno obliko učenja, saj so v povratne informacije vključene zabavne slike in glasovi, pa tudi tekmujejo lahko drug z drugim, kar jih še dodatno motivira.

3.3 Spoznavanje jezikovnih sredstev

Ko so učenci spoznali novo besedišče, smo nadaljevali s spoznavanjem jezikovnih sredstev in posledično tudi slovničnih pravil, ki so jih učenci spoznali s pomočjo i-učbenika, utrjevali z nalogami na spletu in nalogami v delovnem zvezku.

Pri delu smo vključili video posnetke na YouTubu. Tudi tokrat so si učenci najprej ogledali jezikovno lažje posnetke s transkripcijo. Nato so reševali naloge, ki so vsebovale enaka ali podobna besedila z vrzelmi. Razbrati so morali posamezne informacije iz posnetkov in z njimi dopolniti besedila. Ponovno je torej šlo za prepoznavanje znanega in nato za dopolnjevanje. V prvem delu učnega procesa so učenci prepoznavali slušno in pisno podobo. Znana jezikovna sredstva so nato prepoznavali v vedno daljših in kompleksnejših besedilih, tako v i-učbeniku kot tudi v drugih e-gradivih na spletu. Vadili so bralno razumevanje in se pripravljali na samostojen zapis. V tej fazi smo z učenci izvedli nekaj videokonferenc preko Zoom-a, da smo preverili razumevanje navodil in so imeli učenci možnost postavljati vprašanja. Kot se je izkazalo, so bili učenci videokonferenc veseli in so se jih v velikem številu tudi redno udeleževali.

Prednost posnetkov na YouTubu je ta, da pogovore slišijo, lahko vadijo izgovorjavo in spremljajo razlike med zapisom in izgovorjavo. Nekoliko težje pa je najti avtentične posnetke, na katerih ljudje ne govorijo v narečju in hkrati dovolj počasi, da jim učenci lahko sledijo. Najdeni posnetki so pogosto prirejeni za učenje tujega jezika. Podobno je tudi z besedili. Avtentična besedila (zapisi, članki, tuje spletne strani ipd.) velikokrat vsebujejo veliko novega besedišča in če slednje ni podkrepljeno s primernim slikovnim gradivom, postane za učence pretežko in jim pade motivacija. Zato je pomembno najti gradiva, ki so

primerna njihovemu znanju (torej vsebujejo nekoliko težje besedišče, kot so ga vajeni).

3.4 Samostojen zapis

Ko so učenci potrebno besedišče usvojili in spoznali jezikovna sredstva, so jih morali uporabiti za samostojen zapis. Pri tem so si lahko pomagali z vsemi razpoložljivimi sredstvi (spletom, slovarji, učnimi gradivi). Dobili so smernice za delo. Pred tem smo že pri pouku spoznali nekaj spletnih slovarjev in kako naj se jih uporablja, da bodo zapisi pravilni. Pri oddanih nalogah sem opazila, da so tisti učenci, ki so naloge oddajali redno in mi redno pošiljali tudi ekranske slike, bili bolje informirani in natančnejši. Ti učenci so vedeli, kje najdejo posamezna jezikovna sredstva in na kaj morajo biti pozorni. O tem smo se pogovarjali tudi na videokonferencah. Medtem ko so učenci, ki nalog niso delali redno, potrebovali veliko več usmerjanja in vodenja, da jim je določeno nalogo uspelo opraviti.

4   ZAKLJUČEK

V času dela na daljavo se je pokazalo, da so v prednosti bili tisti učenci, ki so IK tehnologijo že obvladali, poznali spletne učilnice in e-gradiva in te redno uporabljali že prej. Pri delu smo uporabljali i-učbenik, delovni zvezek in gradiva na spletu. Največji izziv za učitelja je bil najti naloge, ki so primerne predznanju in zmožnostim otrok in so v pomoč pri doseganju ciljev. Zato sem se v pedagoškem procesu odločila, da nekatere naloge v omenjenih aplikacijah sestavim sama. Učenci so pri delu morali pokazati veliko mero samostojnosti in nenazadnje tudi motivacije. Ker mnoge aplikacije ne omogočajo preverjanja uspešnosti reševanja nalog, so pri nekaterih nalogah morali pošiljati zaslonske slike dela, ki pa niso nujno pomenile, da so nalogo rešili samostojno in ne po sistemu poskusov in napak ali s pomočjo danih rešitev. Pravo znanje učencev se je namreč pokazalo šele pri vsebini in kvaliteti oddane zaključne naloge.

Menim, da še zmeraj mnogo učencev potrebuje pomoč pri uporabi mobilnih naprav in spletnih orodij. Prav tako potrebujejo veliko usmerjanja in preverjanja, saj sicer uberejo lažjo pot, ki jih ne privede nujno do kakovostno opravljenega dela. Zato bodo učenci v tem šolskem letu pri pouku v šoli redno dobivali naloge v spletnih učilnicah, skupaj pa jih bomo pregledali in se pogovorili o namenu in ciljih posameznih nalog.

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Uporaba spletnega orodja Classkick pri izobraževanju na daljavo

Using Classkick instructional tool during distance learning

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POVZETEK

IKT postaja vedno bolj pomemben del šolskega procesa in je vključen tudi v vse učne načrte. Pri izobraževanju na daljavo v času epidemije Covid-19 je ta element postal ključen, saj je predstavljal most med učitelji in učenci. V luči dejstva, da se je glede na analizo izobraževanja na daljavo največ učiteljev posluževalo pisnih navodil za delo ter so kot dokaz o zanju učencev v veliki meri uporabljali rešene liste, članek predstavlja eno od spletnih orodij, ki omogoča dajanje navodil in nalog na malo drugačen način, hkrati pa s pripravo nalog za učence in več možnostmi dajanja povratnih informacij učiteljem olajša delo.

KLJUČNE BESEDE

Classkick, IKT, izobraževanje na daljavo, spletno orodje

ABSTRACT

IT has increasingly proved as one of the most important for parts of the school process and is included in all curricula. Distance learning during the Covid-19 epidemic has further increased the need to use IT as it proved to be the only means of communication between teachers and students. In light of the fact that most teachers used written work instructions during the epidemic and worksheets as an evidence of learning, the article presents one of the instructional tools available, namely the Classkick tool. It enables different ways of preparing work instructions for students as well as making different exercises and providing feedback.

KEYWORDS

Classkick, IT, distance learning, instructional tool

1 UVOD

IKT tehnologija je v zadnjem času eden od ključnih gradnikov pouka. Polega razvijanja računalniške pismenosti je uporaba IKT tehnologije smiselna tudi kot motivacijski moment, omogoča dostop do informacij in povezovanje v realnem času, omogoča učinkovito obdelavo in predstavitev podatkov, uporabo e-gradiv ter podpira vseživljenjsko učenje [3]. Vsi učni načrti za osnovno šolo vsebujejo poglavje o uporabi IKT tehnologije pri pouku. Učni načrt za predmet angleščina tako kot enega od ciljev uporabe informacijske tehnologije navaja: "komuniciranje in sodelovanje na daljavo" [4]. V mesecu marcu, z razglasitvijo epidemije, pa smo se učitelji in učenci znašli v situaciji, ko je IKT tehnologija postala edini način za komunikacijo. V analizi izobraževanja na daljavo Zavod za šolstvo navaja, da se je največ učiteljev (kar 84,5 %) posluževalo pisnih navodil za delo [1]. Prav tako je med predmetnimi in srednješolskimi učitelji največ od njih (15,2 % predmetnih in 16,7 % srednješolskih učiteljev) kot dokaz o znanju uporabljalo rešene učne liste.

Skupaj s sodelavkami v aktivu učiteljev angleškega jezika smo odkrile brezplačno spletno orodje Classkick [2], ki nam je olajšalo pripravo pisnih navodil tako, da smo jim dodale posnetke, povezave in sličice, pa tudi pripravo gradiv za dokaz o zanju in oblikovanje povratne informacije o znanju za učence.

2 SPLETNO ORODJE CLASSKICK

Spletno orodje Classkick najdemo na spletni strani https://classkick.com. Tam se prijavimo kot učitelj z imenom in priimkom. Treba je poudariti, da je orodje sicer v angleškem jeziku, a je precej preprosto, saj v večini uporablja ikone, nudi pa tudi kratke videoposnetke za pomoč novim uporabnikom, kjer so predstavljene osnovne funkcije orodja.

Deluje po principu pripravljanja »nalog« s strani učitelja za učence. Te naloge niso nujno samo naloge, ki jih učenci rešujejo, ampak se lahko uporabijo tudi kot navodila za delo ali razlaga za učence. Naloge učencem dodelimo tako, da jim posredujemo kodo za nalogo. Učenci se za uporabo spletnega orodja v orodje ne potrebujejo prijaviti, vpišejo samo posredovano kodo in svoje ime (ki ga bo učitelj videl pri pregledovanju nalog). Ko učenci naloge opravijo (ali si jih v primeru razlage ogledajo), učitelj vidi njihova imena ter rešitve. Nato lahko učencem na različne načine poda povratno informacijo, ki jo le-ti vidijo, ko se po vpisu kode v spletno orodje ponovno prijavijo s svojim imenom.

2.1 Priprava nalog

Orodje Classkick od učencev zahteva minimalno znanje programa (npr. kako napisati odgovor, kako spremeniti barvo in

velikost besedila, kako narisati črto, kako prenesti sličico, kako posneti odgovor). Orodje nam ob prvi prijavi ponudi predlogo naloge za učence, skozi katero se naučijo uporabe orodja.

Classkick ponuja tudi predloge različnih nalog učiteljev, ki jih lahko kopiramo in uredimo, lahko pa začnemo s prazno predlogo in nalogo pripravimo sami. Obstaja tudi tretja možnost, t. j. izbira predloge iz računalnika, ki pa mora biti v formatu PDF.

Pri izdelavi naloge imamo v orodni vrstici več možnosti (glej Slika 1, po vrsti od leve proti desni):

- osveži,
- povečaj ali pomanjšaj,

- uporabi miško,
- uporabi svinčnik,
- uporabi flomaster,
- uporabi radirko,
- vstavi okvirček za pisanje besedila,
- nariši ravno črto,
- vstavi povezavo,
- vstavi sliko (slikaj ali izberi iz naprave),
- vstavi zvočni posnetek (posnemi ali izberi iz naprave),
- vstavi sliko, ki jo uporabnik lahko premika,
- vstavi kvadratek, v katerega uporabnik vpiše odgovor, in dodaj pravilno rešitev/ve, da bo program sam označil, ali je rešitev pravilna ali ne,
- vstavi možnost izbire med petimi odgovori in označi pravilno rešitev, da bo program sam označil, ali je rešitev pravilna ali ne,
- vstavi vnaprej pripravljeno nalepko (uporabnik jih oblikuje sam; npr. odlično, bravo, še enkrat preglej), ki nam pride prav predvsem pri pripravi povratne informacije,
- spremeni ozadja,
- število točk (določimo, koliko točk lahko učenec doseže na posameznem listu; točk ni potrebno dodeljevati, če ne želimo).
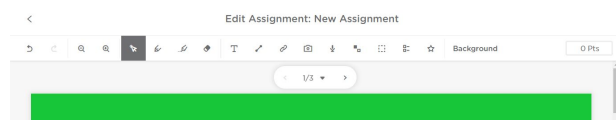
Slika 1. Orodna vrstica za urejanje naloge

Nalogo razdelimo na več listov, ki jih lahko po želji dodajamo ali brišemo.

Slika 2 prikazuje primer pripravljene naloge, kjer je učitelj pripravil navodilo za reševanje naloge, slušni posnetek ter nalogo, kjer učenci označijo pravilno sličico.

Slika 3 prikazuje primer razlage, kjer je poleg zapisane razlage učitelj pripravil tudi povezavo na spletno stran z dodatno razlago in slušni posnetek.

Slika 2. Primer pripravljene naloge
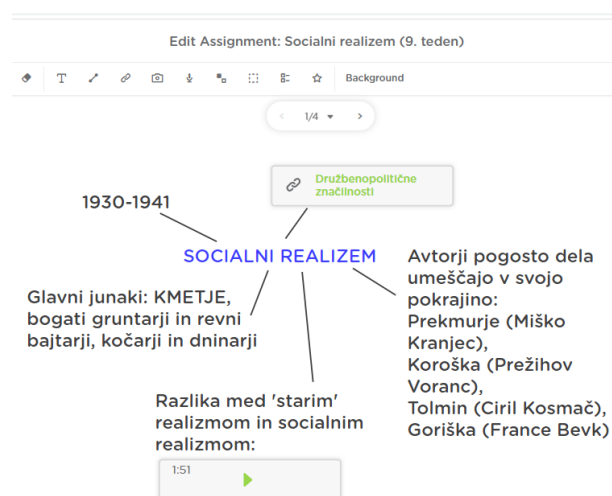
Slika 3. Primer pripravljene razlage

2.2 Reševanje nalog

Ko učitelj dokonča nalogo, nastavi t. i. »roster« (razpored dela), s katerim pridobi kodo, ki jo posreduje učencem. Brez posebne prijave v program, le z uporabo svojega imena (in priimka) lahko učenec reši nalogo (ali si ogleda razlago). Vsak učenec ima možnost dvigniti roko (ikona roke), ki je uporabno orodje predvsem pri pri pouku v šoli.

Učenci imajo na voljo zelo podobno orodno vrstico za reševanje nalog, kot jo ima na voljo učitelj, z izjemo možnosti za ustvarjanje različnih vrst nalog.

2.3 Vrednotenje nalog

Ko učenci nalogo rešijo, učitelj lahko rešene naloge pregleda. Izbere si lahko pogled, kjer vidi vse učence, ki so nalogo reševali. V filtrih ima več možnosti pogleda, od skrivanja učencev, ki z nalogo še niso začeli, ampak so jo samo odprli, do skrivanja imen učencev, pa možnost, ali učenec vidi doseženo število točk ali ne. Prav tako med filtri nastavimo možnost medvrstniškega vrednotenja in pomoči, ki je prav tako dodana vrednost orodja. Ko učitelj odpre pogled za vsakega posameznega učenca, ima več možnosti za dajanje povratne informacije:

- uporaba nalepk (ikona zvezdice), ki si jih prej pripravi ali pa izbere vnaprej pripravljene (glej slika 4),

- dodeljevanje točk (če smo uporabili naloge izbire pravilnega odgovora ali vstavljanja odgovora, pri katerih smo predhodno označili možne pravilne odgovore, program točke dodeli sam)

- pisanje povratne informacije (glej slika 4, zeleno besedilo),

- snemanje posnetka s povratno informacijo (na ikoni mikrofona).

Slika 4. Primer povratne informacije

3 ZAKLJUČEK

Spletno orodje Classkick se je v praksi izkazalo kot zelo uporabno in kvalitetno orodje za izobraževanje na daljavo, saj je z vsemi zgoraj navedenimi možnostmi dovolj fleksibilno za

različne uporabe; od razlage, do utrjevanja, preverjanja znanja in celo dela v skupinah, saj omogoča tudi medvrstniško vrednotenje in pomoč.

Hkrati Classkick dviguje motivacijo učencem, ki so v poplavi pisnih navodil in posnetkov orodje videli kot svež veter, saj jim omogoča, da izrazijo tudi sebe in se igrajo z barvami, velikostmi, oblikami. Všeč jim je bila povratna informacija, ki so jo z veseljem pričakovali.

VIRI IN LITERATURA

[1] Analiza izobraževanja na daljavo v času epidemije Covid-19 v Sloveniji. Delno poročilo, julij 2020, 2020. Ljubljana: Ministrstvo za šolstvo in šport: Zavod RS za šolstvo (spletna izdaja, dostopna na https://www.zrss.si/strokovne-resitve/digitalna-bralnica/podrobno?publikacija=297)

[2] Classkick, dostopen na https://classkick.com

[3] Kreuh, N. 2011. Izhodišča standarda e-kompetentni učitelj, ravnatelj in računalnikar. Ljubljana: Ministrstvo za šolstvo in šport: Zavod RS za šolstvo (el. knjiga, dostopna na https://www.zrss.si/pdf/esolstvo-standard.pdf)

[4] Učni načrt. Program osnovna šola. Angleščina, 2016. Ljubljana: Ministrstvo za šolstvo in šport: zavod RS za šolstvo.

Razredna problematika in delo na daljavo

Class issues and teleworking

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POVZETEK

Tudi pri delu na daljavo je potrebno reševati težave učencev, saj učenci pri učenju ter sodelovanju s sošolci in sošolkami potrebujejo vodenje in včasih tudi pomoč. V okviru razrednih ur, ki so bile izpeljane na daljavo na temo medsebojnih odnosov v razredu in samostojnim šolskim delom učencev, je bil pripravljen vprašalnik s pomočjo spletnega orodja Google Docs, ki so ga učenci rešili anonimno. S pomočjo tega vprašalnika lahko ugotovimo, kako se učenci med seboj razumejo in kakšne težave se med samim učenjem in delom na daljavo pojavljajo. Ugotovitve pri analizi odgovorov vprašalnika predstavljajo osnovo za izpeljavo razredne ure na omenjeno temo.

KLJUČNE BESEDE

Delo na daljavo, Google Docs, razredna ura

ABSTRACT

It is also necessary to solve students' problems when teleworking, as students need guidance and sometimes help in learning and cooperating with their classmates. As part of the class meetings, which were extramural courses on the topic of interpersonal relationships in the classroom and independent schoolwork of students, a questionnaire was prepared using the online tool Google Docs, which students solved anonymously. With the help of this questionnaire, we can find out how students can work with each other and what problems arise during the learning by teleworking. The findings in the analysis of the answers to the questionnaire represent the basis for conducting a class lesson on the mentioned topic.

KEYWORDS

Telework, Google Docs, class meeting

1 DELO NA DALJAVO

Učenci in učitelji smo bili letos primorani precej spremeniti svoj način dela z učenci. Nenadoma delo v razredu v živo ni bilo več mogoče, učitelji smo morali pripraviti pouk na daljavo. Pri nekaterih predmetih je bilo podajanje snovi lažje, učenci so lahko bolj ali manj samostojno predelali učno snov, pri nekaterih predmetih pa so potrebovali tudi razlago učitelja. Ravno tako so nekateri učenci potrebovali tudi pomoč pri soočanju z nastalo situacijo in organizaciji svojega dela. Tudi razredne ure so potekale na čisto drugačen način, preko video konferenc. V letnem delovnem načrtu za izpeljavo razrednih ur je bila za mesec marec izbrana tema medsebojni odnosi in moje šolsko delo. Kljub temu, da učenci niso bili v šoli, sem se odločila, da bomo na razrednih urah čas namenili izbrani temi.

2 PRIPRAVA NA RAZREDNO URO

Pri izbrani temi razrednih ur po navadi izvedem anketo, ki jo učenci rešijo v šoli, sama pa jo potem analiziram v programu Excell ter rezultate predstavim učencem na razredni uri in staršem na roditeljskem sestanku. V letošnjem šolskem letu pa takšen način pridobivanja podatkov učencev ni bil mogoč, zato sem se določila, da bom podatke o šolskem delu učencev in njihovih medsebojnih odnosih pridobila preko aplikacije Google Docs.

2.1 Aplikacija Google Docs

Google Docs je brezplačno spletno orodje, ki jo ponuja Google v okviru svoje storitve Google Drive. V okviru spletne aplikacije Google Dokumenti, ki delujejo tudi na mobilnih napravah za Android, iOS, Windows, BlackBerry in kot namizna aplikacija v Googlovem ChromeOS-u. Aplikacija je združljiva z datotekami datotek Microsoft Office. Uporabnikom omogoča ustvarjanje in urejanje datotek v spletu ob sodelovanju z drugimi uporabniki v realnem času [1]. Uporaba aplikacije se mi je zdela smiselna, saj se učencem ni bilo potrebno posebej prijaviti in ustvariti uporabniških imen in gesel, da so lahko rešili vprašalnik.

3 IZDELAVA VPRAŠALNIKA

3.1 Izbor vprašanj

Vprašanja, ki so bila vsebovana v vprašalniku sem pripravila v sodelovanju s šolsko svetovalno službo. Pomembno je bilo predvsem to, da so razumljiva in da bodo odgovori učencev pokazali, kako se učenci počutijo v razredu, kako med seboj sodelujejo in kakšno je njihovo šolsko delo doma. Pripraviti je bilo potrebno sociometrijo razreda [2].Vprašanja so bila razdeljena na štiri dele. Prva del so bile trditve, ki so opisovale odnose med sošolci in sošolkami, učenci pa so morali trditve

označiti, v kolikšni meri veljajo zanje. Drugi del je bil zasnovan na enak način, učenci pa so ocenjevali trditve v zvezi s poukom in njihovim šolskim delom, ki ga opravljajo doma. Tretji in četrti del pa sta bila osredotočena na prepoznavanje pozitivnih in negativnih interakcij med posameznimi učenci. Rezultat tretjega in četrtega dela je dal odgovor o učencih, ki so v razredu zelo dobro sprejeti in ustrezno sodelujejo v skupini in tistih učencih, s katerimi je sodelovanje oteženo iz tega ali onega razloga.

3.2 Vnos vprašanj v Google Docs

Če želimo pripraviti vprašalnik v spletni aplikaciji Google Docs, moramo imeti uporabniško ime in geslo za račun Google. Kot je prikazano Slika 83 med možnostmi na levi strani izberemo Obrazec.
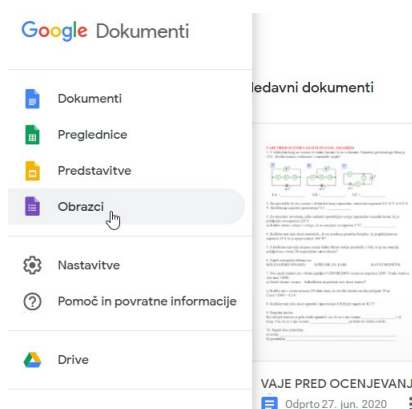
Slika 83: Izbira Obrazci

V desnem spodnjem kotu označimo plus in ustvarimo nov obrazec. Na Slika 84 lahko vidimo tudi kako lahko vprašalnik poimenujemo, pod naslovom pa zapišemo navodila za učence.
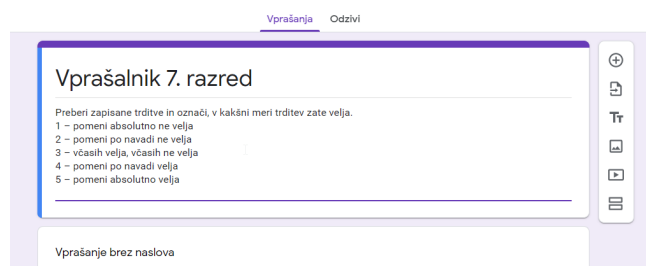
Slika 84: Poimenovanje vprašalnika

Po poimenovanju vprašalnika in zapisu navodil za učence je potrebno pripraviti vprašanja. V mojem vprašalniku sta prvi dve vprašanji sestavljeni iz desetih trditev, za katere morajo učenci oceniti v kolikšni meri veljajo zanje. Takšna vprašanja pripravimo tako, da preimenujemo vprašanje in kot tip vprašanja izberemo Mreža z vprašanji z izbirnimi odgovori (Slika 85).
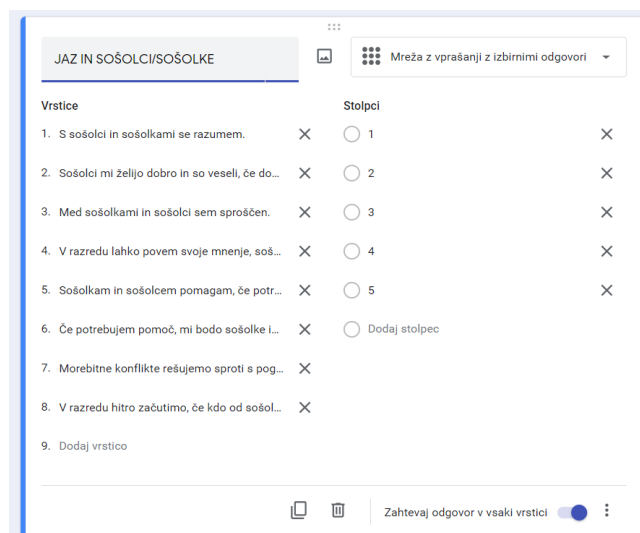
Slika 85: Vpis vprašanja

Na levi strani v stolpec zapišemo trditve, v desni stolpec pa številke od 1 do 5, da bodo lahko učenci označili, do katere mere trditev zanje velja. Ker je pomembno, da izpolnijo vsa polja, pri vprašanju desno spodaj označimo Zahtevaj odgovor v vsako vrstici. Na enak način sem pripravila tudi sklop drugih trditev na temo moje šolsko in domače delo. Novo vprašanje dodamo tako, da na desni strani kliknemo na oznako + (Slika 86).
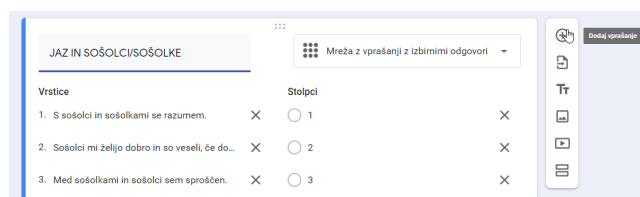
Slika 86: Dodajanje novega vprašanja

Za 7. razred sem želela narediti tudi sociogram, zato sem v Google Docs obrazec dodala še dve vprašanji (Slika 87). Pri prvem vprašanju so morali učenci na seznamu označiti tri sošolce ali sošolke, s katerimi najraje sodelujejo pri šolskem delu. Takšne vrste vprašanj pripravimo tako, da na desni strani označimo, da gre za vprašanje s potrditvenimi polji. Kot možnosti izbire pa zapišemo imena in priimke učencev.
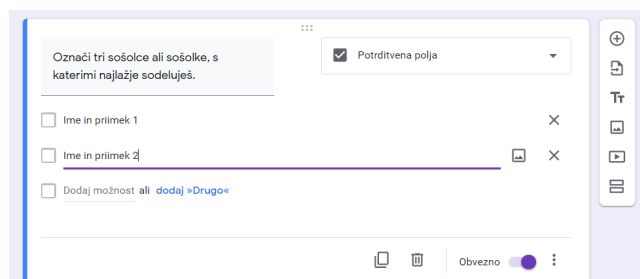
Slika 87: Priprava vprašanja s potrditvenimi polji

Na enak način sem pripravila tudi vprašanje, pri katerem so morali učenci označiti, s katerimi učenci težko sodelujejo pri šolskem delu.

Ko so bila vsa vprašanja vnesena v spletni obrazec, sem učencem posredovala povezavo do vprašalnika. Povezavo lahko pošljemo tako, da desno zgoraj kliknemo na vijolično obarvano polje Pošlji ter vpišemo e-naslove učencev (Slika 88). Če vsi učenci nimajo e-naslovov, lahko povezavo do vprašalnika dodamo v spletno učilnico. Povezavo preprosto kopiramo in prilepimo.
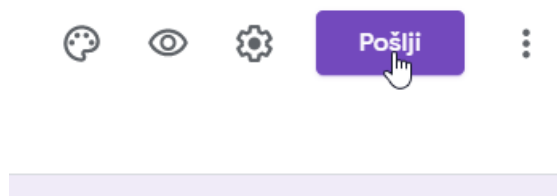
Slika 88: Pošiljanje povezave do ankete

Vprašalniku lahko pred pošiljam še spremenimo barvo. To naredimo tako, da v desnem zgornjem kotu kliknemo na paleto, kar nam omogoči izbiro poljubne barve. Tu lahko izberemo tudi slog pisave.

3.3 Izpolnjevanje vprašalnika

Učenci so po prejemu povezave na vprašalnik odgovorili na vprašanja. Vprašalnik so rešili vsi učenci v razredu. Bil je anonimen, lahko pa bi bilo dodano tudi vprašanje, pri katerem bi morali vpisati svoje ime in priimek, vendar imam občutek, da potem ne bi dobila iskrenih odgovorov. Mi, kot kreatorji Obrazca v Google Docs, lahko vedno preverimo, koliko učencev je na vprašalnik že odgovorilo. Pri zavihku Odzivi se pokaže število izpolnjenih obrazcev (Slika 89). Na ta način lahko tudi ugotovimo, ali so vsi učenci rešili vprašalnik.
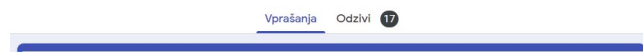
Slika 89: Štetje odzivov

Ko na vprašalnik odgovorijo vsi učenci, lahko onemogočimo nove odgovore. To storimo tako, da pod zavihkom Odzivi označimo, da obrazec ne sprejema več odgovorov. Kako to označiti, je prikazano na Slika 90.
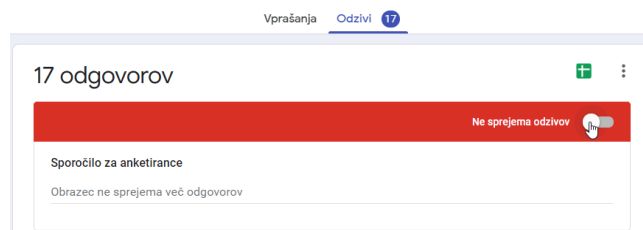
Slika 90: Zaključek reševanja spletnega obrazca

Pod tem zavihkom lahko pregledamo tudi povzetek odgovorov učencev na vprašanja. Odgovore si lahko prenesemo tudi na računalnik, če kliknemo na tri pike desno zgoraj in izberemo Prenos odgovorov (Slika 91). Odgovori bodo preneseni v .csv datoteki.
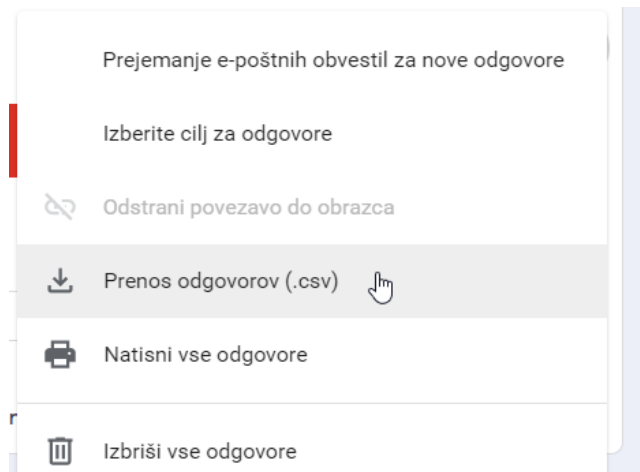
Slika 91: Prenos odgovorov

Kot je že omenjeno, se odgovori prenesejo v datoteki s končnico .csv, zato, če nismo vešči spreminjanja zapisa v datoteki, si odgovore raje natisnemo in sami vnesemo v Excell, kjer jih obdelamo in ugotovitve predstavimo z grafi ali povprečjem.

4 PREDSTAVITEV REZULTATOV

Odgovore učencev si lahko ogledamo že v samem obrazcu pod zavihkom Odzivi, Povzetek (Slika 92).
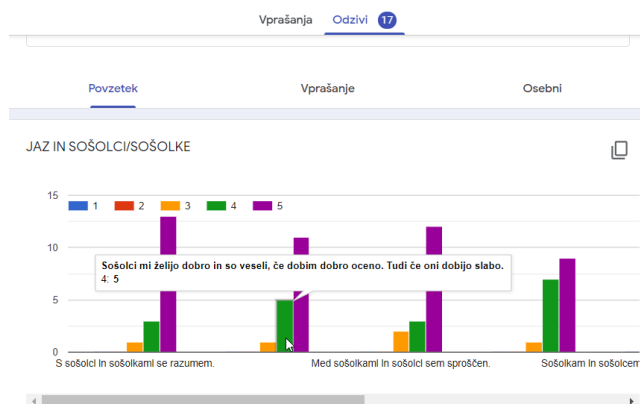
Slika 92: Pregled odgovorov

Rezultate uporabimo pri izpeljavi razredne ure na daljavo, kjer lahko učenci še ustno dopolnijo oziroma razložijo svojo izbiro odgovorov. Na razredni uri in roditeljskem sestanku predstavimo zgolj prva dva dela vprašalnika. Na zadnji dve vprašanji lahko rezultat podamo osebno otroku ali njegovim staršem oziroma skrbnikom.

Oznaci tri sosolce oziroma sosolke, s katerimi tezko sodeluješ pri skupinskem delu.
17 odgovorov
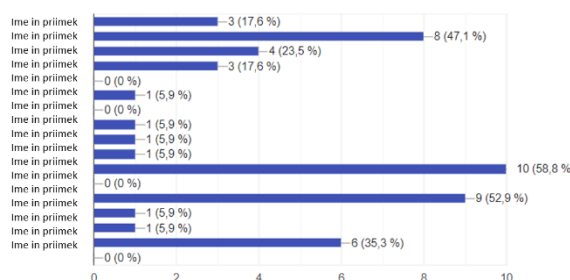
Slika 93: Rezultati pri tretjem vprašanju

Učitelj razrednik pa dobi pri odgovorih na zadnji dve vprašanji (Slika 93) vpogled, katerim učencem je potrebno pri sodelovanju s sošolci pomagati. S temi učenci lahko pri nadaljnjem delu več sodelujemo in jim pomagamo pri boljšem vključevanju v skupino.

5 ZAKLJUČEK

Pri uvedbi pouka na daljavo je bilo potrebno spremeniti način vodenja razreda in pridobiti informacijo o delu učencev na daljavo ter njihovih medsebojnih odnosih ter narediti sociogram. V živo ni bilo moč dobiti odgovorov na moja vprašanja, zato sem s odločila, da uporabim aplikacijo Obrazci Google Docs. Pridobivanje odgovorov učencev na ta način je bil edini smiseln, saj z učenci nisem imela kontakta v živo. Hkrati pa je bilo to tudi za njih nekaj novega, zato so imeli nekaj več motivacije pri odgovarjanju na vprašanja.

VIRI IN LITERATURA

[1] *Wikipedia. Google Docs* (pridobljeno 10. 8. 2020). DOI= https://en.wikipedia.org/wiki/Google_Docs

[2] KOŠIR, Katja. 2011. *Pregled preučevanja vrstniških odnosov pri šolskih otrocih in mladostnikih.* Anthropos 1-2 (221-222) 2011, str. 111-140 (pridobljeno 11. 8. 2020). DOI= http://www.dlib.si/stream/URN:NBN:SI:DOC-BNQ9EFOI/40c692c8-7793-4c12-a600-905e7d476f7b/PDF

Poučevanje programiranja s snovanjem iger

Teaching programming through game design

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POVZETEK

Potreba po znanju programiranja se v svetu povečuje iz dneva v dan. Zmožnost algoritmičnega razmišljanja in pisanja kode postaja bistvena veščina, saj je povezana z logičnim sklepanjem ter sposobnostjo reševanja problemov, in je pri iskanju zaposlitve vedno bolj zaželena. Na področju računalništva primanjkuje ustrezno usposobljenega osebja, zato je cilj projekta Coding4Girls spodbujati otroke v zadnjih letih osnovne ter v začetnih letih srednje šole k učenju programiranja, saj mnogo učencev v tem odbobju izgubi zanimanje za računalništvo. Projekt želi za programiranje in nadaljevanje študija na področju računalništva navdušiti predvsem dekleta in s tem zmanjšati neenakost med spoloma, saj ženske predstavljajo le majhen delež zaposlenih na tem področju. V prispevku si bomo podrobneje ogledali pristop k učenju programiranja s snovanjem iger, predstavili pa bomo tudi pripravljene učne scenarije, ki jih lahko učitelji uporabijo in jih po želji prilagajajo lastnim potrebam.

KLJUČNE BESEDE

Programiranje, učenje s snovanjem iger

ABSTRACT

The need for programming skills is growing day by day in the world. The ability to think algorithmically and write code is becoming an essential skill as it is linked to logical thinking and problem solving skills and is increasingly desirable when looking for a job. There is a lack of appropriately qualified personnel in the field of computer science, which is why the Coding4Girls project aims to encourage children in the last years of primary and early secondary school to learn programming, as many students lose interest in computer science during this time. The project aims to inspire girls to program and continue their studies in the field of computer science in order to reduce gender inequality, as women represent only a small percentage of the workforce in this field. In this paper we will take a closer look at the game design based learning approach and present prepared learning scenarios that can be used and adapted by teachers as they wish.

KEYWORDS

Programming, game design based learning

1 UVOD

Pomen igre za otrokovo učenje so izpostavljali že vodilni psihologi prejšnjega stoletja in ji pripisovali eno najpomembnejših vlog pri razvoju življenjsko pomembnih veščin, ne glede na starost ali razvojno stopnjo otroka. Otrok se hitro prilagaja novim okoliščinam, z lahkoto obvladuje spremembe in odkriva osnovne koncepte iz resničnega sveta [1].

Na področju izobraževanja prihajajo vedno bolj v ospredje aktivne oblike učenja, kjer se korenito spremenita vlogi učitelja in učenca. Pri tem je naloga prvega priprava primernega okolja in izzivov, usmerjanja in podajanja povratnih informacij učencem, naloga učenca pa razmišljanje, vrednotenje ter samostojna gradnja znanja, pri čemer mu je lahko v veliko pomoč tudi informacijsko-komunikacijska tehnologija (IKT) [2].

2 UČENJE S SNOVANJEM IGER

Wu in Wang [3] opredeljujeta učenje s snovanjem iger (angl. *game design based learning*) kot učni pristop, pri katerem učence spodbujamo k snovalskim odločitvam [4] z namenom razvijanja svojih lastnih ali spreminjanjem obstoječih iger na osnovi izbranega okvira za razvoj iger. Učinkovitost omenjenega pristopa za poučevanje in učenje so prepoznali tudi številni raziskovalci. Kafai [5] trdi, da je učenje najbolj učinkovito, v kolikor so učenci vključeni v postopek snovanja, saj le-to spodbuja njihovo razmišljanje in učenje, zlasti če snujejo nekaj osebnega in smiselnega.

Integracija učenja s snovanjem iger se uspešno uporablja v številnih disciplinah [6]. Čeprav je pristop najbolj razširjen na področju računalništva, zlasti programiranja, konceptualnega razmišljanja, kompetenc za delo z IKT in umetno inteligenco, pa lahko najdemo tudi primere z drugih področij, kot so jezikovna pismenost, oblikovanje ter tudi umetnost [3], [4], [7]. Za učitelje pa je bistvenega pomena, da je pristop dokazano učinkovit za poučevanje digitalnih kompetenc [6].

2.1 Učne teorije

V tem poglavju si bomo ogledali številne učne teorije, ki podpirajo uporabo učenja s snovanjem iger v izobraževalnih okoljih.

2.1.1 Konstruktivizem

Piagetova konstruktivistična teorija učenja pravi, da morajo biti učenci aktivni ustvarjalci v procesu pridobivanja znanja ter poudarja pomen razumevanja in znanja o svetu in okolju, kjer naše izkušnje in ideje sodelujejo pri oblikovanju tega znanja [8]. Duffy and Jonassen [9] kot bistvem pojem konstruktivizma navajata še sodelovanje in socialna pogajanja, saj ponujata možnosti za razvijanje novega razumevanja s pomočjo razprav, kjer lahko učenci spoznajo še stališča. Učenci v procesu snovanja iger komunicirajo s svojimi učitelji, vrstniki in kontekstom, zato takšno učno okolje zagotavlja ustrezna pogoje za proces oblikovanja znanja [10].

2.1.2 Območje bližnjega razvoja

Koncept območja bližnjega razvoja je opredelil Vigotsky [11], ki poudarja vlogo odraslega človeka ali izkušenejšega vrstnika v razvoju učenca. Pri snovanju iger imajo učenci možnost sodelovanja v skupinah, kjer si lahko pomagajo, skupaj oblikujejo igre in razvijajo dodatne kompetence [6], pri čemer imajo tudi pomoč učitelja za nasvete in usmeritev.

2.1.3 Konstrukcionizem

Papertova konstrukcionistična teorija poudarja, da se učenci največ naučijo, ko sami gradijo svoje znanje [12]. Teorija zagovarja dve bistveni predpostavki – prva je miselna konstrukcija znanja, do katere pride preko izkušenj iz resničnega sveta, druga pa zagovarja, da lahko učenci učinkoviteje ustvarijo novo znanje z izdelavo izdelka, ki je zanje osebno pomemben [3]. Igra ima za učence vlogo artefakta in je po mnenju Caportona [13] primerna za konstrukcionistično učenje, saj so postale igre pri mladih zelo priljubljene, kar pomeni, da je postopek oblikovanja le-teh zanje vznemirljiv in pomemben.

2.1.4 Trialoško učenje

Za trialoško učenje je bistvenega pomena interakcija, do katere pride med ustvarjanjem konkretnih artefaktov. Aktivnosti so organizirane tako, da učenci v obliki sistematičnega procesa med seboj sodelujejo in razvijajo nek artefakt na osnovi skupnega znanja, npr. ideje, pravila, cilje ali igro [14]. Vlogo artefakta ima lahko tudi računalniška igra, saj jo učenci oblikujejo od začetne ideje ter jo skupaj izboljšujejo z upoštevanjem različnih pogledov. Različna IKT orodja (npr. Google Drive) omogočajo takojšnje deljenje idej in nadaljevanje dela, kar lahko izboljša ustvarjanje novega znanja in vpliva na nadaljnje delo drugih učencev [15].

2.1.5 Problemsko učenje

Problemsko učenje poudarja uporabo problemov iz resničnega sveta in proces skupinskega odkrivanja pri učenju, pri čemer je vloga učitelja zagotoviti ustrezna učna gradiva in vire [6], obenem pa je pomembno, da so učenci čim bolj samostojni. Pri snovanju iger gredo skozi različne faze – izdelava prototipa (faza izdelave), izvedba (faza konstrukcije) in evalvacija igre (prehodna faza) [3].

Pristop učenja s snovanjem iger, ki smo ga uporabili v okviru projekta Coding4Girls, zajema veliko elementov zgoraj

omenjenih učnih teorij in zato predstavlja odlično izhodišče za učenje programiranja. Pri tem pomaga tudi dejstvo, da je igranje iger vedno bolj popularno in si veliko učencev želi svojo igro tudi izdelati. Pri tem morajo skozi zahteven postopek od osnovne ideje do razčlenitve na manjše dele in povezave v smiselno celoto. Za pomoč imajo na voljo učitelja in vrstnike, vseeno pa igro oblikujejo sami in imajo na koncu svoj lasten izdelek, kar jih še posebej motivira.

3 PROJEKT CODING4GIRLS

Coding4Girls je projekt, ki ga financira Evropska unija v programu Erasmus+. Nastal je z željo vzbuditi večje zanimanje deklet za izobraževanje na področju računalništva, saj se za to področje tradicionalno zanimajo predvsem fantje. V projektu se trudimo odpravljati napačne predstave o vlogi žensk na področju računalništva in zmotno prepričanje o njihovih manjših sposobnostih za računalniško programiranje. Glavni cilj projekta je ozaveščanje deklet o širokem naboru možnosti, ki jih področje računalništva in programiranja ponuja za profesionalni in osebni ravzoj ter priprava na nadaljnje izobraževanje na tem področju. Pri tem seveda ne izključujemo fantov, saj je tudi spodbujanje enakosti med spoloma pomemben cilj projekta [16].

3.1 Pričakovani rezultati

V tem razdelku so predstavljeni rezultati projekta Coding4Girls.

3.1.1 Metodološki okvir za reševanje problemov

Pripravili smo metodološki okvir, ki temelji na snovalskem razmišljanju (angl. *design thinking*) in mlade spodbuja k izbiri poklicne poti na področju računalništva. Okvir bo učence spodbudil, da si pred oblikovanjem podrobne rešitve problema ustvarijo širšo sliko ter razmišljajo o tem, kako lahko digitalna tehnologija pomaga reševati probleme iz vsakdanjega življenja [16].

3.1.2 Spodbujanje razvoja programerskih spretnosti s pomočjo izobraževalnih iger

Učence in dijake med 10. in 16. letom starosti želimo spodbujati k sodelovanju v programerskih aktivnostih s pripravljenimi aktivnostmi. Le-te si sledijo po težavnosti, od lažjih do težjih, ki so namenjene predvsem uspešnejšim učencem (*low entry – high ceiling approach*) [17]. Učenci tako dobijo delno rešene naloge, ki jih morajo sami dokončati v vizualnem programskem jeziku Snap!

3.1.3 Izobraževalne vsebine za učitelje

Pripravili smo 22 učnih scenarijev, ki omogočajo integracijo predlaganega pristopa s snovalskim razmišljanjem in učenja s pomočjo izobraževalnih iger v šolsko prakso [16]. Učni scenariji so v pisni obliki na voljo na spletni strani projekta[1] v angleškem in slovenskem jeziku ter v jezikih vseh ostalih partnerjev v projektu. Na YouTube kanalu[2] pa so objavljeni tudi videovodiči s podrobnejšo razlago učnih scenarijev v angleščini.

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[1] Spletna stran projekta Coding4Girls:
https://www.coding4girls.eu/

[2] YouTube kanal projekta Coding4Girls:
https://www.youtube.com/channel/UC0DEdwkV9PsJ4Fb70MA JQrg

3.2 Učni scenariji

Aktivnosti smo skušali povezati s problemi iz resničnega sveta kot so npr. pobiranje odpadkov in onesnaževanje zraka. Pred pripravo učnih scenarijev smo tudi raziskali, kakšne so preference deklet pri igranju iger. Ugotovili smo, da imajo dekleta rada igre vlog [18] ter igre z raziskovanjem [19], rada svoj lik urejajo [20], motivira jih zgodba v ozadju [21] in povratne informacije [22], v igri pa so dekletom pomembni tudi izzivi in zabava med igranjem [23], [24].

Pripravljeni učni scenariji se delijo na dva dela: v prvem delu učenci v enem scenariju spoznajo po en programerski koncept, v drugem delu pa se koncepti prepletajo. Učitelji lahko uporabijo predlagani vrstni red scenarijev ali pa ga po želji priredijo. Prav tako lahko priredijo aktivnosti ali dodajo svoje naloge. Scenariji vsebujejo specifikacijo pričakovanega predznanja, splošne ter specifične učne cilje, koncepte, pričakovane rezultate, navodila za izvedbo aktivnosti po korakih, vprašanja za spodbujanje razprave ter dodatne naloge za sposobnejše učence [17]. Pripravili smo tudi navodila za učence za posamezno aktivnost, ki učencem pomagajo pri samostojnem reševanju nalog.

3.2.1 Seznam učnih scenarijev

Tabela prikazuje seznam učnih scenarijev in učne cilje, s katerimi se učenec pri aktivnosti sreča prvič. Lažji scenariji so v 1. delu (1 – 12), zahtevnejši pa v drugem (13 – 21).

Tabela 1 Seznam učnih scenarijev

Ime aktivnosti	Učni cilji
1. Uvod v okolje Snap!	Seznanjanje z vizualnim programskim jezikom Snap!, dodajanje in urejanje lika in ozadja.
2. Lik oživi	Sestavljanje kode za premikanje in govorjenje lika.
3. Premikanje po odru	Premikanje po x in y osi ter zanka ponovi x krat.
4. Menjava obleke in obrat	Spreminjanje obleke lika.
5. Zvoki na kmetiji	Dodajanje zvoka (uvažanje ali snemanje), ki se izvaja ob pritisku tipke.
6. Kameleon na počitnicah	Uporaba dogodkov za premikanje lika s tipkami, bloka za zaznavanje barve in pridobivanje boolean vrednosti, spoznavanje neskončne zanke ter pogojnega bloka »če..., sicer«, podajanje odziva in sprememba obleke glede na pozicijo lika.
7. Pomagaj princu in princeski najti svoje živali	Spoznavanje blokov za risanje v kombinaciji s premikanjem lika, nastavitev lika na začetke koordinate.
8. Risanje s kredo	Uporaba zanke pri risanju lika, obračanje za x stopinj ter menjava ozadja.
9. Pobiranje smeti in čiščenje parka	Uvod v spremenljivke preko štetja točk pri pobiranju odpadkov, paralelno izvajanje kod, podvajanje likov in kod.
10. Nahrani mucke	Nastavljanje vrednosti spremenljivke znotraj zanke, spoznavanje naključnih števil, združevanja nizov ter logičih in

	aritmetičih operatorjev za računanje. Učitelj lahko predstavi tudi rešitev s for zanko.
11. Mačje zavetišče	Spoznavanje zanke »ponavljaj dokler« ter operatorjev za primerjanje vrednosti.
12. Lovljenje zdrave hrane	Uporaba naključnega premikanja in naključne hitrosti likov, kombinacija dogodkov za začetek s klikom miške ali pritiskom na tipko, opcijska uporaba spremenljivke in pogojnega stavka za preprečevanje začetka igre.
13. Sestavi zgodbo	Načrtovanje dialogov in aktivnosti likov v zgodbi, pošiljanje in prejemanje obvesil za izvedbo dialogov med liki.
14. Onesnažen zrak	Uporaba sporočil s klikom na lik za paralelno izvajanje dogodkov, risanje kroga.
15. Ulovi miš	Uporaba neskončne zanke za premikanje lika, obračanje lika za naključno število stopinj, uporaba časovnika za konec igre.
16. Kupovanje hrane za piknik	Uporaba spremenljivke za določanje cene izdelka, preverjanje vrednosti spremenljivke in prirejanje njene vrednosti glede na potek igre.
17. Računanje	Spoznavanje menjave ozadja in obleke lika s pomočjo spremenljivke.
18. Recikliranje	Uporaba zanke »čakaj dokler« spremenljivka ne doseže določene vrednosti.
19.1 Zaigraj na klavir 1*	Ustvarjanje melodije s sestavljanjem zaporedja tonov.
19.2 Zaigraj na klavir 2*	* Učitelj uporabi eno ali drugo aktivnost.
20. Test	Izvedba kviza s spreminjanjem ozadja, menjava obleke lika glede na pravilnost odgovora.
21. Enostavni Pacman	Spoznavanje s kloniranjem objektov.

Slika 1 Del kode in oder iz učnega scenarija 6 - Kameleon na počitnicah

3.3 Coding4Girls okolje

Kot dodatek k učnim scenarijem je bilo izdelano Coding4Girls okolje, ki je sestavljeno iz platforme za učitelje ter igre za učence. Vsaka aktivnost je razdeljena na 4 korake: 1) Učenec se sprehaja po 3D svetu in 2) igra mini igro, ki je povezana z vsebino. 3) Ko mini igro konča, se prikažejo navodila ter razlaga programerskih konceptov, nato pa sledi 4) izziv v programskem okolju Snap! [25]. Izzive učencem v platformi pripravi učitelj. Odloči se, katere mini igre želi uporabiti in preprosto vpiše vprašanja, za katera želi, da se v mini igri prikažejo. Primer je na sliki 2, kjer se učenci sprehajajo po 3D okolju in glede na izbrani odgovor nadaljujejo svojo pot. Igra služi kot uvod v pogojni stavek »če..., sicer«. Podrobnejša navodila in dostop do platforme so na voljo na spletni strani projekta.
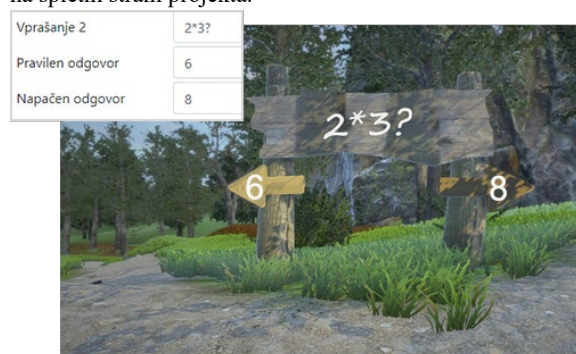
Slika 2 Primer platforme (levo zgoraj) in mini igre

4 METODE IN REZULTATI

V testiranje smo vključili učence, dijake, študente, učitelje in druge strokovnjake s področja računalništva iz sedmih držav: Bolgarije, Grčije, Hrvaške, Italije, Portugalske, Turčije in Slovenije. Testirali smo pripravljene učne scenarije in Coding4Girls okolje. V Sloveniji smo v letošnjem letu izvedli zimsko šolo ter dve delavnici, potekal pa je tudi krožek na osnovni šoli, ki smo ga kasneje premestili v spletno učilnico. V nadaljevanju je v načrtu tudi izvedba izobraževanja za učitelje.

Zbiranje rezultatov poteka s pomočjo začetnega in končnega vprašalnika za učence ter njihovih komentarjev, s pomočjo opazovanj in komentarjev učitelja, svoje komentarje pa so podali tudi drugi strokovnjaki s področja računalništva. Testiranje še poteka, zato bomo lahko rezultate objavili kasneje.

5 ZAKLJUČEK

Rezultati testiranja učnih scenarijev in okolja nam bodo dali odgovor o uspešnosti novo razvitega pristopa učenja s snovanjem iger ter o ustreznosti oblikovanja iger specifične preference deklet.

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Prepoznavanje disleksije s spletno aplikacijo

Screening for dyslexia using web application

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POVZETEK

Disleksija je nevrološko pogojena bralno-napisovalna motnja, ki izvira iz razvojnih posebnosti ali iz posebnosti delovanja osrednjega živčevja. Zanjo je značilna šibka sposobnost branja in črkovanja, ki ni v skladu z drugimi sposobnostmi ter pomanjkljivi avtomatizacija in tekočnost branja in črkovanja. Disleksija ni povezana s stopnjo inteligentnosti, čeprav jo ponavadi zaznamo pri osnovnošolcih prav zaradi učnih težav. Z namenom čim prejšnjega prepoznavanja disleksije pri otrocih smo razvili spletno aplikacijo, ki vsebuje štiri sklope nalog za prepoznavanje različnih simptomov disleksije. Aplikacija je dostopna širši javnosti in v primerjavi s klasičnimi pristopi omogoča hitrejše in bolj množično testiranje; primerna je za testiranje na daljavo, v otroku domačem okolju.

KLJUČNE BESEDE

Disleksija, spletna aplikacija, testiranje

ABSTRACT

Dyslexia is a specific learning disorder, which is neurological in origin. It stems from developmental peculiarities or from specific characteristics of functioning of the central nervous system. It is characterized by poor reading and spelling abilities, which are not in accordance with other abilities, and by impaired automatization and spelling and reading fluency. Dyslexia is not related to the level of intelligence, even though it is precisely the learning difficulties that usually lead to detecting dyslexia in primary school pupils. The purpose of developing this web application, which consists of four tasks, was to provide a freely accessible way of recognising dyslexia in children as early as possible. In comparison with traditional approaches it enables quicker and more extensive testing. In addition to that, it is appropriate for remote testing in an environment familiar to the child.

KEYWORDS

Dyslexia, web application, testing

1 UVOD

Disleksija je kot najpogostejša oblika motenj branja in pisanja ena izmed najbolj raziskanih motenj v skupini specifičnih učnih težav. Zanjo velja, da se razprostirajo na kontinuumu od lažjih do izrazitih ter od kratkotrajnih do tistih, ki trajajo vse življenje. Disleksija je notranje (nevrofiziološko) pogojena bralnonapisovalna težava in izvira iz razvojnih posebnosti ali iz posebnosti delovanja osrednjega živčevja. Vključuje skupino raznolikih, a medsebojno povezanih dejavnikov, ki so del posameznika in vplivajo nanj ter na njegovo delovanje skozi vse življenje [1]. Obstaja kar nekaj vzročnih teorij o disleksiji, a večina raziskovalcev trdi, da je glavni razlog za težave pri disleksiji pomanjkljivo fonološko zavedanje, ki se kaže kot slabša sposobnost prepoznavanja, razlikovanja in manipuliranja z glasovi ter slabša sposobnost naučiti se ujemanja glasov in črk. To poudarjajo tudi številne opredelitve disleksije, ki vsebujejo podobne komponente. Disleksijo opisujejo kot učno težavo ali pa nevrološko motnjo, ki vpliva na razvoj zmožnosti branja in pisanja [2]. Zaradi značilnih težav natančnega in/ali tekočega prepoznavanja besed, šibkega črkovanja in šibke sposobnosti dekodiranja posamezniki težje usvajajo branje, bralno razumevanje in pisanje. Težave pa niso omejene le na branje in črkovanje. Prisotne so tudi težave z vzdrževanjem pozornosti, avtomatizacijo novega znanja ter z groboin finomotoričnimi spretnostmi. Ob nevrološko pogojenih razlikah pa so prisotne tudi kognitivne težave, ki lahko vplivajo na organizacijske spretnosti, na zmožnost računanja ter druge kognitivne in

čustvene sposobnosti. Posamezniki z disleksijo so lahko izjemno nadarjeni in izvirni pri reševanju različnih vrst problemov, pogosto pa imajo tudi dobre vizualne sposobnosti [3]. V populaciji je približno 10 % otrok in mladostnikov z disleksijo. Raziskave navajajo, da je pogostost motnje enaka pri obeh spolih, z nekoliko večjo pogostostjo pri dečkih [4]. Ponavadi disleksijo zaznamo pri osnovnošolskih otrocih zaradi počasnega napredka pri učenju branja in pisanja. Težave se pogosto odražajo v nižjem učnem uspehu in posledično slabši samopodobi, zato je pomembno, da jo čim prej prepoznamo in ustrezno obravnavamo. S tem preprečujemo stigmatizacijo otrok in mladostnikov z disleksijo, njihovo lažje vključevanje v družbo in manj težav v odrasli dobi. V Sloveniji so učenci z blago do zmerno izraženo disleksijo po Zakonu o osnovni šoli [5], deležni prilagojenih metod in oblik poučevanja in preverjanja znanja, tisti z izrazito disleksijo pa so po Zakonu o usmerjanju otrok s posebnimi potrebami [6] deležni intenzivnejših prilagoditev in dodatne strokovne pomoči. V procesu prepoznavanja in diagnostičnega ocenjevanja disleksije, za katerega je potreben multidisciplinarni tim strokovnjakov (psiholog, specialni in rehabilitacijski pedagog, logoped, učitelj), ločimo več stopenj – od detekcije, klasifikacije, načrtovanja pomoči in spremljanja napredovanja do evalvacije [7]. Prvo stopnjo prepoznavanja oseb z disleksijo (detekcija) predstavljajo presejalni preizkusi, katerih namen je prednostna obravnava identificiranih oseb, ki potrebujejo diagnostično ocenjevanje ter informiranje posameznikov o verjetnosti pojava disleksije pri njih [8]. S presejalnimi preizkusi omogočajo potrditev disleksije pri učencih in izvajanje ustrezne obravnave, še preden se pri njih pojavi občutek neuspeha [9]. Motnja se med posamezniki zelo razlikuje; testi za odkrivanje disleksije obsegajo testiranje spomina, črkovanja, razumevanja besedila, bralne naloge, hitro poimenovanje, pozornost idr. Cilj projekta je bil razviti računalniški sistem za zgodnje odkrivanje znakov disleksije in z njo povezanih motenj pri osnovnošolskih otrocih z namenom čimprejšnjega ukrepanja in nudenja ustrezne pomoči v šoli.

1.1 Diagnostično ocenjevanje disleksije

Zgodnja detekcija disleksije je ključnega pomena za zagotavljanje ustreznih oblik pomoči in podpore učencem z disleksijo. Zaradi večdimenzionalne narave motnje se za učinkovito odkrivanje disleksije uporablja več različnih testov, preizkušenj in baterij. Pomembno je dobro presejalno testiranje, ki loči učence s tveganjem za nastanek motenj branja in pisanja od učencev brez tveganja. V slovenskem prostoru imamo kar nekaj preizkusov za ugotavljanje težav na področju branja in pisanja, s katerimi preverjamo različne elemente branja in pisanja (fonološko zavedanje, hitrost in pravilnost branja, avtomatizacijo branja, bralno razumevanje, pisanje po nareku, pisno izražanje): Test v motenosti branja in pisanja oz. Šalijev test [10] – test je le delno standardiziran za populacijo otrok drugega razreda; SNAP – profil ocene posebnih potreb (SNAP ni test v psihometričnem smislu, temveč pripomoček za zbiranje informacij o učencu, ki so pomembne za ugotavljanje morebitnih težav pri določeni spretnosti.) [11]; Enominutni test glasnega branja [12]; Preizkus bralnega razumevanja [13]; Bralni test [14] - (test je standardiziran merski instrument, ki ugotavlja splošno bralno zmožnost ob koncu prvega triletja); Ocenjevalna shema bralnih zmožnosti učencev 1.–3. razreda: OSBZ [15] - (test je standardiziran merski instrument in podatki, zbrani z ocenjevalno shemo, dajo informacijo, katere bralne zmožnosti je učenec že uspel razviti).; Preizkus tekočnosti branja po modelu, ki temelji na kurikulumu za 2., 3. in 4. razred [16], Test glasovnega zavedanja [17]. V svetu je ja IKT postala glavno sredstvo za tako za odkrivanje disleksije s presejalnimi testi kot tudi za intervencije, ki so prilagojene učnimi težavami in potrebami otrok in mladostnikov [18]. Uporaba IKT predstavlja izjemen dejavnik za izboljšanje običajnih metod odkrivanja disleksije, sproža pa tudi raziskovanja novih perspektiv, kar zadeva identifikacijo posameznikov z disleksijo [18]. Rooms (2000) izpostavlja potencialne koristi uporabe IKT za osnovnošolske otroke z disleksijo in poudaril, da je lahko dostopna in na voljo, ne da bi se učenci z disleksijo počutili drugače ali izključeni, vključuje veččutne pristope (slušni, ustni, vizualni, kinestetični) ter vključiti sisteme za izboljšanje težav otrok z disleksijo [19]. Diagnostično ocenjevanje s pomočjo IKT omogoča tako psihologom kot drugim strokovnim delavcem, da na enostaven in hiter način izvedejo pregled kognitivnih sposobnosti in drugih vitalnih spretnosti [20]. Interaktivna multimedija, navidezna okolja, nevronske mreže, programska oprema, mehka logika, tehnike, ki temeljijo na igrah, in mobilne aplikacije pomagajo in povečajo učinkovitost običajnih postopkov presejanja disleksije, in vsak od njih ima sofisticirane funkcije, ki olajšajo postopke ocenjevanja [28]. V svetu je že dokaj dobro uveljavljena uporaba IKT za prepoznavanje učencev z disleksijo, saj je učiteljem na voljo več različnih programov, od presejalne programske opreme do podrobnejših računalniških ocenjevalnih baterij. Večina teh računalniških programov za odkrivanje disleksije se opira na ocenjevanje branja in črkovanja, skupaj s kognitivnimi sposobnostmi, kot sta fonološko zavedanje in verbalno pomnjenje, ki podpirajo razvoj pismenosti in ki so na splošno dobri napovedniki disleksije [21]. Tako klasični testi, kot aplikacija imajo svoje prednosti in slabosti. Prednost klasičnih testov je, da je pri njih prisoten testator. Oseba, ki test izvaja, hkrati tudi opazuje otroka, sproti preverja njegovo razumevanje, prilagaja navodila, da jih otrok razume, opazuje otrokovo pozornost, morebitno utrujenost. Hkrati lahko oseba otroka spodbuja, mu nudi oporo. Slabost klasičnih preizkusov pa je predvsem časovna zamudnost, ki jo lahko odpravimo s pomočjo aplikacije ter izpostavljenost posameznika. Aplikacijo lahko rešuje več otrok naenkrat, tako lahko v kratkem časovnem obdobju ocenimo veliko otrok in presejemo rizične otroke od nerizičnih. Aplikacija je dobra tudi z motivacijskega vidika, saj je bolj podobna računalniški igri, kot ocenjevanju.

2 METODOLOGIJA

Sledili smo protokolu razvoja psiholoških testov po mednarodnih smernicah (npr.različne smernice International Test Commission) in ameriških standardih za pedagoške in psihološke pripomočke [22]. Pregledali smo vire, ki usmerjajo razvijalce računalniško ali internetnih psiholoških testov. Pri našem delu smo prehodili šele prve faze razvoja: pregledali teoretično ozadje disleksije, se odločili, komu bo aplikacija namenjena in opredelili teoretično strukturo testov. Izvedli smo tudi nekaj začetnih meritev.

Kot velevajo standardi, so pri razvoju sodelovali strokovnjaki z različnih področij: za disleksijo, razvoj psiholoških pripomočkov in računalničarji.

Odločili smo se, da bo aplikacija namenjena 8-letnikom. Pripravljena bo tako, da jo bodo lahko izpolnjevali praktično sami. Na začetku bo potrebno dovoljenje odrasle osebe – starša ali skrbnika, ki bo imel dovolj navodil za pomoč otroku, če jo bo ta potreboval.

Preizkus je sestavljen iz štirih sklopov nalog, ki zahtevajo rabo kognitivnih procesov, ključnih za uspešno branje in pisanje: fonološko zavedanje, bralno razumevanje, kratkoročni spomin in koncept zaporedja. Za vsak test smo izdelali naloge in navodila. Predvsem smo se posvečali nazorni in jasni predstavitvi načina reševanja otroku; preko različnih vaj preverjamo, da otrok dejansko razume nalogo, saj je to ključno za veljavnost meritve.

Fonološko zavedanje obsega zavedanje, da je govor sestavljen iz besed, besede pa iz različnih zlogov in glasov, kar posledično posamezniku omogoča povezovanje črk s pripadajočimi glasovi [23]. V klasičnih preizkusih tipa papir-svinčnik nalogo ponavadi izvajamo tako, da testator prebere besedo, iz katere je potrebno izločiti določen glas ali pa določiti prvi ali zadnji glas v njej, testiranec pa ustno poda odgovor. Za namene spletne aplikacije smo način odgovarjanja prilagodili, saj nismo imeli dostopa do tehnologije, ki bi omogočala zanesljivo avtomatsko prepoznavanje govora, pisno podajanje odgovorov pa bi prineslo še kopico drugih težav, ki bi lahko prispevale k manjši veljavnosti preizkusa, zato smo se odločili za različico postavk izbirnega tipa. Otroku se zaporedoma predvajajo različni možni odgovori, za vsakega pa mora označiti, ali je pravilen ali napačen. Besede, ki smo jih vključili v postavke, so štiričrkovne besede z enim soglasniškim sklopom. Soglasniški sklop se v enakomernih deležih besed pojavi na začetku, v sredini ali na koncu besede, glas, ki ga je potrebno izločiti je v polovici besed prvi v soglasniškem sklopu, v polovici besed pa drugi. Polovica besed je izmišljenih, polovica pa ne.

Bralno razumevanje zahteva rabo višjih miselnih procesov, kot sta delovni spomin in inhibicija, okrnjeno bralno razumevanje pri otrocih z disleksijo pa dosledno dokazujejo izsledki številnih raziskav [24, 25, 26]. V nalogo smo na podlagi vnaprej izbranih kriterijev, ki pri otrocih napovedujejo kasnejšo pismenost in sposobnost branja, in upoštevanja tekočnosti in hitrosti branja otrok z disleksijo vključili štiri besedila. Besedila se razlikujejo po dolžini (krajše in daljše) in po zahtevnosti (lažje in zahtevnejše), predstavljena pa so v obliki zgodbe s temami iz vsakodnevnega življenja. Otrok po prebranem besedilu odgovarja na dihotomne postavke tipa da/ne in postavke izbirnega tipa.

Številni posamezniki z disleksijo izkazujejo primanjkljaj v kratkoročnem spominu in imajo težave z zapomnitvijo informacij, ki niso smiselno povezane [23]. Izsledki raziskav so najbolj dosledni glede primanjkljajev v verbalni komponenti kratkoročnega in delovnega spomina [27, 28, 29, 30, 31, 32, 33]. Naloga, ki smo jo oblikovali, predstavlja različico klasične naloge preverjanja obsega kratkoročnega spomina s slušnimi verbalnimi dražljaji (besedami). Da bi bila naloga bolj privlačna za otroke, smo jo postavili v kontekst hranjenja živali v živalskem vrtu. V nalogi mora otrok s kliki na sličice živali nahraniti živali v enakem vrstnem redu, kot so naštete v predhodno slišanem zaporedju. V nalogi se pojavlja 16 živali. Izbrali smo takšne, ki naj bi bile otroku poznane in katerih imena niso predolga. Najdaljša dolžina imena živali je 6 črk, največje število zlogov v imenu pa tri.

Otroci z disleksijo imajo pogosto težave z razumevanjem koncepta zaporedja in posledičnosti, kar se kaže v težavah pri urejanju elementov v zaporedje, priklicu abecede, vrstnega reda dni v tednu in mesecev. Naloga, ki smo jo oblikovali, preverja otrokovo zmožnost urejanja števil, mesecev in dni v tednu v ustrezno zaporedje. Postavke se stopnjujejo po težavnosti glede na to, ali je elemente potrebno urediti v pravilnem ali obratnem vrstnem redu.

Pilotna raziskava bo vključevala osemletne otroke, od tega 10 s potrjeno disleksijo in 20 brez. Glavna raziskava bo vključevala 50 do 100 otrok s potrjeno disleksijo, 100 brez disleksije, 100 s sumom na disleksijo. Vključitveni kriterij za otroke z disleksijo je odločba Zavoda RS za šolstvo, za otroke s sumom na disleksijo subjektivna pritožba brez odločbe, za otroke brez disleksije pa rezultat nad 20. percentilom na Ocenjevalni shemi bralnih zmožnosti za učence od 1. do 3. razreda [14]. Izključitveni kriteriji za udeležence so materni jezik, ki ni slovenščina, primarne vizualne ali slušne okvare, primanjkljaji na področju inteligentnosti ali katerekoli druge duševne in nevrološke motnje.

V splošnem je struktura sklopov nalog enotna: vsak sklop je sestavljen iz navodila, prikaza reševanja, vaje in postavk, ki se točkujejo. Pri oblikovanju navodil smo bili posebno pozorni, da niso predolga, da vključujejo preproste in kratke stavčne strukture, a da hkrati zajamejo vse informacije, ki so potrebne za jasnost zahtev naloge. Prikaz reševanja služi seznanitvi z nalogo, vaje pa preverjanju, da otrok res razume, kaj se od njega pričakuje. Vaje so oblikovane tako, da v primeru napačnega odgovora pravilni začne utripati ali se poveča, kar služi kot namig. Pri vsakem sklopu ima otrok pred reševanjem dela, ki se točkuje, možnost večkratnega poslušanja navodil in reševanja vaj. Uporabniški vmesnik smo oblikovali tako, da je privlačen za otroke, da posamičen prikaz ne vsebuje nepotrebnih in motečih dražljajev ter preveč elementov naenkrat, da se informacije prikazujejo zaporedoma in da je barvni kontrast med besedilom in ozadjem ustrezen in nemoteč v skladu s specifičnimi lastnostmi vidnega procesiranja otrok z disleksijo.

3 NALOGE

3.1 Preverjanje fonološkega zavedanja

Splošna oblika postavk je: »Beseda je x, x. Kaj dobiš, ko rečeš x brez y?«, pri čemer je x beseda, iz katere je treba izločiti glas y. Pri vsaki postavki se zaporedoma zaslišijo trije možni odgovori, testiranec pa mora za vsakega določiti, ali je pravilen ali napačen. Ko določen odgovor označi kot pravilnega, se naloga premakne na naslednjo postavko, za vse ostale odgovore pa se šteje, kot da jih je označil za napačne. Med podajanjem odgovorov pri določeni postavki lahko s pritiskom na ikono zvočnika na ekranu ponovno posluša vprašanje.

Po slišanem in izpisanem navodilu sledi prikaz reševanja ki je sestavljen iz dveh delov. V prvem ponazorimo sam proces izločanja glasu iz besede. Najprej se predvaja zvočni posnetek, npr.: »Beseda je dres, dres. Kaj dobiš, ko rečeš dres brez d?«. Nato se prikaže animacija, kjer iz besede dres izgine črka d, nato pa se predvaja zvočni posnetek: »Pravilni odgovor je res.« V drugem delu ponazorimo način podajanja odgovora za isti primer. Ponovno se zasliši beseda in vprašanje. Nato se zasliši prvi možni odgovor des, prikažeta se dva gumba, zelena kljukica in rdeč križec, kurzor pa se premakne na križec in ga klikne. Nato se sliši

drug možni odgovor, res, ki je pravilen, ponovno se prikažeta oba gumba, kurzor pa se premakne na ikono zvočnika in še enkrat posluša vprašanje, nato pa pritisne kljukico. Zasliši se: »Res je pravilni odgovor, zato klikneš kljukico.« Po končanem prikazu reševanja ima posameznik možnost ponovno poslušati navodila ali pa iti naprej na vajo. Primer, ki smo ga izbrali za prikaz reševanja, je lahek, saj je potrebno izločiti prvi glas v besedi, vendar je podoben testnim postavkam.

Primeri, ki smo jih izbrali za vajo, so beseda ma brez m, on brez n in bam brez b. Izbrali smo primere, ki so lažji kot testne postavke, saj so krajši in ne vsebujejo soglasniškega sklopa, vedno pa se izloči prvi ali zadnji glas v besedi. Služijo ogrevanju, seznanitvi z nalogo ter preverjanju osnovnega razumevanja zahtev naloge. Za vsako besedo oz. vprašanje, ki se nanjo nanaša, sta podana dva možna odgovora, pri čemer je vedno prvi napačen in drugi pravilen. Če otrok posamezen odgovor neustrezno označi kot pravilnega ali nepravilnega se zasliši in izpiše opozorilo: »To ni pravilni odgovor. Poslušaj še enkrat.« Ponovno se zasliši vprašanje, le da se sedaj kljukica in križec prikažeta tako, da se ustrezni gumb poveča, kar otroku služi kot namig. Ko otrok pri posameznem možnem odgovoru pritisne ustrezni gumb, se naloga nadaljuje z zvočnim posnetkom naslednjega možnega odgovora oz. naslednje vaje. Po tretji vaji ima otrok možnost ponoviti vajo ali nadaljevati na testne postavke.

Vsaka postavka, ki se točkuje, ima tri možne odgovore, pravilni odgovor pa je v enakomernih deležih postavk prvi, drugi ali tretji izmed podanih. Vrstni red postavk oz. besed je naključen.
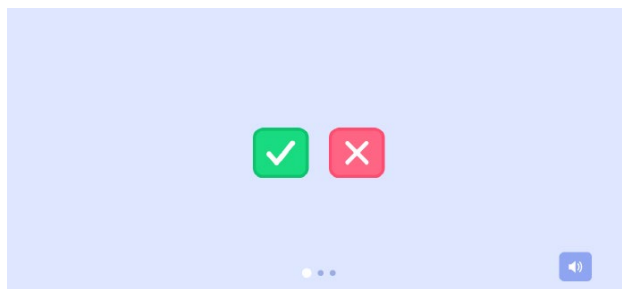
Figure 1: Naloga s fonološkim zavedanjem.

3.2 Branje in bralno razumevanje

V nalogi se na zaslonu najprej prikaže besedilo nato pa še vprašanja, ki preverjajo razumevanje tega besedila, z odgovori, med katerimi testiranec izbira. Besedilo se prikaže na levi polovici zaslona, testiranec pa, ko ga je prebral, sproži prikaz prvega vprašanja s klikom na gumb. Takrat se zabeleži tudi čas, ki ga je porabil za branje besedila in klik na gumb. Naloga dopušča tudi možnost vključitve naprave za sledenje pogledu, s katero bi bilo preverjanje hitrosti branja natančnejše, hkrati pa bi lahko bralce razvrščali v skupine po podobnosti vzorcev branja na podlagi strojnega učenja, kar bi pripomoglo pri odkrivanju znakov disleksije. Vprašanja se prikazujejo posamezno na desni polovici zaslona, pri čemer besedilo ves čas ostane vidno. Pod vsakim vprašanjem so prikazani vsi možni odgovori, od katerih je vsakič pravilen le eden, tako vprašanja kot vsi odgovori pa so opremljeni še z zvočnim posnetkom, v katerem so prebrani. Ko testiranec odgovori na prvo vrpašanje, se prikaže naslednje itn. do zadnjega. Za preverjanje smo pripravili 4 besedila, od katerih sta dve krajši – 35 besed, dve pa daljši – 80 besed. Ti dolžini smo

izbrali, saj so za slovenščino že določene norme hitrosti branja pri osmih letih za dolžino besedila 80 besed. Pri obeh dolžinah besedil je eno besedilo manj, drugo bolj zahtevno. Kriteriji, ki smo jih upoštevali pri določanju zahtevnosti pri obeh dolžinah besedil, so bili: koliko je povedi, ali so povedi eno- ali večstavčne, koliko je stavkov v večstavčnih povedih, koliko je dolgih besed nad s tremi zlogi ali več, koliko besed vsebuje soglasniške sklope, ali je sklop v besedi eden ali jih je več in koliko je v sklopu soglasnikov. Karakteristike oblikovanih besedil so prikazane. Posamezna vprašanja so pri vseh besedilih enakega tipa, prilagojena so le toliko, da ustrezajo vsebini določenega besedila. Prvo vprašanje je slikovno. Pri njem testiranci izberejo sličico, ki se najbolj ujema z vsebino besedila. Izbrani motivi se skladajo s širšo tematiko besedila, a je glede na besedilo očitno ustrezen samo en. Drugo vprašanje je podobno prvemu, saj sprašuje, o čem govori besedilo, le da so tokrat odgovori besedilni. Med njimi je eden od napačnih odgovorov blizu pravilnemu, eden pa je popolnoma nepovezan z vsebino besedila. Tretje vprašanje podrobneje sprašuje, kaj je počel subjekt v besedilu, pri četrtem in petem vprašanju pa testiranci ocenjujejo pravilnost oz. napačnost trditve.

3.3 Kratkoročni spomin

Splošna oblika postavke je: »Nahraniti moraš x.«, kjer je x zaporedje živali. Živali so prebrane v ritmu ena žival na sekundo. Zaporedje živali je podano v obliki zvočnega posnetka ob praznem ekranu, nato pa se na pojavi 6 sličic različnih živali, enakomerno razporejenih čez ekran v dve vrsti po 3. Živali, ki so prikazane, so izbrane naključno, vendar tako, da nikoli nista prikazani dve ali več vizualno ali semantično podobni živali hkrati. Otrok nato nahrani živali z zaporednimi kliki na sličice živali v istem vrstnem redu, kot jih je slišal. Ob kliku na žival se zasliši zvok hranjenja živali. Ko zaključi s hranjenjem, pritisne na puščico, živali izginejo in zasliši se novo zaporedje živali. Med klikom na puščico naprej in začetkom predvajanja zvočnega posnetka naslednjega zaporedja je razmak treh sekund.

Figure 2: Naloga z branjem in bralnim razumevanjem.

Naloga je sestavljena iz navodil, prikaza reševanja, treh vaj in 15 postavk. Prikaz reševanja je sestavljen iz dveh delov. Prvi del je namenjen seznanitvi z živalmi, ki se bodo pojavljale v nalogi, s čimer zagotovimo, da napačen odgovor ni posledica neustreznega prepoznavanja prikazanih živali. Na ekranu se ena za drugo prikažejo sličice vseh 16 živali. Zraven vsake prikazane živali se predvaja zvok njenega tipičnega oglašanja, ime živali se pod sličico tudi izpiše, prikaz pa je dolg 3 sekunde. V drugem delu otroka seznanimo z načinom podajanja odgovora. Zasliši se zvočni posnetek: »Nahrani slona, kravo.« Nato se na ekranu

pojavijo sličice, kurzor klikne najprej na slona in nato na kravo. Nato se zasliši in izpiše: »Ko zaključiš s hranjenjem živali, klikni na puščico.« Kurzor klikne puščico. Primer, ki smo ga izbrali, je zaporedje dolžine dveh enot, ki je tudi najkrajša dolžina, ki se pojavi v postavkah. Otrok ima po prikazu reševanja možnost še enkrat poslušati navodila ali iti naprej na vajo.

Pri prvi vaji je potrebno nahraniti sovo, na ekranu pa se pri tej vaji pojavi le ena žival namesto šestih. Namenjena je seznanitvi s potekom reševanja. Pri drugi vaji mora otrok nahraniti leva in miš, gre za dve kratki besedi, ena dvozložna in ena enozložna, pri tretji pa opico in zajca, ta vaja je težja, saj sta besedi daljši kot pri drugi vaji, prav tako sta obe dvozložni. Pri vaji otrok dobi povratno informacijo v slušni in pisni obliki glede na to, ali je rešil pravilno ali napačno. Pri napačnih odgovorih se izpišejo različne povratne informacije glede na tip napake: ali je nahranil preveč ali premalo živali, koliko živali preveč je nahranil, ali je nahranil živali, ki so naštete v zaporedju, vendar v napačnem zaporedju, ali je nahranil zgolj nekatere živali ali pa nobene živali iz zaporedja, ali je isto žival nahranil večkrat. V vsakem primeru po povratni informaciji živali ostanejo na ekranu, še enkrat se zasliši zaporedje, nato pa se najprej poveča prva žival iz zaporedja, nato pa še druga, kar služi kot namig. Živali, ki niso naštete v zaporedju, v tej točki ne more več klikniti. Ko reši pravilno, se naloga premakne na naslednjo vajo.

Po tretji vaji ima otrok možnost ponoviti vajo ali iti na testni del. V testnem delu se stopnjuje dolžina zaporedja živali. Najkrajša dolžina je dve enoti, najdaljša pa šest enot, pri vsaki dolžini pa so tri različna zaporedja. Pred vsakim zaporedjem, ki je za eno enoto daljše od prehodnega, se predvaja zvočni posnetek: »Zdaj moraš nahraniti eno žival več.« Živali se pojavljajo preko vseh zaporedij v enakomernih deležih, v posameznem zaporedju pa se ista žival ne pojavi več kot enkrat. Zahtevnost postavk se, poleg dolžine zaporedja, stopnjuje tudi preko dolžine imena živali, kjer je preko zaporedij znotraj ene dolžine in preko različnih dolžin vključenih čedalje več živali s čedalje daljšimi imeni.
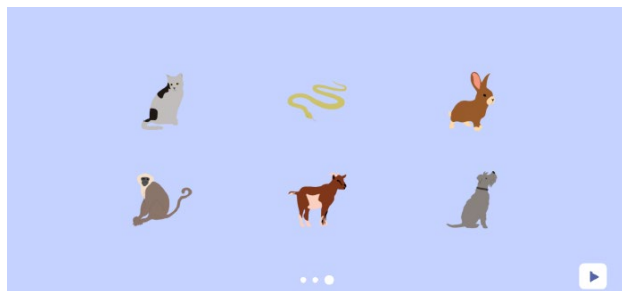
Figure 3: Naloga s kratkoročnim spominom.

3.4 Zaporedja

V nalogi se na zaslonu v pomešanem vrstnem redu prikažejo elementi, testiranec pa jih mora pravilno razvrstiti, s čimer smo želeli preveriti sposobnost razporejanja v določen vrstni red. Za elemente smo izbrali besede za dneve in mesece ter števila. Pred prikazom elementov se na zaslonu izpiše in hkrati zasliši prebrano navodilo, v katero smer je treba razporejati, npr. »Razporedi dneve v tednu od četrtka nazaj.« ali »Razporedi števila od največjega do najmanjšega.« Po podanem navodilu se

na zaslonu eden naenkrat prikazujejo elementi, pri tem pa je vsak opremljen z zvočnim posnetkov prebrane besede ali števke. Vrstni red prikaza elementov je določen in enak za vse testirance. Ko so prikazani vsi elementi, jih testiranec razvršča tako, da z miško klikne nanje v pravem vrstnem redu, pri čemer lahko svoj odgovor pred končno oddajo tudi popravlja. Naloga ima 8 primerov, od katerih so pri 4 elementi sekvence besede – dvakrat so uporabljene besede za dneve, dvakrat pa za mesece – pri 4 pa so elementi števila. V dveh primerih razporeja testiranec besede za dneve in mesece v pravi vrstni red, v dveh pa v obratni. Enako je pri številih, le da pri njih v pravi vrstni red razporeja dve sekvenci, prav tako dve pa v obratni. Kot pravilni odgovor štejemo, če so pravilno razvrščeni vsi elementi in gre vrstni red v pravo smer. V nalogi si števila ne sledijo po vrsti, v korakih po dve (v dveh primerih, enkrat pri razporejanju od najmanjšega do največjega in enkrat pri razporejanju od največjega do najmanjšega), v korakih po dve pri vsakem drugem številu (v enem primeru) ali v različnih korakih (v enem primeru). Otrok odgovorov ne poda ustno, saj tehnologija prepoznave govora za slovenščino še ni dovolj razvita, da bi jo lahko uporabili pri testiranju z avtomatskim preverjanjem rezultatov.

Primer naloge:
Navodilo: "Razporedi dneve v tednu od torka naprej."
torek, sreda, četrtek, petek, sobota

4 APLIKACIJA

Razvili smo tako zaledni del aplikacije kot njen uporabniški vmesnik. Aplikacija deluje v okviru strežniškega sistema na Fakulteti za računalništvo in informatiko; na ta način smo zagotovili ustrezne zmogljivosti aplikacije ob morebitnem hkratnem večjem številu uporabnikov ter za varnost podatkov, ki jih aplikacija beleži. Vsaka naloga vsebuje pisna in slušna navodila, ki so sicer skrbno pripravljena tako, da bi jih morali razumeti tudi otroci, vseeno pa računamo na pomoč odraslih, če otrok navodil ne bi razumel. Navodilom sledi kratek demo – predstavitev reševanja, pri kateri otrok dobi nazorno vizualno predstavo o nalogi, ki jo bo reševal. Sledi sklop vaj, med katerimi se testiranje ne izvaja; vaje so namenjene zgolj preverjanju otrokovega dojemanja navodil – ali je otrok razumel, kaj mora pri nalogi delati. Med vajami lahko kadarkoli ponovno pogledajo tudi navodila.

Figure 4: Naloga z zaporedji.

Zaledni del aplikacije smo razvili s pomočjo ogrodja Django, za bazo smo uporabili PostgreSQL, za uporabniški vmesnik pa programski jezik Javascript. Ob vpisu starosti na začetni strani se

v bazi ustvari nov zapis za uporabnika. Vsakič, ko uporabnik reši nalogo, se zanj ustvari nov zapis z rešitvijo, časom pričetka reševanja, trajanjem reševanja in morebitnimi drugimi podatki, npr. kolikokrat je popravil rešitev, če je bilo popravljanje rešitev možno.

Ker smo aplikacijo razvili v času izbruha pandemije covid-19, je nismo mogli testirati na osnovnih šolah. Odločili smo se za poskusno testiranje pri otrocih, ki smo jih sami poznali. Tako je aplikacijo preizkusilo 9 otrok, a smo s pomočjo njihovega reševanja ugotovili pomanjkljivosti in nejasnosti v aplikaciji, tako da smo jo lahko izpopolnili. Testiranje večjega števila otrok nameravamo izvesti v šolskem letu 2020/21.

5 ZAKLJUČEK

S pomočjo aplikacije za presejalno testiranje disleksije bomo lahko hitreje in bolj točno opredelili skupino otrok, ki ima povišano tveganje za razvoj disleksije in potrebuje dodatno diagnostiko. Pričakujemo, da se bo s tem za otroke z disleksijo pomembno skrajšal čas čakanja na učno pomoč. V Sloveniji podobnih testov za prepoznavanje disleksije v elektronski obliki še ni; obstajajo klasična testiranja otrok ob prisotnosti strokovnjaka, vendar zaradi daljših čakalnih dob in težje dostopnosti (v primerjavi s spletno aplikacijo) obravnava otroka zamuja, s čimer izgubljamo dragocen čas za pomoč otrokom z disleksijo. Potrebo po elektronskem testiranju je prepoznala tudi stroka, ki si ob aplikaciji za testiranje želi še razvoja ločene aplikacije z vajami za tiste, pri katerih bi ugotovili znake disleksije. Vaje bi lahko otroci tako delali v domačem okolju, prek spleta.

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INFORMATION SOCIETY – IS 2020
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Interakcija človek-računalnik v informacijski družbi
Human-Computer Interaction in Information Society

Uredili / Edited by

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http://is.ijs.si

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PREDGOVOR

Interakcija človek–računalnik v informacijski družbi je konferenca, ki jo organizira Slovenska skupnost za
proučevanje interakcije človek–računalnik. Namen konference je zbrati raziskovalce, strokovne delavce in študente s področja in ponuditi možnost izmenjave izkušenj in raziskovalnih rezultatov, kakor tudi navezave stikov za bodoča   sodelovanja   .

Tokratna, peta reinkarnacija konference se že drugič odvija pod okriljem SIGCHI poglavja ACM Chapter Bled, ki je nastalo tudi kot posledica prejšnjih konferenc. O rasti HCI skupnosti v regiji pa priča tudi vse večje število prispevkov, ki prihajajo z vseh večjih visokošolskih zavodov v Sloveniji.

Teme, ki jih konferenca pokriva   segajo od bolj uveljavljenih, kot so vizualizacija, snovanje grafičnih in uporabniških vmesnikov, ki temeljijo na govoru, personalizacija in prilagajanje interakcije uporabnikom, pa do virtualne in nadgrajene resničnosti ter   uporabniških vmesnikih v turizmu, umetnosti in e-učenju.

FOREWORD

Human-computer interaction in information society is a conference organized by the Slovenian HCI community. The purpose of the conference is to gather researchers, practitioners and students in the field and offer the opportunity to exchange experiences and research results, as well as to establish contacts for future cooperations.

This year's fifth reincarnation of the conference is, for the second time, organized by the SIGCHI Chapter ACM Chapter Bled, which   has been established also   as a result of previous conferences. The growth of the HCI community in the region is   witnessed by the doubled number of contributions coming from all major higher education institutions in Slovenia.

The topics covered by the conference range from the more established ones, such as visualization and design of graphical and audio user interfaces, personalisation and interaction adaptation, to virtual and augmented reality, and the ap   plication of user   interfaces in tourism, arts, and e-learning.

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Investigating the Role of Context and Personality in Mobile Advertising

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ABSTRACT

More than three billion smartphones carried by their users at virtually all times, represent an unprecedented platform for in-situ advertisement delivery. While recent efforts in data analysis and machine learning led to significant advances in the way relevant content is selected to be shown to a user, thorough investigation on how the content should be displayed to a mobile user is yet to be conducted. In this work we present our preliminary research on the role of the context in which an advertisement is consumed and the personality of a user consuming it on the perception of the ad content. We conduct a 7-week study with 14 mobile users who were exposed to both video and picture ads. Through mobile sensing and experience sampling we capture the information on the context in which the ad was seen, the user's attitude towards the ad, as well as the user's personality traits. Statistical analysis based on mixed-effect modelling demonstrates that personality traits play an important role in ad perception, as does the ad type, with picture ads being preferred to video ads, while the effect of the context on ad perception appears to be negligible.

CCS CONCEPTS

• **Human-centered computing** → **Interaction techniques**; **Ubiquitous and mobile devices**; Empirical studies in ubiquitous and mobile computing.

KEYWORDS

mobile advertising, multilevel models, ubiquitous computing

1 INTRODUCTION AND BACKGROUND

Tremendous amounts of digital traces, just-in-time sensor information, and the advances in data processing have resulted in major shifts in how the advertising is performed.

Machine learning and recommender systems are at the core of modern advertising solutions [9]. The selection of the ad to be show to the user benefits from the history of purchases, information on the similarity among users, but also on the information about a user's personality [6].

Moving to the mobile domain, contextual information, such as location may impact the relevance of an ad [2]. The context, that can be sensed by a smartphone, such as a user's location, his physical activity, time of day, and other factors, can also be used to determine the suitability of a moment for information delivery [7].

While the previous work focuses on the content or the timing of the ad delivery, the type of the ad, to the best of our knowledge, has not been examined in the mobile domain. Nevertheless, the type of the ad, whether it is a picture, a short or a long video, or perhaps an interactive content (e.g. a short game) is an important parameter that influences the overall design of an ad, the platforms at which the ad can be shown, advertisement budget, etc. In this paper we focus on the perception of an ad type in mobile computing and pose the following research question: *Can the contextual information collected by the mobile phone sensors and the information on a user's personality predict a user's perception of different types of mobile ads?*

2 METHODOLOGY

To obtain ecologically valid data on mobile ad perception in different contexts we developed a data collection mobile application that serves ads, captures a user's attitudes towards the displayed ads, and collects sensor data pertaining to the context of use. In the rest of the section we present the details of our app.

Mobile Application

We implemented a full-fledged mobile app that caters to the need of our target users – students at our University. The application was built for the Android platform and serves as a utility tool allowing its users to: obtain information on nearby restaurants providing subsidised student meals, get real-time public transport timetables, record or share important student notes, retrieve latest student related news

Figure 1: Data collection app: one of the functionalities (left), advertisement (center) and an ESM questionnaire (right).

feeds, save and access their most needed school gadgets, and organise their class schedules (Figure 1 left).

Mobile ads. Mobile ads come in different flavours ranging from simple picture-based ads, over video ads, to more interactive game-like ads. We opted to investigate the two most frequent types of ads in our study – pictures and videos. We further divide the video ads into two groups – short videos, with the length of 30 seconds or less, and long videos with the length between 30 and 80 seconds. From each of the three groups – pictures, short videos, and long videos – we gathered 31 different publicly available ads and pre-loaded them on our server. After five actions that a user makes within our app, a request is made to our back-end system which responds with a random ad of a randomly chosen category. Simultaneously, we activate mobile phone's sensors and capture the user's context, including the physical activity (through Android's Google Activity Recognition functionality), location (clustered as *work*, *home*, or *other*, according to the method described in [7]), screen brightness, battery level, time of day, and the Internet connectivity type.

Experience sampling method (ESM) questionnaires. ESM is commonly used to gather the participants own thoughts, emotions, behaviour, etc [3]. In our case it provided us with feedback regarding the participants assessment of overall ad suitability. With the included questionnaire we also wanted to measure the interaction level between the user and the displayed ad. Thus, the questionnaire consisted of following questions: what was shown on the ad, which brand/trademark was advertised, and was the ad shown in an appropriate form. The first two questions were used to assess whether the user

was engaged with the ad. The last question focused on the appropriateness of the displayed ad. The answers are recorded with five-level Likert scales. Figure 1 represents the data collecting workflow, where a user made an action, which led to the ad being displayed, followed by the ESM questionnaire.

Personality test. Previous research demonstrates that personality traits have a moderate effect on a user's attitude towards advertisement [1]. Therefore, we included the BFI-10 personality test [8] as a part of our app. The test includes ten questions about a user's traits answered on a seven-point Likert scale. The processed BFI-10 data, assessing a user's personality along the five dimensions (extraversion, agreeableness, openness, conscientiousness, and neuroticism), was further compared to the statistics calculated on a larger population set in order to extract the percentiles to which the participants personality trait scores belong [8].

Data collection campaign

Our data collection campaign lasted for seven weeks in spring 2020 and included 14 participants who in total viewed 994 ads, out of which 501 they labeled, i.e. an ESM questionnaire was completed immediately after the ad was viewed. The distribution of labeled and unlabeled ad types is roughly even. The viewing was reasonably evenly distributed among users, with the least active participant contributing 2.4% and the most active participant contribution 12.6% of the data. In our study we included 12 picture ads, 9 short video ads, and 10 long video ads. The ads were randomly shown both within and among users, i.e. each two users saw different ads where a participant shown a picture ad from a specific brand

need not have seen a video ad from the same trademark. The majority of viewed ads, that are labeled, were pictures (40.5%), followed by short videos (34.7%). The least amount of user feedback was from long videos (24.8%). The average score (questionnaire answers ranging from "Strongly disagree" to "Strongly agree" were transformed to the integer [-2, 2] scale) over all ads was 0.377, yet it differs across the ad types. Labeled pictures had an average score of 0.695, short videos 0.253, and long videos 0.032.

3 MOBILE AD PERCEPTION MODELLING

Our data collection study elaborated in Section 2 has resulted in a heterogeneous dataset with an uneven number of datapoints across users, across contextual characteristics, and ad types. The natural organisation of our data into groups makes multilevel modelling-based analysis particularly appropriate. Such models generalise the linear regression in a manner that allows that the effect of a group (e.g. a particular user, a personality type, etc.) is disentangled from the effect of predictors, such as contextual variables [4] [5].

With hierarchical modeling we gradually increase the model complexity by including different parameters as a part of fixed or random effects. At each step we need to compare our new model to the previous one. This is done by preforming a chi-squared test checking if the residual sum of squares of the new model is statistically significantly smaller than that of the old model. To further verify which model is better we calculated the AIC (Akaike information criterion) and BIC (Bayesian Information Criterion) metrics, where smaller values indicate a better model, since the relative amount of information lost is lower.

In this section we present the results of multilevel modelling with two models constructed on the labeled data in order to investigate the impact of different parameters on the ad perception – a model where the *user ID* is the grouping variable and a model where the user's *personality* is the grouping variable. We then use both labeled and unlabeled data in a semi-supervised learning fashion to construct our final predictive model rooted in users' personalities.

User ID-based model

The basic user model includes merely the participants' IDs as the grouping variable. From there on we gradually increase the model complexity by separately adding context-based parameters. We experiment with the inclusion of the physical activity, location, screen brightness, battery level, time of day, and the internet connectivity type information in our model, and find that none of the contextual variables have a statistically significant influence on whether a user marks an ad as appropriate or not. In addition, the comparison of the basic model with the context-based ones reveals that the AIC and BIC metrics increase, and the p-value of the chi-squared

model comparison remains above the 0.05 threshold, again indicating the superiority of the basic model.

Since the context is shown to be irrelevant, we focus on the content and the type-based models. With the inclusion of ad type, as a part of fixed effects, we were able to build a model that preforms better then the basic one. We suspect that different users score different ad types in different manners, thus we included the type parameter as a random slope. Metrics AIC, BIC show a significant decrease, indicating that the new model preforms better than the previous one. The analysis of the model reveals that picture ads receive a predominantly positive score, short videos neutral-negative, and long videos very negative score. Slope coefficients for ad type were also found to be varying within users. We further experiment with content-based models, where the each particular ad is encoded as its own content category.The AIC, BIC, and chi-square-based comparison indicate that the content has a statistically significant impact on ad scoring. With both content and ad type being relevant we further investigate whether it is possible to combine both models and also include the ad viewing duration as a parameter. Indeed, our best preforming model includes *the duration of ad watching*, and cross-level *interaction of ad content and ad type* as fixed effects, and *ad type* as the random effect. The conditional R^2 metric of such a model is 0.455 whilst the marginal R^2 is 0.204 indicating a reasonably good fit.

Personality-based model

The above user ID-based model demonstrates the impact of individual traits on the ad perception. Nevertheless, the model is not suitable for real-world use, as it requires that an individual's data is available *before* predictions can be made. Therefore, we now design a model that, instead of data from a particular user, is based on the information about personality traits of a user. Such information can be obtained quickly through a personality test.

The basic personality-based model only includes a grouping variable based on personality traits without any fixed effects or random slopes. As before, we find that the inclusion of context parameters does not improve the basic model so we focus on the ad content and ad type as the next modeling level. Gradually increasing the complexity of our model we come to similar conclusions as in the previous section. The fixed effects include a cross-level interaction of ad content and ad type, where the random effects include ad type only. The final personality-based model demonstrates that ad types are marked differently within different personality groups. One particular group consisting of extrovert, non-conflicting, non-conscious, and emotionally stable users is found to stand out. In the mentioned group pictures had an average score of -0.4, short videos 0.636 and long videos -0.75. To see if the scores were indeed significantly different, we

preform a Welch's t-test between this outlying and all other personality groups (Table 1). We find that the difference in short video scoring between the compared groups is not statistically significant, whilst the scores of pictures are.

Metrics	Pictures	Short videos	Long videos
t-test	-4.087	1.026	-1.545
p-value	0.001	0.326	0.162
95% conf. interval	[-1.771, -0.565]	[-0.467, 1.286]	[-2.089, 0.416]
Outlying group avg.	-0.4	0.636	-0.75
Other groups avg.	0.768	0.227	0.086

Table 1: Welch's t-test between the outlying personality group (extrovert, non-conflicting, non-conscious, and emotionally stable) and other personality groups.

Even though we built a personality-based model with the intent to make it more general, we found that not all personality combinations are included, as our sample size is not large enough. With 14 participants, out of 16 different possible personality groups (openness omitted) only 7 are covered. The final model's R^2 metric conditional value is 0.377 and the marginal is 0.198.

Predictive personality-based model

The user ID-based model demonstrates that *who* is watching the ad is more important than *in what situation* is someone watching the ad. Predictions of an attitude towards an ad could be used to decide whether to show an ad of a certain type, or whether to show an ad at all. Yet, personalised user-based models would require labeled data for each user, making their construction impractical. The analysis of the personality-based multilevel models demonstrates that general personality traits, obtainable through a simple 10-item questionnaire, can be used to build an informative model. Here we examine the predictive potential of a fully generaliseable model based on personality traits information.

With semi-supervised learning, we first label the unlabeled data – using the previously constructed user ID-based model, we predict the labels for the 493 unlabeled points. We then proceed with constructing a new personality-based model. Repeating the gradual increase of complexity procedure we find that the following context variables significantly impact the fit: screen brightness, battery level, and Internet connection type. Nevertheless, the variables do not feature highly in the final model, as ad content and ad type prove to be much more impactfull on the final ad scoring. Our final generalised personality-based model constructed on all gathered data includes a cross-level interaction of ad content and ad type as fixed effects and ad type as a random effect.

To assess the potential of the model to correctly predict the score a previously unseen user will give to an ad in a certain situation, we perform a leave-one-person out evaluation and in each step calculate the (root) mean square error

(R)MSE and mean absolute error (MAE) of our model and the baseline model that predicts the mean score across the dataset. Average RMSE, MSE, and MAE for the personality-based model are 0.967, 1.014, and 0.785, whereas the baseline results in 1.117, 1.347, and 0.865, respectively, indicating that the personality-based predictive model fits the data better than the majority classifier. The R^2 metric's conditional value of the model is 0.488 and the marginal is 0.308.

4 DISCUSSION AND CONCLUSION

In this paper we examined of the role of context and a user's personality on ad perception. While our initial assumption was that users would prefer either picture or video ads depending on the context of viewing, we discovered that picture ads are almost universally better accepted. This surprising finding might stem from our data collection limitations – conducted during the COVID-19 pandemics, the data fails to capture the full range of locations and activities we would expect to see during regular times. A prominent role of a user's personality in the perception of an ad is another interesting finding. We discover that certain personalities actually prefer short videos over picture ads. Our general predictive model takes personalities into account and is able to predict the attitude that a previously unobserved user will have towards an ad better than the baseline model. The initial analysis also demonstrates that the content of the ad, a property that was outside of the scope of our study, may significantly impact the perception and should be further examined.

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Interaktivna vizualizacija proračuna Republike Slovenije s Sankeyevim diagramom

Interactive Visualization of the Slovenian Budget with the Sankey Diagram

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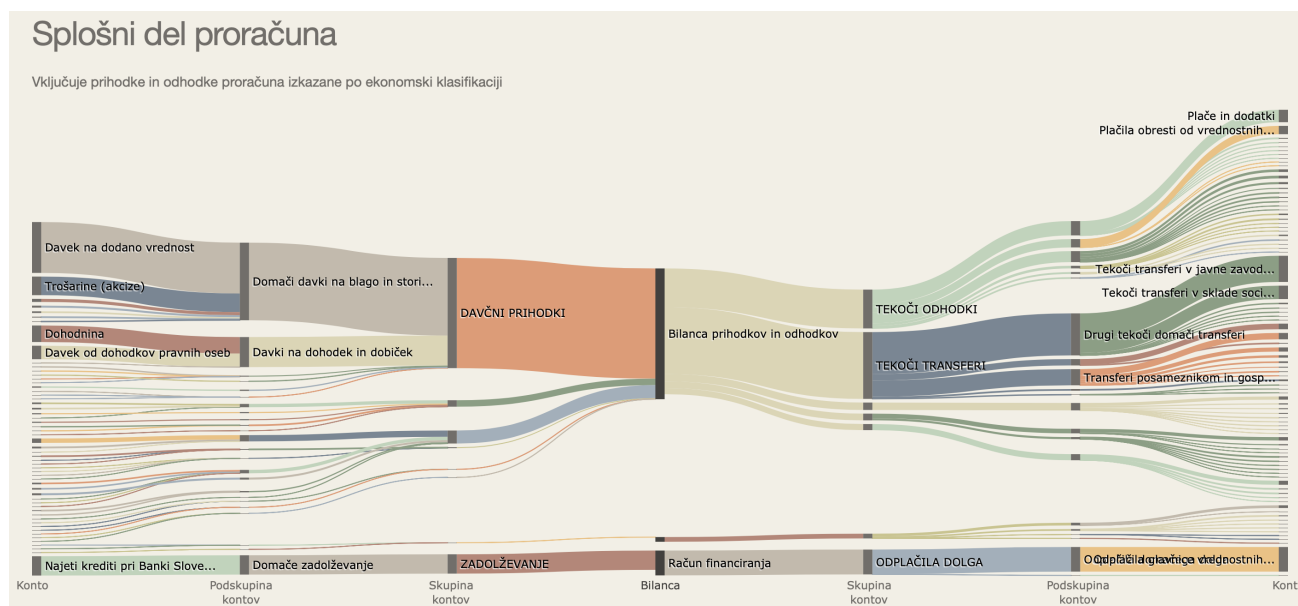
Slika 1: Sankeyev diagram za splošni del proračuna za leto 2020

POVZETEK

Predstavljamo spletno aplikacijo z interaktivno vizualizacijo proračuna Republike Slovenije. Z dvema Sankeyevima diagramoma, ki prikazujeta različne kategorije proračuna in denarne tokove med njimi, vizualiziramo tako splošni kot posebni del državnega proračuna. Interakcija omogoča spreminjanje pogledov, s katerimi lahko prikažemo več podrobnosti. Aplikacija ne ponuja vnaprej izbranih vidikov proračuna, ampak je namenjena prostemu raziskovanju po njegovih podatkih in kot taka predstavlja alternativo obstoječim vizualizacijam proračuna. Na voljo je na naslovu http://proracun.herokuapp.com.

KLJUČNE BESEDE

državni proračun, interaktivna vizualizacija, Sankeyev diagram

ABSTRACT

We present a web application with interactive visualizations of the Slovenian budget. With two Sankey diagrams that show different budget categories and the cash flows between them, we visualize both the general and the specific budget part. Interaction allows to change views, so that more details can be shown. The application does not produce pre-selected aspects of the budget, but is intended for free searching among its data and as such represents an alternative to existing budget visualizations. It is available at http://proracun.herokuapp.com

KEYWORDS

state budget, interactive visualization, Sankey diagram

1 UVOD

Živimo v času velepodatkov, družabnih omrežij in takojšnje komunikacije, ki nam v vsakem trenutku nudijo ogromne količine informacij. Ta preobremenjenost z informacijami nam otežuje poglabljanje vanje in njihovo preverjanje. Tako se pogosto zanašamo na tuje interpretacije in se nehote znajdemo v pasivni vlogi prejemnika informacij, ki so lahko tudi pomanjkljive ali (namenoma) napačne.

Temu se je moč izogniti z lastnim preverjanjem podatkov, ki pa je lahko zelo zahtevno opravilo. Na voljo moramo imeti dostop do podatkov, možnost obdelave velike količine podatkov, metode za vizualizacijo ter znanje potrebno za umestitev podatkov v širši kontekst in njihovo pravilno interpretacijo. Pri tem nam lahko

pomagajo orodja, ki pridobivanje in obdelavo podatkov opravijo namesto nas.

V prispevku predstavljamo novo takšno orodje (slika 1), na voljo na naslovu http://proracun.herokuapp.com, ki preko interaktivne vizualizacije s t.i. Sankeyevim diagramom uporabniku pomaga pri razumevanju proračuna Republike Slovenije in iskanju informacij v njem. To je relevantno, saj je državni proračun največja izmed štirih blagajn javnega financiranja in predstavlja nekaj manj kot polovico vseh javnofinančnih odhodkov [10]. Razkriva fiskalno politiko, razvojne cilje, prednostna področja ter politične in strateške prednostne naloge vlade.

Kot pri vseh vizualizacijah, ki predstavljajo kompleksne podatke, je tudi tu bistvenega pomena interaktivnost. Pri obsežnih zbirkah podatkov namreč zaradi omejitev ljudi na eni in računalniških vizualizacij na drugi strani ni mogoče vseh podatkov pokazati naenkrat. Bolje se izkaže interakcija, pri kateri uporabnik s svojimi dejanji sproža spremembe pogledov. Za razliko od statičnega pogleda, ki lahko naenkrat prikaže samo en vidik podatkov, interakcija podpira številne poizvedbe. Še posebej je koristna pri preiskovanju na več ravneh podrobnosti, ko nam omogoča, da se (postopoma) premaknemo od pregleda na najvišji ravni preko vmesnih pregledov do najbolj podrobnega pregleda, ki lahko prikazuje le majhen del vseh podatkov [5].

Naloga, ki jo novo orodje naslavlja, ni predstavljanje ali razlaganje vnaprej izbranih vidikov proračuna, temveč podpora pri prostem raziskovanju po njegovih podatkih, ki uporabniku pomaga, da najde lastne vpoglede vanje. Kot tako je torej dopolnitev obstoječim vizualizacijam proračuna, kot so razlagalne infografike in druge vizualizacije, ki jih pripravlja Ministrstvo za finance Republike Slovenije (več o njih v razdelku 2.3). Orodje je namenjeno tako navadnim državljanom kot novinarjem in drugim profilom, ki jih proračun tako ali drugače zadeva in ga želijo raziskati ter tako bolje razumeti.

V nadaljevanju najprej na kratko predstavimo državni proračun, njegovo strukturo, dostopnost podatkov in obstoječe vizualizacije. Nato se posvetimo novemu orodju za vizualizacijo proračuna. Po opisu Sankeyevega diagrama razložimo kako ga lahko obogatimo z uporabo interakcije. Predstavimo tudi podrobnosti izdelave vizualizacije in razpravljamo o njenih lastnostih. Prispevek zaključimo s povzetkom in zamislimi za nadgradnjo orodja.

2 DRŽAVNI PRORAČUN

Državni proračun Republike Slovenije je gospodarsko-politični akt, ki vključuje predvidene prihodke in odhodke države za eno leto. Sprejme ga Državni zbor po predpisanem postopku. Kadar so dejanski prihodki manjši od načrtovanih ali nastanejo nove obveznosti, ki v proračunu niso bile predvidene, vlada lahko predlaga *rebalans proračuna*[1]. Z njim proračun uskladi s spremenjenimi okoliščinami.

Državni proračun je ena od štirih blagajn javnega financiranja. Preostale tri so *pokojninska blagajna*, iz katere se pretežno izplačujejo pokojnine in invalidnine, *zdravstvena blagajna*, ki pokriva predvsem stroške delovanja zdravstvenih domov, bolnišnic in zdravil ter *občinski proračuni*, ki obsegajo prihodke in odhodke vseh 212 občin. Največja blagajna je ravno državni proračun, ki

predstavlja 48,4 % vseh javnofinančnih odhodkov. Sledijo pokojninska blagajna s 27,1 % odhodkov, zdravstvena blagajna s 14,2 % odhodkov in občinski proračuni z 10,3 % odhodkov [10].

2.1 Struktura proračuna

Državni proračun je sestavljen iz treh delov.

I. del: Splošni del proračuna vključuje bilanco prihodkov in odhodkov, račun finančnih terjatev in naložb ter račun financiranja. Izkazuje se po ekonomski klasifikaciji (skupina kontov, podskupina kontov in konto).

II. del: Posebni del proračuna izkazuje porabo javnofinančnih sredstev posameznih proračunskih uporabnikov preko institucionalne klasifikacije (nadskupina proračunskih uporabnikov, skupina proračunskih uporabnikov in proračunski uporabnik) ter vključuje odhodke in druge izdatke delovanja predstavljene po programski klasifikaciji (politika, program in podprogram).

III. del Načrt razvojnih programov predstavlja načrt odhodkov po podprogramih, ukrepih, skupinah projektov, projektih in virih financiranja po posameznih letih za celotno obdobje izvajanja projektov in ukrepov.

Tako za splošni kot za posebni del proračuna so na voljo tudi dodatne obrazložitve. V nadaljevanju se osredotočamo le na ta dva dela proračuna.

2.2 Dostopnost podatkov

Na spletišču državne uprave (https://www.gov.si/) je pod okriljem Ministrstva za finance podanih mnogo informacij o državnem proračunu [8]. Med njimi so prosto dostopni tudi podatki o sprejetih proračunih za vsa leta med letoma 2004 in 2021. Ti so na voljo v tabelarični obliki v datotečnem formatu PDF za vse tri dele proračuna. Namenjeni so torej predvsem pregledu in niso primerni za dodatno računalniško obdelavo.

Ravno nadaljnji obdelavi pa so namenjeni podatki v datotečnem formatu CSV na portalu Odprti podatki Slovenije (OPSI, https://podatki.gov.si/). Na portalu sta za vse proračune med letoma 2014 in 2021 na voljo splošni in posebni del proračuna, od leta 2019 naprej pa še načrt razvojnih programov [11]. Vsi podatki uporabljeni v tem prispevku izhajajo iz portala OPSI.

2.3 Obstoječe vizualizacije

Ministrstvo za finance poleg golih podatkov o proračunu od leta 2017 naprej objavlja tudi infografike s ključnimi podatki o proračunu, s katerimi želi proračun približati širšemu krogu državljanov. Primer takšne infografike je prikazan na sliki 2 [9]. Infografika izpostavlja določene vidike posebnega proračuna – v tem primeru 16 politik, pri čemer so nekatere združene, saj je originalnih politik, zajetih v proračun, 24. Manjše število politik je lažje za razumevanje, a neizogibno skriva nekatere podrobnosti.

Poleg infografik so od začetka leta 2020 na voljo tudi tri vrste (interaktivnih) vizualizacij proračuna [12]. Prva omogoča vpogled v trenutno stanje prihodkov in odhodkov proračuna, ki se dnevno osvežuje. Iz nje je razvidno ali se proračun izvaja skladno s pričakovanji. Druga vizualizacija je interaktivna in za vseh 24 politik proračuna omogoča podrobnejši pogled porabe v posebnem oknu, v katerem so odhodki dodatno razdeljeni po programih in kontih. Odhodki vsake politike so prikazani tudi za pretekla leta (od leta 2009 naprej). Tretja vizualizacija pa nudi vpogled v posamezne projekte, kjer interaktivnost omogoča iskanje projektov po različnih kriterijih, med drugim tudi po tem v kateri regiji in občini se izvajajo.

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[1]V času pisanja tega prispevka se pripravlja rebalans proračuna za leto 2020 [13]. Povod zanj je izraziti upad proračunskih prihodkov med epidemijo COVID-19, hkrati pa rast izdatkov zaradi sprejetih ukrepov vlade za omilitev posledic krize in ohranitev gospodarske aktivnosti.
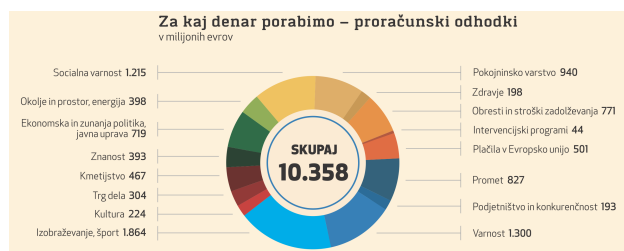
Slika 2: Infografika bilance odhodkov za posebni proračun za leto 2020 (vir: Ministrstvo za finance [9])

3 INTERAKTIVNA VIZUALIZACIJA S SANKEYEVIM DIAGRAMOM

Kot dopolnitev obstoječim grafičnim prikazom predlagamo vizualizacijo proračuna z dvema Sankeyevima diagramoma – enim za splošni in drugim za posebni del proračuna.

3.1 Sankeyev diagram

Sankeyev diagram (poznan tudi kot aluvialni diagram) prikazuje kategorije in kvantitativne odnose med njimi [4]. Kategorije so vizualizirane kot pravokotniki (na sliki 1 obarvani v sivo), odnosi med njimi pa kot tokovi (na sliki 1 v različnih barvah). Širina toka je sorazmerna s količino, ki povezuje dve kategoriji.

Čeprav je Sankeyev diagram poimenovan po diagramih energetske učinkovitosti parnega stroja Matthewa Sankeya iz leta 1898 [3], je bil v rabi že prej. Eden najbolj poznanih Sankeyevih diagramov je Napoleonova ruska kampanija, ki jo leta 1869 ustvaril Charles Minard [7].

Sankeyev diagram je videti kot nalašč za vizualizacijo proračunskih podatkov, saj lahko na eni sami sliki prikaže mnogo raznolikih prihodkov in odhodkov ter morebitno razliko med njunima vsotama. Na sliki 1 so bilance označene s temno sivo barvo in postavljene na sredino grafičnega prikaza. Kategorije na levi kažejo prihodke v proračun, kategorije na desni pa njegove odhodke. Sankeyev diagram dobro prikaže tudi kako se neka kategorija razčleni na več podkategorij in kakšna so razmerja med njimi. Na sliki je to vidno za hierarhijo bilanca – skupina kontov – podskupina kontov – konto (na strani prihodkov in odhodkov).

Sankeyevega diagrama za posebni del proračuna zaradi omejenega prostora v prispevku ne prikazujemo v celoti (v nadaljevanju bomo videli nekatere njegove dele).

3.2 Uporaba interakcije

Sankeyevemu diagramu lahko izrazno moč povečamo z uporabo interakcije. Predlagano orodje podpira naslednje interakcije:

- *Izpis več podatkov.* Ker se zneski v državnem proračunu med seboj precej razlikujejo, so nekatere kategorije in tokovi lahko zelo debeli, drugi pa komaj vidni. Poleg tega je na določenih ravneh število kategorij in tokov precejšnje. To pomeni, da ne moremo izpisati imena vseh kategorij, ampak se omejimo le na največje. Interakcijo lahko koristimo za to, da se imena kategorij (tudi tistih najmanjših) v celoti izpišejo šele takrat, ko se z miško postavimo nad njimi (glej sliko 3 zgoraj). Na podoben način interakcijo uporabimo tudi pri premikanju miške nad tokovi, kjer se ob tem pokaže več informacij o toku (njegov izvor in ponor ter znesek, slika 3 spodaj).

Slika 3: Izpis dodatnih podatkov ob interakciji s kategorijo (zgoraj) in tokom (spodaj) posebnega dela proračuna za leto 2020
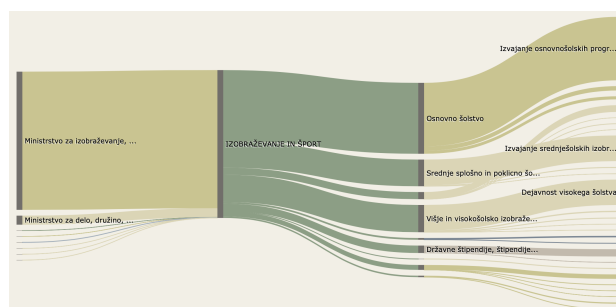
Slika 4: Podrobnejši pregled kategorije Izobraževanje in šport posebnega dela proračuna za leto 2020

- *Sprememba pogleda.* S klikom na kategorijo spremenimo pogled tako, da se približamo izbrani kategoriji in vsem njenim podrejenim kategorijam (ter v primeru posebnega proračuna tudi njenim prvim nadrejenim kategorijam). Na ta način lahko prikažemo kategorije in tokove, ki so v izvirnem pogledu predrobni ali preveč nagneteni, da bi jih lahko dobro videli. Primer takšne spremembe pogleda na diagramu posebnega dela proračuna je ilustriran na sliki 4. Tu je kategorija Izobraževanja in športa povečana čez celoten zaslon, kar nam omogoča, da v podrobnosti vidimo njene podkategorije in njihova medsebojna razmerja. Hkrati pa vidimo tudi katera ministrstva so odgovorna za to politiko. V takšnem pogledu se lahko odločimo, da nadaljujemo s pregledovanjem drugih kategorij (s klikom nanje) ali pa se s klikom na katerikoli tok vrnemo na prvotni pogled.
- *Izbira podatkov.* Preko zavihka (ni viden na slikah) lahko izberemo leto proračuna, ki nas zanima. Trenutno imamo na voljo podatke za proračune za leta 2019, 2020 in 2021. Ob spremembi leta se izrišeta nova dva Sankeyeva diagrama (za splošni in posebni del proračuna), ki vsebujeta podatke za izbrano leto.

3.3 Izdelava vizualizacije

3.3.1 Priprava podatkov. Kot že omenjeno, so vsi podatki, uporabljeni v tem orodju, pridobljeni s portala OPSI [11]. Podatki so vzorno pripravljeni, saj z njihovim rokovanjem nismo imeli težav. Pred uporabo smo podatke dodatno obdelali. Najprej smo odstranili vse tiste povezave med kategorijami, pri katerih so bili zneski manjši od 1000 EUR. S tem smo želeli izpustiti podatke, ki so

relativno majhni in, v kontekstu državnega proračuna, praktično nepomembni. Poleg tega smo na tak način zmanjšali velikost podatkovne zbirke in malenkost izboljšali odzivnost orodja, ki se ob velikem številu kategorij in tokov zmanjša.

Izračunali smo tudi vse skupne zneske po kategorijah. Nato smo pripravili uporabniku prijazen zapis zneskov, ki števila zaokroži in uporablja okrajšave za milijon in milijardo. Končno smo podatke preoblikovali v obliko, ki jo zahteva knjižnica za izris Sankeyevih diagramov (več v tem v nadaljevanju). Tako pripravljene podatke smo shranili za uporabo v nadaljevanju (opisana obdelava podatkov se izvede samo enkrat – orodje nato deluje na že obdelanih podatkih).

3.3.2 Tehnična izvedba. Za implementacijo Sankeyevih diagramov smo uporabili Pythonovo knjižnico Plotly [6], ki ponuja številne interaktivne grafične prikaze in delo z njimi precej poenostavi. Plotly zahteva podatke o kategorijah in tokovih med njimi in iz njih avtomatično zgradi Sankeyev diagram.

Spletno aplikacijo smo zgradili z ogrodjem Dash [1] in jo objavili preko platforme Heroku [2]. Trenutno je na naslovu http://proracun.herokuapp.com na voljo verzija 0.3.

3.3.3 Oblikovalske odločitve. Ob oblikovanju diagramov smo morali sprejeti nekaj odločitev, ki so vplivale na uporabo in izgled diagramov. V prvi vrsti smo se odločali za funkcionalnost interakcij (glej razdelek 3.2). Pri spremembi pogleda se tako v primeru posebnega dela proračuna pokažejo tudi nadrejene kategorije, ker to nudi več konteksta, ki v splošnem delu proračuna ni tako pomemben.

Ime kategorije se pokaže, če je znesek kategorije vsaj 5 % vsote vseh kategorij v istem stolpcu. Podobno prikazujemo le prvih 30 znakov imena, celotno ime pa le ob interakciji. Obe meji (5 % in 30 znakov) smo določili empirično.

Vse kategorije so obarvane enako (svetlo sivo), razen bilanc, ki so temnejše, da bolj izstopajo. Tokovi so različnih barv, ki so določene tako, da so kategorije z istimi imeni vedno enako obarvane. To olajša razumevanje in primerjavo med različnimi leti proračuna. Z napisi na dnu prikaza, ki pojasnjujejo klasifikacijo, smo vnesli kontekst, ki pomaga pri orientaciji med spreminjanjem pogledov.

3.4 Razprava

Po začetnem testiranju uporabe, ki pa še ne vključuje prave uporabniške študije, lahko rečemo, da je Sankeyev diagram dober način za raziskovanje proračuna. Eden glavnih uvidov pri uporabi orodja je bil, da je servisiranje javnega dolga večja postavka od pričakovane (ker je poleg bilance odhodkov vsebovana tudi v računu financiranja, na preostalih vizualizacijah ne nastopa tako izstopajoče).

Interakcija omogoča "sprehajanje" po diagramu na različnih ravneh podrobnosti in v uporabniku zbudi željo po dodatnih informacijah, ki trenutno v vizualizacijo niso zajete. Te so na voljo le v obrazložitvah proračuna v datotečnem formatu PDF, kar otežuje njihovo morebitno dodajanje v aplikacijo.

Verjetno največja prednost takšnega prikaza je primerjava med posameznimi kategorijami in tokovi, ki je precej bolj intuitivna od obstoječih vizualizacij proračuna. Slabost je odzivnost, za katero bi si želeli, da bi bila boljša. Žal je to lastnost, ki se ne da dovolj dobro predvideti in se izkaže šele v zadnjih fazah implementacije takšne aplikacije.

Uporaba knjižnice Plotly je zelo olajšala delo in zmanjšala čas, potreben za razvoj takšne aplikcaije. Vendar ima ta enostavnost

uporabe za posledico (pre)malo nadzora nad končnim izgledom, ki bi ga želeli dodatno prilagoditi, a to ni mogoče. Moteča so tudi občasna prekrivanja imen v kategorijah (glej spodaj desno na sliki 1), ki se jim je pri interaktivnih vizualizacijah težko izogniti.

4 ZAKLJUČKI

Predstavili smo novo vizualizacijo proračuna Republike Slovenije s Sankeyevim diagramom, ki podpira interaktivnost in tako omogoča poglobljeno raziskovanje kategorij in denarnih tokov proračuna. Na ta način vizualiziramo tako splošni kot posebni del proračuna.

V nadaljevanju bi želeli poskusiti na isti način vizualizirati tudi razlike med dvema proračunoma. Tako bi lahko primerjali proračune dveh različnih let ali pa osnovni proračun z njegovim rebalansom.

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MightyFields Voice: Voice-based Mobile Application Interaction

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ABSTRACT

We present MightyFileds Voice (MFVoice), a service and an extension of the MightyFields application that enables voice interaction with a mobile application. The user can issue voice commands for transitioning between application views and filling out the forms. Google speech-to-text engine is used to obtain text, which is then fed into the developed MFVoice service together with the structured application view representation. MFVoice service then returns appropriate action to take, which is executed by the Mighty Fields application extension. The MFVoice natural language understanding service was tested in real-life use cases, achieving 93% intent recognition accuracy, 88% entity recognition success when the system was used as intended. When no training to the user was provided, intent and entity recognition achieved 68% and 52% accuracy, respectively. Note that in case of no training provided, the users assumed general knowledge of the language semantics, which is out-of-scope for the current state-of-the-art research in natural language.

KEYWORDS

voice assistant, voice interaction, natural language understanding

1 INTRODUCTION

Interaction with devices by voice has become quite common in recent times. More known examples of applications allowing voice commands are voice assistants like Cortana [4] and Siri [1]. Voice interaction is attractive to users as it offers a hands-free application interaction and is therefore a desired feature in many applications. This feature is useful for people with spelling difficulties. It can also help those with physical disabilities who often find typing difficult. The proposed service is not used for two-way conversation, as in platforms such as the one from Rasa [3]. However, the part of the service used to recognize user's command, is very similar to the ones from other virtual assistants. The modifications applied take into account the specifics of the task at hand.

In this paper we focus on the task of filling out custom forms through the voice interaction. Here, a custom form is a small information gathering application, made for specific purpose, e.g., electric grid inspection form, or police report regarding an incident. Since the domain is open ended, i.e., each individual can make his or her own custom forms, the voice understanding

feature cannot be specialized and has to work satisfactory in general setting. Three steps are performed to enable voice interaction. First, speech is transformed into text by using Google speech-to-text (STT) engine [2]. Second, approach from [5] is utilized to extract intent keywords. The full intended command is then inferred based on what the user is currently seeing on the screen and from the rest of the spoken words. Third, the recognized action is performed within the application itself.

In Section 2, an architecture of our service is presented. In Section 3, we present our MFVoice natural language understanding (NLU) service and show its implementation. We then explain the tests conducted on the service and their results in Section 4 and discuss them in section 5. We conclude the paper with a summary in Section 6.

2 MFVOICE ARCHITECTURE

MFVoice comprises several parts (Figure 1) that enable voice interaction:

(1) MF application itself: this is the main MightyFields application.
(2) MF agent: the program that enables programmatic access to the application view - reading and interacting.
(3) STT: a service that transforms spoken commands into text.
(4) MFVoice NLU service: the service that parses free text and returns structured information about recognized intent and entities.

3 THE MFVOICE NLU SERVICE

The MFVoice NLU comprises the following steps (Figure 2):

(1) Application view context processing
(2) Intent recognition
(3) Entity recognition

When the application context and transcription of the voice command are provided to the NLU application programming interface (API), the service first identifies possible actions to take, given the context, then it processes the context content, which in turn enables recognition of the intent and, finally, the entities. The so-obtained structured action data is then forwarded back to the MF agent, which can execute appropriate actions. In this section we will describe each of the MFVoice NLU parts in more details.

3.1 Application View Context Processing

The application view context provides structured data on the elements that are visible on the screen. This includes field labels, field IDs, possible values of fields (where applicable), interaction options, and available tabs for multi-page forms. Upon the API
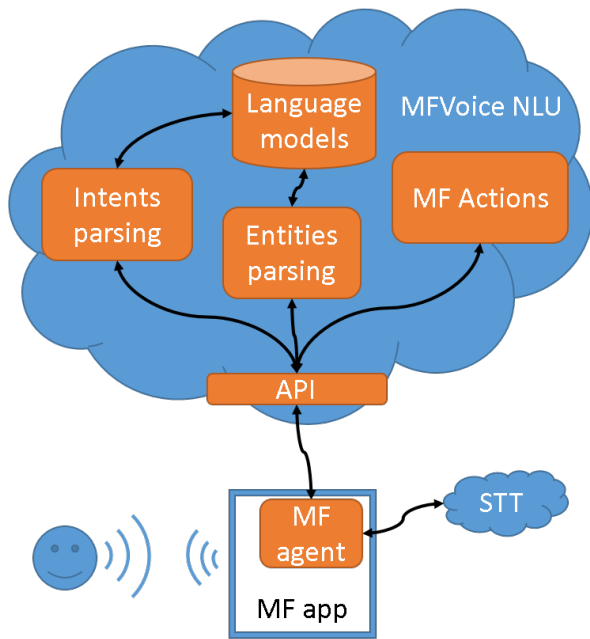
Figure 1: The MFVoice architecture overview
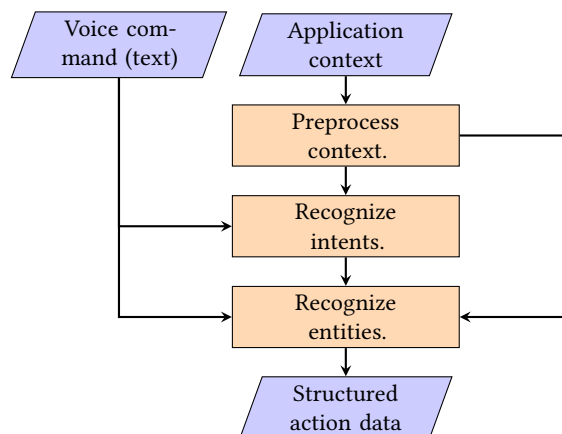
Figure 2: The MFVoice service processing pipeline

call, the application context is pre-processed. The text visible to the user is normalized and transformed into search friendly form that is used in intent and entity recognition.

The transformation is cached to speed-up its future use in subsequent steps. Least recently used cache is used, since user interacts with one application view as long as he or she does not fill-out the form in short time period.

3.2 Intent Recognition

Intent defines what the user wants the application to do. In the case of form filling, the following intents were identified:

(1) "Choose" an element from a list of elements. This is often used to pick the element from a dropdown or checklist elements.
(2) "Write" some text into a field. This is used for input or text-area elements.
(3) "Clear" the value of a field to delete a wrong value entry for any kind of element.

(4) "Tap" the field or graphical element. This is used to interact with buttons and navigate the application.

Due to non-existent training data, keyword-based intent recognition was utilized. For each intent a set of intent "key-phrases" were defined:

(1) "Choose": choose, pick, select, is
(2) "Write": is, write, input
(3) "Clear": clear, delete, remove
(4) "Tap": choose, go to, tab, click, pick

In the intent inference step, the score for each of the "key-phrases" is computed. If the highest score exceeds the predefined threshold, the corresponding intent is chosen [5]. To simplify the NLU pipeline only one intent and one field per utterance is allowed. This is especially problematic in voice assistants, since the users naturally communicate differently when talking than when writing. To resolve the disambiguation of one "key-phrase" being associated with multiple intents, the following order of intents is taken into account: "Choose", "Write", "Clear", "Tap". Further, since not every intent is possible with every field, the intent list is first filtered and only the intents that make sense in the current context are kept and iterated over. For instance, if the context comprises only of the input fields and navigation tabs, "Choose" does not make sense.

The "key-phrases" used for inferring the intent are tagged with the intent tag (IT), which is later used in the entity recognition step.

3.3 Entity Recognition

There are two types of entities present in our use-cases: "label entities" (e.g., name in *"The **name** is John."*) and "value entities" (e.g., John in *"The name is **John**."*).

Label entities are the labels of the fields in the user generated form. Since they are user generated, their value is not restricted. Their semantic meaning is sometimes harder to grasp automatically, since not much additional info is usually provided (for instance description). In general, the recognition of label entities cannot be learning-based, since the users are not expected to provide examples.

Value entities can further be divided into known value entities (button labels, the items in the drop-down lists or checkbox lists and similar) or unknown value entities (text input fields). The reasoning for known value entities is the same as for the label entities – they are user generated and cannot be learned in general. For the unknown value entities, the value corresponding to a certain label should be recognized from the free text, generated from the STT service. The unknown value entities can comprise one or several words.

Score, related to the probability of the entity appearing in the text, is used to recognize the label entities and known value entities, while a heuristic is used to recognize the unknown value entities.

3.3.1 Label and Known Value Entities Recognition. These entities are the ones set by the user in the form creation phase. To recognize the entities from free text, text similarity scores are applied and evaluated for each possible label or known value entity [5]. Only the entities with scores that exceed threshold are recognized and can be used in the next pipeline steps.

In some instances, the MFVoice NLU has to modify the text received by the STT engine. Common examples for this are:

(1) Letter-by-letter dictation transformation, e.g. in transcribed command "the form ID is 1 2 3 4 5 a" the empty spaces in the form ID have to be deleted so "12345a" is obtained.

(2) Zero padded numbers transformation, e.g. in transcribed command "the house number is 23", sometimes the dropdown values include only known value entity "023". Therefore, the preceding zeros have to be dropped when computing the text similarity.

(3) Numbers in text transformation, e.g. in transcribed command "pick option three", the number "3" is transcribed as "three". In those cases, the textual representation has to be transformed into a number.

The words that correspond to the highly-scored entities are tagged with the label entity (LE) or known value entity tag (KVE), to be later used in the unknown value entity recognition.

Some examples of label entity and known value entity recognition are:

(1)

form number   123456
    LE   KVE

(2)

female
 KVE

Note that when the user speaks command "female", the MFVoice NLU service recognizes the known value entity that belongs to the field with label "sex". Additionally, even without specifying the intent keyword, the application logic infers that the user wants to pick the option "female" in the field "sex".

Since the text similarity metrics are used for scoring the labeled and known value entities, in some cases the entities are not recognized correctly:

(1) Multi-word synonyms are not recognized, e.g. "city" ∼ "place of living"

clear   the place of living
 IT   OTHR

While the systems supports synonyms, they have to be manually entered by the form creator and are therefore less practical.

(2) Multiple occurrences of the same or very similar label entities or known value entities cannot be properly disambiguated. Consider, for example, a form that comprises house number field with possible value "4", and household size field also with possible value "4". User usually fills the form in a linear way, top to bottom. When the user encounters the first of the mentioned field, he or she may voice command "four". In this case, NLU service will provide two possible actions: "house number is 4" and "household size is 4".

3.3.2 Unknown Value Entity Recognition. The unknown value entity recognition is computed only when the intent "Write" is considered, since this is the only type of the"open" form field that allows for unknown values. The following heuristic is used to tag the unknown value entity (UVE):

(1) If IT tag is not present in the text, every word not tagged with LE is tagged with UVE.

age 31
LE UVE

(2) If IT tag is present in the text, then begin tagging word to the left or to the right of LE-tagged word with OTHR tag. Stop if text-end or IT-tagged word are reached. Check if there is any remaining word:

(a) If there are remaining words, tag those with UVE tag.

his   name   really   is   John Doe
OTHR   LE   OTHR   IT   UVE

(b) If there are no remaining words, re-tag all the words to the right of LE tag with UVE tags.

insert   the   name   John Doe
  IT   OTHR   LE   UVE

The previous steps capture the majority of the unknown value entity recognition cases. However, there are still commands that would not be understood by the MFVoice NLU service:

(1)

John Doe the   name   is   ≠   John Doe   the   name   is
  OTHR   LE   IT   UVE   OTHR   LE   IT

(2)

John Doe really   is   his   name
    UVE   IT OTHR   LE

≠ John Doe   really   is   his   name
     UVE   OTHR   IT OTHR   LE

4 TESTING

The MFVoice NLU service was tested in two ways: laboratory testing and real-world testing. For laboratory testing, the text was entered into the service directly, bypassing the STT service. This way, the STT performance issues were ignored and only the recognition capability of the MFVoice NLU service was tested. The examples, however, were still obtained from the final MFVoice users. The test user was presented with an application screen and told to fill the form using only his or hers voice.

For the real-world testing, the users were given written instructions on how to use the app, however, no instruction on how to actually voice commands were given. First, the form was filled out using screen and keyboard interactions. Second, the field that a user wants for fill with a voice command was marked. Third, voice interaction was activated and the command was spoken. Fourth, the transcribed voice command, the context, and the marked item were stored for future analysis. We did not provide any examples on how to use MFVoice. This allowed us to research what the users actually expect from the system.

The forms used in testing included six free-text input field widgets (name, surname, age, settlement, street, house number), one radio widget with two options (gender: male, female), one checkbox field with five options (language: Slovene, Slovak, Spanish, Swedish, Sumerian), and four dropdown fields (country, settlement, street, and house number).

4.1 Laboratory Testing Set-up and Results

We have gathered 70 and 69 commands for application interaction in Slovenian and English languages, respectively. Laboratory testing is performed upon each git push to the code repository and is run within the continuous integration pipeline. This enables us to track the performance of the MFVoice NLU pipeline.

Table 1: Intent confusion matrix for commands in Slovenian

	write	choose	clear	tap	missing
write	22	0	0	0	2
choose	0	21	0	0	0
clear	0	0	2	0	0
tap	0	0	0	20	3

4.1.1 Intent Recognition. After each continuous integration pipeline run, the intent confusion matrix is computed. Table 1 is an example of the intent confusion matrix for voice commands in Slovenian for the last version of MFVoice. According to the matrix, the accuracy of intent recognition is above 90%. The only errors were the ones, where the system was not able to determine the item to be interacted with, which was labeled with the "missing" classification label.

4.1.2 Entity Recognition. For each command also the field labels and values recognized by the NLU service and the ground truth labels and values are compared. Examples where the NLU fails to recognize the label or value correctly are:

(1) "Age 26 years." Expected value: "26", got "26 years"
(2) "She is 26 years old." Expected label: "age", got nothing.
(3) "She lives in Ljubljana." Expected label: "Place", got nothing.

4.2 Real-life Testing Set-up and Results

We have gathered 172 spoken voice commands in the real-life setting in Slovenian. Unfortunately, there were only 86 commands that were labeled correctly by the test users and STT performed well there. STT issues occurred in 42 out of 172 cases (24%). These could either be result of too much background noise, command not being recorded properly, or just the problem with the STT service used for the Slovenian language. Incorrect user labeling occurred in 42 out of 172 cases (24%). The most common mistakes in those cases were: the user forgot to set the ground truth either by entering the value or choosing the item, the user obviously picked the wrong item (e.g., for command "the name is John" an item with label age was selected).

Out of 86 valid commands, 45 were recognized correctly and 41 incorrectly. For 23 cases the label value was completely missing and could not be inferred from the surrounding text (e.g., "John", "45", "Ljubljana"). For 18 cases the label value could be inferred from the surrounding text (e.g., "he is 23 years old", "she lives in Ljubljana"). In some cases (12) this would require some general reasoning about the words and their relations and in other the unknown value entity included additional text, e.g. "his name miki", was not recognized because of minor STT-engine mistakes (1), or the known value entity score was not high enough to be included (5). This results in 88% accuracy for entity recognition when the system was used as intended, 72% when the synonyms were assumed, and 52% when general knowledge of the language semantics was assumed.

Note that the testing was performed without some planned features implemented. The *Zero padded numbers transformation* and *Numbers in text transformation* steps were missing. The accuracy percentages should improve to 94%, 76%, and 56% for uses as intended, assuming synonyms, and assuming general knowledge of language semantics, respectively.

5 DISCUSSION

According to the results, the intent recognition process performs very good, despite the fact that it is only based on keyword recognition and the context processing. We do not think that any additional work would benefit the performance in this regard, with the exception of adding additional intent keywords, which will be obtained during the application usage.

After the user familiarizes with the way the MFVoice application works, also the named entity recognition performs well. Most of the errors were actually a result of a user expecting the system to be too advanced. All 43 incorrectly recognized entities were the result of MFVoice not being able to reason that, for instance, "John" is a person name. While this could be done for certain special cases, e.g. person names and geographic names, at the moment this cannot be solved in general. This is a result of letting the users to create their own forms, which are often very domain specific. In the future we will perform the testing of the system after users are given some basic training on how to use MFVoice. This should greatly improve the percentage of properly labeled instances and also help us uncover additional edge cases to be addressed by the entity recognition pipeline.

The MFVoice NLU was designed in a way to easily support multiple languages. In the current form, to support a new language, the translations of the intent keywords and language word vectors have to added. For certain languages the module for unknown value entity has to be adjusted, since the sentence syntax can be different. This enabled us to quickly add support for English, after Slovenian voice interaction performed well.

6 CONCLUSION

In this paper we presented our service that is used for filling forms with voice commands in a mobile application. While some operating system do include voice interaction, e.g., Cortana [4] and Siri [1]), their use in a dedicated application is limited. MFVoice enables more advanced voice interaction. MFVoice application first gets the text which was converted from speech by using the Google STT engine [2]. Then, the MFVoice NLU service uses keyword recognition and context preprocessing to infer the command the user intended. Because of the simplicity of the implementation, the service is less accurate when commands are voiced in the form of long and complex sentence. However, this simplicity does make the service more robust and accurate with commands voiced in concise form. We believe that users should have a comfortable user experience, after they get used to forming commands in a more concise manner.

ACKNOWLEDGMENTS

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eBralec 4: hibridni sintetizator slovenskega govora

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POVZETEK

V članku predstavljamo nov sintetizator slovenskega govora eBralec4 (https://ebralec.si/). Razvit je bil povsem nov ženski glas »*Nadja eBralec*«, ki je razumljivejši in zveni bolj naravno od predhodnega ženskega glasu. Opisujemo zgradbo sintetizatorja govora, njegove module, jezikovne vire uporabljene pri razvoju ter potek izgradnje govorne zbirke za nov ženski glas.

KLJUČNE BESEDE

sinteza slovenskega govora, govorna zbirka, postopek sinteze slovenskega govora

1 Uvod

V članku predstavljamo nov sintetizator slovenskega govora eBralec4 (https://ebralec.si/). Pri razvoju smo izhajali iz obstoječe tehnologije, sintetizatorja govora za slovenski jezik *eBralec* [1], ki je bil razvit v okviru projekta Knjižnica slepih in slabovidnih, in je prvenstveno namenjen slepim in slabovidnim uporabnikom ter osebam z motnjami branja.

V okviru projekta CityVOICE smo identificirali več priložnosti za izboljšavo in nadgradnje *eBralca*, tako glede naravnosti kot tudi razumljivosti. V sodelovanju s skupino končnih uporabnikov smo pregledali in raziskali pomanjkljivosti obstoječega sintetizatorja govora ter zbrali dodatne želje končnih uporabnikov za izboljšave sintetizatorja govora, kar je rezultiralo v novem produktu *eBralec4*.

Kot poglavitna pomanjkljivost se je izkazala prvotna govorna zbirka, na kateri sloni delovanje izhodiščnega sintetizatorja govora. Ni zasnovana dovolj konsistentno (deloma neustrezni in spremenljivi snemalni pogoji) in robustno – v smislu zajema raznovrstnosti ciljnega besedišča, kar povzroča slabšo razumljivost sintetičnega govora ob črkovanju in izgovarjavi posebnih simbolov.

Identificirana je bila tudi spremenljiva kakovost sintetiziranega govora, ki izhaja iz sejne spremenljivosti ob snemanju izvorne govorne zbirke. Zaradi neustreznega dinamičnega obsega pri

snemanju je manj uporabna za uporabo v mobilnih aplikacijah ob hrupnem akustičnem ozadju.

Zato smo velik del analize posvetili možnim izboljšavam pri gradnji nove govorne zbirke, ki omogoča boljše delovanje akustičnega modula. To še posebej velja za ženski glas, ki ga je zaradi fizikalne narave tudi sicer težje kvalitetno sintetizirati. Nova govorna zbirka za glas »*Nadja eBralec*« je bila posneta z branim govorom. To ustreza najpogostejšim oblikam rabe sintetizatorjev govora, lažje je izdelati transkripcijo, snemanje je bolj nadzorovano in predvidljivo. Pri spontanem govoru je namreč govorno zbirko težko fonetično in prozodično uravnotežiti.

Na osnovi analize delovanja izhodiščnega jezikovnega modula smo izboljšali pomensko analizo povedi in na novo razvili samodejno določanje vrste povedi, ki ima še posebej veliko težo tudi v postopku gradnje govorne baze.

Izpostavljene so bile tudi težave *eBralca* pri sintetiziranju kratkih besedilnih segmentov in posameznih simbolov, kar se kot najbolj moteče pokaže pri črkovanju, ki je bilo mestoma slabo nerazumljivo. Težavo smo rešili z uvedbo hibridnega pristopa k akustičnemu modeliranju govornega signala, kjer kratke segmente sintetiziramo z visoko razumljivo difonsko konkatenacijo govornih segmentov, daljše segmente pa z naravno zvenečimi parametričnimi reprezentacijami govornega signala s pomočjo prikritih Markovovih modelov.

Obstoječima glasovoma *eBralca*, moškemu glasu »*Renato eBralec*« in ženskemu glasu »*Maja eBralec*«, se je v novem produktu *eBralec4* pridružil novi in opazno bolj naravno zvenči ženski glas »*Nadja eBralec*«.

V članku opisujemo zgradbo sintetizatorja govora, njegove module, jezikovne vire, ki so bili uporabljeni pri njegovem razvoju, potek izgradnje nove govorne zbirke za ženski glas »*Nadja eBralec*« in postopek hibridnega akustičnega modela za generiranje govornega signala. Opisujemo tudi izboljšave pri jezikovni analizi vhodnega besedila.

2 Zgradba sintetizatorja

Naloga jedra sintetizatorja govora *eBralec* oziroma povezovalnega cevovoda je povezovanje sestavnih modulov sintetizatorja govora v enoten proces. Jedro sintetizatorja govora usklajuje delo posameznih delov sintetizatorja tako, da v ustreznem vrstnem redu vključuje oziroma kliče module sintetizatorja govora. Posamezni moduli pretvorbe zaradi pohitritve in večje paralelizacije procesov lahko hkrati delujejo v ločenih nitih.

Zasnova jedra sintetizatorja govora *eBralec* je prikazana na sliki 1. Moduli, ki jih vključuje jedro *eBralca*, so: jezikovni analizator, besednik, modul za grafemsko-fonemsko pretvorbo in modul za sintezo govornega signala [1]. Na vhodu in izhodu se jedro sintetizatorja govora lahko poveže z ustreznim vmesnikom, npr. SAPI 5, s pomočjo katerega vhodno besedilo z morebitnimi dodatnimi ukazi spreminja v ustrezen govorni signal.

Vhodno besedilo sprva obdela jezikovni analizator, ki poskrbi za ustrezno predobdelavo vhodnega besedila ter razdvoumljanje izgovornih različic. Rezultat modula je zapis, v katerem so vsebovane vse potrebne informacije o izgovarjavi besed glede na njihovo pozicijo in pomen v vhodnem stavku oziroma povedi.

Modul besednik v odvisnosti od vhodnih nastavitev poskrbi za pretvorbo simbolov in števil v besede. Ti elementi so namreč zelo pogost sestavni del besedil, zato je njihovo pravilno izgovarjanje pomembno za razumljivost govora. Modul »grafemsko-fonemska pretvorba« poskrbi za pretvorbo v fonemski zapis.

Modul za »sintezo govornega signala« je zadolžen za oblikovanje prozodije in tvorjenje izhodnega govornega signala.
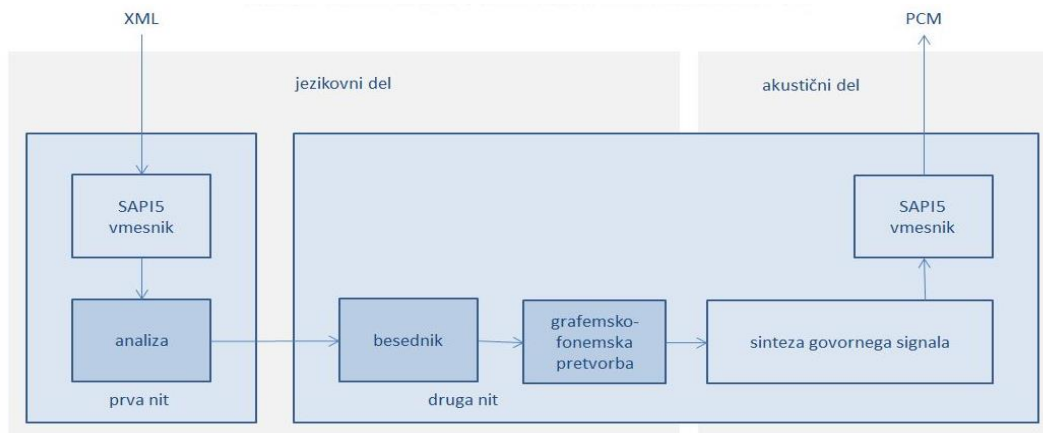
Slika 1: Shema jedra sintetizatorja govora.

3   Jezikovna analiza besedila

Jezikovna analiza uporablja podatke iz Amebisove jezikovne baze Ases [2]. Ta za slovenščino v tem trenutku vsebuje več kot 257.000 lem, ki vsebujejo 8,1 milijona oblik, od katerih je 5,7 milijona oblik dodatno opremljenih s podatki o izgovarjavi. Dodatno je za slovenščino v bazi še 36.000 zvez in 8.000 glagolskih predlog. Glagolske predloge podajajo informacije o vezljivosti glagola.

Jezikovni analizator mora narediti razrez besedila na povedi, stavke in besede, potem pa za vsako besedo določiti še ustrezno lemo in oblikoskladenjsko oznako. Ases ločuje leme, ki se različno izgovarjajo, npr. »téma« in »temà« predstavljata dve ločeni lemi. Jezikovni analizator deluje na podlagi pravil in podatkov iz jezikovne baze *Ases*, pri čemer so osnova glagolske predloge.

Na izboljšano delovanje sintetizatorja govora lahko jezikovno procesiranje vpliva predvsem s še boljšo analizo besedila, ki jo lahko uporabimo tako v postopku gradnje govorne baze kot tudi pri analizi besedila v fazi sintetiziranja govora

Na podlagi identificiranih težav delovanja jezikovnega modula obstoječega sintetizatorja smo veliko pozornosti posvetili možnim izboljšavam jezikovnega analizatorja. Posebej pomembni med njimi sta izboljšanje pomenske analize povedi in *določanje vrste povedi*, ki ima še posebej veliko težo tudi v postopku gradnje govorne baze, gl. poglavje 4.

Raziskali smo tudi možnost pohitritve odzivnosti oz. latence jezikovnega analizatorja s pomočjo postopkov za učinkovito računalniško predstavitev leksikalnih jezikovnih virov, ki jih razvijamo v okviru projekta OptiLEX. Pri tem rešujemo vrsto problemov, kot so: zahteva po delovanju v realnem času, zahteva po kompaktnem zapisu jezikovnih virov ter zahteva po majhnem odtisu zapisa jezikovnih virov v delovnem pomnilniku [4].

3.1   Samodejno določanje vrste povedi

Pri izbiri optimalnih fonetično in drugače uravnoteženih besedilnih predlog za govorno bazo smo se posvetili izboljšanemu označevanju povedi, predvsem označevanju in določanju vrste povedi, kjer smo poleg klasične metode s pomočjo pravil analizirali tudi možnost določanja vrste povedi s pomočjo različnih metod strojnega učenja. Razviti postopek smo uporabili tudi v izboljšani različici jezikovnega analizatorja.

Za potrebe določanja vrste povedi, predvsem večstavčnih, smo definirali ustrezne zapise. Osnovni zapis, prilagojen zdajšnjemu zapisu analize povedi, je kompleksen. Poved je zapisana v posebnem meta jeziku, ki vsebuje vse informacije, ki jih lahko izluščimo iz povedi na osnovi avtomatske stavčne analize.

Tak zapis omogoča združen zapis večstavčnih povedi, v katerem nastopajo tudi vse stavčne odvisnosti. Stavki v povedi namreč lahko nastopajo kot priredja, soredja ali podredja. V primeru podredja pa je navzoča tudi informacija glede njihove odvisnosti, torej ali gre za prilastkov, osebkov, predmetni, prislovni ali kateri drugi odvisnik.

Poleg tega daljšega zapisa smo definirali tudi skrajšan, poenostavljeni zapis, ki podaja informacijo o vrsti povedi, ki smo ga uporabili pri izbiri končne množice izbranih povedi.

Ker izboljšani stavčni analizator svojo analizo zapiše v daljšem zapisu, smo razvili pretvornik iz tega zapisa v poenostavljeni zapis, ki ohrani le najbolj pomembne podatke o tipu strukture povedi. Primer tega zapisa za poved "*Miha, ki je bil lačen, je pojedel malico.*" je "*[[-gp/[[-r-/]]]]*".

S pomočjo pretvornika smo vhodni množici povedi dodali informacijo o *vrsti povedi*, ta pa je v postopku izbire povedi služila kot eden izmed parametrov pri izbiri in uravnoteženju ciljnega števila povedi. Analizator, ki zapiše analizo povedi z informacijo o vrsti povedi v daljši zapis, smo realizirali s pomočjo pravil in z metodami strojnega učenja. V analizator smo vgradili rešitev, ki je ob evaluaciji dala najboljše rezultate [5].

4 Govorna zbirka CITYVOICE

V osrednjem delu analize smo izhajali predvsem iz zaznanih pomanjkljivosti obstoječega sintetizatorja govora, *eBralca*, ki bi jih bilo mogoče izboljšati, ter zbranih uporabniških zahtev ter identificirali priložnosti za razvoj izboljšanega produkta. Sem vsekakor sodijo težave zaradi neoptimalne govorne baze, zato smo velik del analize posvetili možnim izboljšavam pri gradnji nove govorne baze, ki pomembno vpliva na izboljšano delovanje akustičnega modula sintetizatorja govora.

Izbira velikosti govorne zbirke je posledica kompromisa med želenim številom variacij glasov oz. njihovim pokrtjem na eni strani ter časom in stroški, vezanimi na razvoj, na drugi strani. Upoštevali smo tudi čas za kasnejše preiskovanje govorne zbirke in potreben prostor za njeno hranjenje. Najpomembnejši preostali dejavniki, ki smo jih upoštevali pri snovanju nove govorne zbirke za sintezo govora, so: izbira vsebine posnetkov, izbira govorcev, postopek snemanja in označevanje posnetkov.

Izbor povedi za govorno bazo poteka na osnovi večjega števila kriterijev, med katerimi so pokritost osnovnih govornih enot, uravnoteženost dolžin, tipov in vrst povedi, pravilna fonetična transkripcija itd [6]. Med njimi bi posebej omenili *vrsto povedi*. Ta omogoča bolj natančno modeliranje prozodije, ki je pomembna za naravnost sintetičnega govora. Ena od glavnih težav starega postopka je bila v tem, da nismo imeli orodja za avtomatsko določanje vrste povedi, kar bi lahko bistveno pohitrilo in izboljšalo izbiro povedi.

Pri izbiri optimalnih fonetično in drugače uravnoteženih vsebin (povedi) smo se zato v veliki meri posvetili izboljšanemu označevanju povedi, predvsem označevanju in določanju *vrste povedi*, kjer smo poleg klasične metode s pomočjo pravil analizirali tudi možnost določanja vrste povedi s pomočjo različnih metod strojnega učenja, kot je to opisano v poglavju 3.1.

Za razliko od avtomatskega določanja *tipa* povedi, ki je v večini primerov odvisna od končnega ločila (trdilni, vprašalni, velelni) je določanje *vrste* povedi precej bolj zapleteno. Če je poved enostavčna, težav ni. Če pa je poved večstavčna, je potrebna zahtevna analiza povedi in vseh njenih stavkov za določitev njihove odvisnosti. Ti lahko nastopajo kot priredja, soredja ali podredja.

Snemanje govornega gradiva je potekalo ob prisotnosti izkušenega snemalnega operaterja z namenom, da se je preprečilo neustrezne izgovarjave besedilnih predlog in napake pri snemanju govora, gl. sliko 2.

Slika 2: Govorka med snemanjem oz. branjem pripravljenega gradiva v tonskem studiu. V ozadju tonski tehnik, ki med snemanjem na zaslonu spremlja tako signal laringografa Lx kot tudi mikrofonski signal Sp.

Govorcu smo pred snemalnimi sejami podali ustrezna navodila in ga zaprosili, da povedi prebira razločno in enakomerno hitro. Med branjem besedila so imeli govorci nameščene elektrode laringografa, s katerimi smo spremljali nihanje njihovih glasilk zaradi lažjega kasnejšega označevanja osnovnih period govornega signala, gl. sliki 1 in 2. Uporabili smo tri nivoje anotacij oz. prepisov govorjenega besedila: grafemski prepis, fonetični prepis in prozodijske oznake (slika 3).
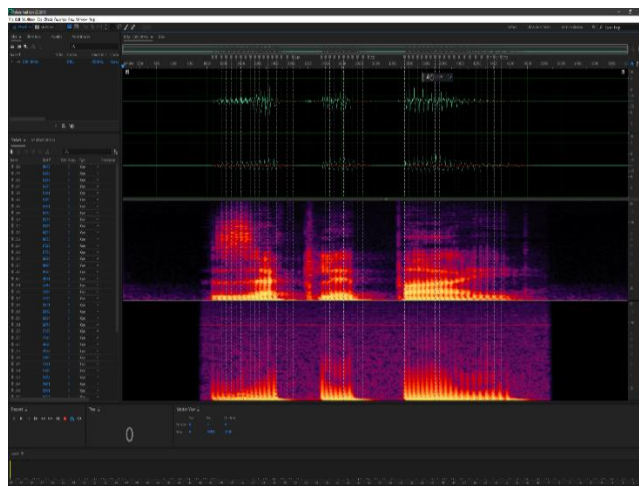
Slika 3: Primer govornega signala z označenimi osnovnimi periodami. Zgoraj je govorni signal posnet z mikrofonom, sledi signal laringografa Lx in spektralna prikaza obeh signalov. Navpične črte predstavljajo oznake period govornega signala.

Uporabili smo tri nivoje anotacij oz. prepisov govorjenega besedila: grafemski prepis, fonetični prepis in prozodijske oznake (slika 3).

5 Akustično modeliranje govora s hibridnim postopkom

Specifikacije končnih uporabnikov so narekovale hitro odzivnost sintetizatorja govora ter kompaktno velikost pomnilniškega prostora, potrebnega za namestitev ter delovanje sintetizatorja govora.

To je ponovno narekovalo izvedbeno različico končnega sintetizatorja govora, ki, podobno kot pri *eBralcu*, temelji na parametrični predstavitvi zakonitosti govora v slovenskem jeziku [1] z uporabo prikritih Markovovih modelov PMM [7,8]. Teh zakonitosti se sintetizator govora nauči samodejno na podlagi obsežnega učnega govornega korpusa, ki je bil posebej posnet v te namene, in ki vključuje relevantne akustične ter prozodijske fenomene, ki so značilni za govorjeno slovenščino.

Sinteza govora z uporabo prikritih modelov Markova (PMM) ima v primerjavi z bolj klasičnimi postopki tvorbe govora, pri katerih govor tvorimo z »lepljenjem« krajših ali daljših govornih izsekov, nekaj privlačnih prednosti, saj za zadovoljivo kakovost govora potrebujemo razmeroma majhno govorno zbirko (zadošča že ura ali več posnetega govora). Nadalje omogoča enovito, kakovostno in sočasno modeliranje akustičnih in prozodičnih značilnosti govora. Omogoča tudi zgoščen zapis akustičnega in prozodijskega modela govora, saj za tvorbo govora ni treba hraniti celotne izvorne govorne zbirke.

Po drugi strani pa imajo sistemi PMM tudi nekatere slabosti. Govor je lahko na trenutke nekoliko manj razumljiv. Govor ima lahko ponekod značilen »robotski« prizvok, ki je posledica parametrizacije govornega signala.

Podrobna analiza uporabniške izkušnje slepih in slabovidnih uporabnikov *eBralca* je pokazala, da je še posebej slabo razumljiva sinteza govora *krajših* besednih enot, kot je denimo črkovanje, ki ga ta skupine končnih uporabnikov zelo pogosto uporablja. Slepi in slabovidni uporabniki namreč za uspešno uporabo računalnika uporabljajo t. i. bralnike zaslona, programe, ki s pomočjo sintetizatorja govora uporabnikom sporočajo informacije o tem, kaj se prikazuje na ekranu.

Za točno sliko ekrana zelo pogosto uporabijo *branje v načinu črkovanja*, ki besede bere črko po črko, oz. znak po znak. Pri tem je potrebna velika hitrost branja oz. izgovarjanja, pri čemer metoda PMM ni najbolj uporabna, ker je premalo odzivna ter rezultira v manj razumljivih kratkih izoliranih segmentih.

Ker je postopek sinteze s pomočjo PMM manj primeren za uspešno sintezo kratkih govornih segmentov, smo se odločili za razvoj unikatnega **hibridnega akustičnega modela**, ki omogoča kakovostno sintezo govora *kratkih* govornih segmentov s pomočjo difonskega sintetizatorja govora z uporabo konkatenacije osnovnih govornih segmentov z metodo TD-PSOLA [9,10], daljši govorni segmenti pa so generirani z uporabo pristopa s pomočjo prikritih Markovovih modelov PMM.

6 Zaključek

V prispevku smo predstavili zasnovo in izvedbo novega visokokakovostnega sintetizatorja govora za slovenski jezik, *eBralec4*. Za samodejno tvorjenje govora smo uporabili optimizacijo postopka pridobivanja govornih jezikovnih virov v kombinaciji z napredno parametrično predstavitvijo govora z modeliranjem govora s pomočjo prikritih Markovih modelov ter difonsko konkatenacijsko sintezo govora za sintezo krajših govornih segmentov, predvsem pri črkovanju.

Izdelali smo govorno zbirko za nov ženski glas, »*Nadja eBralec*«. Pri izdelavi govorne zbirke smo posebno pozornost namenili določanju optimalnih pogojev za snemanje ter določanju optimalnih fonetično in drugače uravnoteženih besedilnih vsebin, pri čemer smo dodali raznovrstnost povedi glede na novo razviti postopek samodejnega določanja zvrsti povedi.

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Sound 2121: The Future of Music

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Figure 1: Concept: We see a future where we no longer need tangible interfaces. Rather humans would let go of these interfaces to give way to a more seamless music interface.

ABSTRACT

Music has always been an integral part of our society since the prehistoric times. For the past five centuries, music instruments have been perfected and the industry is nowadays worth billions of dollars. With recent innovations in computer interfaces, music information retrieval and artificial intelligence, playing music is not in the sole domain of humans anymore. Thus we are faced with the questions: "What

really is music? What is the future of music? How will we consume music a hundred years from now?" In this paper, we shortly present how music has been consumed throughout history and how we imagine it a century from now. We make a wild speculation about the future of music and its interface, while encouraging the discussion regarding these visions.

KEYWORDS

music, interface, interaction design, sound, future

1 INTRODUCTION

Music is considered to be culturally universal [2, 17] and present across all parts of the globe, reshaping the ways human live, express themselves and convey emotions [9, 13]. Humans have been expressing themselves through music

for a very long time. It is believed that music originated from naturally occurring sounds and rhythms that humans echoed by merging them in patterns, making repetitions while changing tonality using their voice, hands clapping [11], and smacking stones, sticks and other objects around them [12]. For example, one of such ambient sound is rain, that has a calming and a relaxing effect, even now since early humans felt safe during the rain while predators do not hunt [1]. Music has also helped humans in terms of survival, forging a sense of group identity and mutual trust [4].

The voice box, which allowed humans to sing, first emerged about a million years [13] ago and they learned how to use it around 530,000 years ago [14]. The voice box is considered the first music instrument. Besides voice and hands, the earlier instruments were the objects found in the environment such as sticks and stones. Some authors argue that since the oldest instruments found are so sophisticated (such as over 40 thousand year-old bone flutes [4, 8, 19]) there must have been less sophisticated instruments used by humans before [4, 14]. Nevertheless, the instruments the humans made and used have rapidly evolved together with the complexity of music compositions in the last couple of centuries. In this period a variety of string, brass, percussion and woodwind instruments have evolved from earlier less sophisticated ones [3].

As newer technologies are introduced, other ways of creating, producing, interacting with and even sharing music [18] are also taking place. MIDI interfaces, electric guitars and synthesizers are just some of the devices made of circuits that imitate traditional music instruments, and can be connected to the computer. Novel algorithms, music information retrieval (MIR) [5, 6] and artificial intelligence (AI) techniques allow us to work with and create new music content. With the advent of social platforms, sharing music on a grand scale has become a norm.

Throughout this evolution one of the main components of music is expressing and generating emotions. Changes in vocal parameters occurring during speech as well as singing have been shown to effect our state of emotions [10]. It has been also confirmed that sadness, happiness and other emotions can be communicated to listeners by music composers. As such, music is considered as a popular and easily-applicable means for triggering emotions [10] and is globally consumed by everyone. We listen to music in order to make us happy, sad, to reminisce or reflect on our emotions.

This paper attempts to share the authors' visions on how humans will consume and interact with music in the future. We present our position based on the trends in how music instruments and music consumption have evolved throughout the history. These visions have also emerged from shared ideas in our small crowd-sourcing study we conducted online. We present two scenarios of how future music

consumption might look like. Lastly, we present questions and challenges that provoke discussions involving usability, security, intellectual property and many other relevant key topics on music.

2 RE-IMAGINING MUSIC AND THE MUSIC INTERFACE

Humans create and consume music for four different purposes: (1) dancing as a social exercise, (2) providing a common form of personal or community entertainment, (3) communicating ideas and emotions and (4) having and celebrating rituals and other activities [13]. While these purposes come in handy for a variety of music activities, this position paper is focusing on music listening only. This is present in (1) where listening is a shared experience, as well as in (2) and (4) where listening can be a shared and also a personal experience.

When looking at how music listening has evolved in history, we can envision human tribes gathered around the fire where one or several members performed a music piece. This type of music listening has been present for a long period of time and even nowadays people gather in live concerts to listen to music. With recordings, music has moved to people's homes and the group has been reduced to family members and friends and listening become more personal. The headphones enabled users to experience music individually and the Walkman enabled us to do it on-the-go. Smartphones and internet have expanded the instant availability of music but the consumption remained mainly personal. The advances in virtually reality (VR) and augmented reality (AR) have made personal music listening an immersive experience with lights and visualisations augmenting music. Looking at how listening to music has moved closer and closer to us with in-ear headphones that we even try to insert as close as possible to our body, it is not far-fetched if our vision is that listening to music will move inside our heads.

Music is not just about sounds as it is also about rhythmic vibrations; for example, it has been noted that the part of the brain responsible for hearing, works perfectly in deaf people as well [16]. In order to feel music, we do not need to hear it but rather receive the vibrations to the hearing region of the brain. Because of this, we envision a future where we do not need external devices (such as headphones or speakers) to be able to hear music, enjoy concerts, etc. Rather we will be listening to music within our brain in a seamless way. Currently, researchers are already experimenting with micro-controllers plugged into the brain and we envision having similar devices plugged into the hearing part of our brain. Sound signals will be delivered straight into our auditory cortex. People will no longer have to depend on their ears to listen and hear things. As such, people could enjoy music even while spacewalking, diving, skiing or surfing.
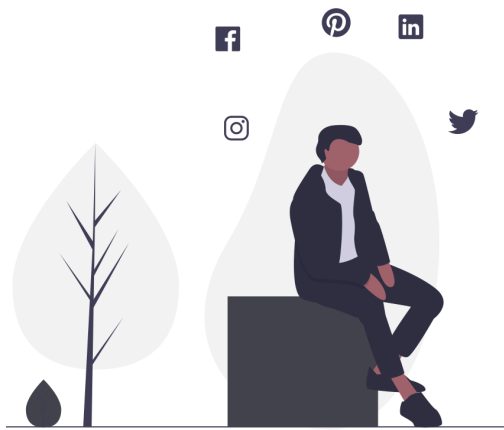
Figure 2: Concept: Humans do not need tablets, mobile devices, or digital walls. Ideas and concepts are conceived in and are played into our brains from the surrounding objects.

At the same time, we envision a future where biological and artificial objects around us will be connected to the cloud [15] where they will have access to a superb computing power. These objects will be equipped with for example nano-chips that will allow them to be part of the global link of information and capable of moving it depending on the needs. This is partly also a vision of IoT [20], which we are expanding to music listening. These technologies will allow humans and objects to telepathically communicate.

In the future humans will be able to amplify their emotions by the music naturally produced by the objects surrounding them (see Fig 2. Traditionally, there are two ways on how music becomes a gateway for our emotions. If we feel sad, we wish to hear music so we can reflect, dive deeper and understand the sadness that we feel [emotions going in]. This experience gives us lessons on how to manage our emotions, and how to grow stronger. At times, we may feel sad so we wish to hear music in order to improve our mood [emotions going out] and spend the better part of our days. In our envisioned interface, humans can create gateways for their emotions with music.

Algorithms will design and produce rhythms in on-the-fly and have them played via vibration by these nearby objects (moving on their own). Humans will simply need to think of their emotions and sounds, and the objects near them will seamlessly produce the vibrations recreating these sounds. Objects around us, will produce a unique rhythm, providing a new definition of audio augmented reality. Humans will get to enjoy their favorite sounds and rhythms through this seamless interface and played directly in their minds. We

believe that through this interface, humans will be able to listen and consume music, various melodies and sounds while being able to perform their daily tasks at the same time.

As humans are connected to the global highway of information, unobtrusive sensors no longer need to detect and distinguish the current affect that they feel. Because of their neurological connection to the world, their emotions are easily read and "felt" by the objects around them. Similar to how empathetic spaces that are context and emotion aware, objects nearby will be act as local producers of music to either amplify or address the emotions that humans are feeling.

3 DESIGN SCENARIOS

To better explain how we re-imagined this music interface, we describe two design scenarios with our vision in different contexts.

Figure 3: Concept: Listening to music while surfing in the wide ocean will no longer require waterproof music gear. Rather, natural elements that are interlinked together create vibrations that humans can hear. Humans can finally achieve a non-obtrusive way of listening music while enjoying their wet hobbies.

Surfing. It is a lovely sunny and windy day. Cuauthli decides that these are perfect conditions to go surfing (as seen in Fig 3). While doing it he likes to feel the adrenaline rush with the sound of rock music. In 2020 Cuauthli would have to wear water-proof in-ear headphones tightly plugged into his ears to prevent them from falling off. This would prevent him to hear the surroundings. However, when surfing he also has to hear the surroundings for his safety. In order to do this, he would have to balance spatial awareness and enjoy at the same time, which takes a lot of effort [7]. In 2121 he will not have this problem anymore since, not only can he hear his preferred rock music, but the music blends with the sound of the environment around him. In addition, if Cuauthli wants to listen to the environment, the algorithm understands this and can mute the music just through his thoughts. This can be done using two approaches. First, Cuauthli can listen to

his favorite track in full volume and when he wants to listen to the background noise, a chip inside his head can understand this and allows the environment sound to be heard. Second, the noise of the environment around him can be used as an input and then be used to create a new sound that blends with his taste and with the noise around him. These can be based on Cuauthli's favorite tunes and algorithms produce a specific tune that fits his current preferences and allows him to not lose the connection with the environment around him.

Amplifying emotions at the blink of an eye. It is a rainy day and Cuauthli is sitting by the window, thinking about his loved one. Since he is in Germany on a research visit, he misses her dearly. Cuauthli would love to get lost in his thinking about her. He then decides to listen to a song, which helps him reflect on his feelings for her and on his current mood. The music helps him bringing back the the memories. This is done by reducing other background noise as inputs and allows him to focus on the memories that are in his brain. After a while, the rain stops falling and Cuauthli needs to go back to work, but is feeling somewhat depressed. He thinks of a happy and exciting song, which starts playing and helps him to focus on his work as well as changes his mood. The algorithms and his neurological link take care of processing his thoughts and produce the sounds that he needs to hear.

4 CONCLUSION

The visions and scenarios we presented come with their respective issues and challenges in implementation and in policy design. If we imagine a natural and seamless interface, evaluating its usability will introduce a new paradigm for HCI researchers. Will existing models such as Fitts' Law (which has always worked on any interface developed - mechanical, digital, virtual) still work in neurological links managed by our seamless thoughts? The intangible interaction provided by this *"online network"* could potentially blur concepts such as piracy and intellectual property. As music is composed by ubiquitous algorithms connected to our personal thoughts and feelings, are all our emotions and the music that are generated by them considered unique and shareable? These, among many others, are interesting questions that we leave to our readers as we re-imagined a music interface. While these visions appear to be very far from reality, we are only left with our own thoughts to begin with and maybe hopefully in the not so near future too.

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Ohranjanje kulturne dediščine s pomočjo navidezne in obogatene resničnosti

Cultural heritage preservation through virtual and augmented reality

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Povzetek

Kulturna dediščina izginja zaradi različnih dejavnikov in pri njenem ohranjanju si v zadnjih letih vse pogosteje pomagamo s sodobnimi tehnologijami, ki omogočajo njeno digitalizacijo. Kot primer dobre prakse predstavimo uporabo navidezne in obogatene resničnosti. Vedno pogosteje se uporablja tudi mešana resničnost, ki združuje virtualne objekte in resnično okolje. V članku predstavljamo možnost virtualne razstave muzejskih eksponatov s pomočjo očal Microsoft HoloLens in igralnega pogona Unity. V ta namen smo v okviru diplomske naloge ustvarili aplikacijo, ki omogoča interakcijo s šestimi artefakti iz časov Rimljanov, najdenih na štirih različnih nahajališčih na Balkanu. V članku predstavljamo prednosti in slabosti, ki jih taka predstavitev nudi uporabniku in kako lahko le-to uporabimo za ohranjanje kulturne dediščine.

Ključne besede

Kulturna dediščina, mešana resničnost, obogatena resničnost, navidezna resničnost, Microsoft HoloLens

Abstract

Cultural heritage is disappearing due to various factors. In recent years, we have increasingly used modern technologies together with its digitalization in order to preserve it. As an example of good practice, we present the use of virtual and augmented reality. Increasingly, mixed reality is also used combining virtual objects and a real environment. In this article, we present the possibility of virtual exhibition of museum artefacts with the help of Microsoft HoloLens glasses and Unity game engine. For that purpose, we created an application that enables the interaction between user and six artefacts from Roman era, found in four different sites through the Balkan. In this article the advantages and disadvantages of such a presentation are presented and the possibility of its use for cultural heritage preservation.

Keywords

Cultural heritage, mixed reality, virtual reality, augmented reality, Microsoft HoloLens

1 Uvod

Kulturna dediščina je podedovana zapuščina, ohranjena v sedanjosti. V osnovi jo delimo na materialno in nematerialno. Z ohranjanjem kulturne dediščine se ukvarja UNESCO, agencija znotraj organizacije Združenih narodov, ki je na seznam kulturne dediščine uvrstila 1121 območij [1]. Od tega jih je kar 53 ogroženih zaradi naravnih katastrof, vremenskih sprememb, vojn in človeške malomarnosti. Zaradi razvoja in priljubljenosti sodobnih tehnologij, so njihovo vrednost prepoznali tudi pri ohranjanju kulturne dediščine. Več milijonov turistov, ki vsakoletno obiskujejo znamenitosti po svetu, bi lahko namesto dolgih potovanj in visokih stroškov iz udobja domačega fotelja doživeli cenejšo, ampak še vedno zadovoljivo izkušnjo, hkrati pa s tem tudi te znamenitosti razbremenili in tako pripomogli pri ohranjanju kulturne dediščine tudi za prihodnje generacije.

Problem izginjanja kulturne dediščine in priložnost njenega ohranjanja za prihodnje generacije s pomočjo sodobnih tehnologij smo želeli preveriti tudi v praksi. Izdelali smo aplikacijo za prikazovanje artefaktov iz časov Rimljanov, ki deluje na »pametnih« očalih za prikazovanje mešane resničnosti, Microsoft HoloLens in uporabniku omogoča osnovno interakcijo z artefakti ter njihov nemoten ogled iz vseh smeri.

Članek sestavlja pet razdelkov. V drugem razdelku predstavimo obstoječe aplikacije obogatene in mešane resničnosti, ki se uporabljajo pri ohranjanju kulturne dediščine. Naslednji razdelek, to je tretji, nas seznani z načrtovanjem in izdelavo aplikacije. V četrtem razdelku predstavimo delovanje aplikacije. Zadnji, peti razdelek je namenjen predstavitvi doseženih rezultatov.

2 Pregled področja

Čeprav sodobne tehnologije v javnosti pogosto označujejo kot grožnjo, ki lahko privede v odvisnost, socialno izolacijo in zmanjša ustvarjalnost [2], so ravno te tehnološke inovacije pogosto ključne pri ohranjanju kulturne dediščine za prihodne generacije. V zadnjih letih med najbolj priljubljene tehnologije za ohranjanje kulturne dediščine štejemo navidezno, obogateno in mešano resničnost.

S stališča računalništva štejemo pod pojem navidezna resničnost področje, katerega cilj je ustvariti virtualni svet, ki omogoča interakcijo z uporabnikom, medtem ko uporablja posebne naprave za simulacijo okolja, ki skrbijo za čim bolj realno izkušnjo. Obogatena resničnost se za razliko od navidezne osredotoča na dopolnitev resničnega sveta s pomočjo dodajanja plasti virtualnih objektov ali dodatnih informacij v resnično okolje.

Priljubljenost obogatene resničnosti z leti eksponentno narašča, vendar so v raziskavi ohranjanja kulturne dediščine na evropskem območju [3] ugotovili, da trenutno obstaja zelo malo aplikacij, ki jih večinoma razvijajo muzeji oziroma ustanove za ohranjanje kulturne dediščine [4]. Aplikacije se večinoma aktivirajo na podlagi sprožilca (npr. simbol, označba, predmet, lokacija naprave), v manjši meri pa tudi na podlagi pogleda.

Mobilna aplikacija England Originals [1] ter funkcija Pocket Gallery [2] znotraj aplikacije Google Arts&Culture [3] delujeta na podoben način – ob zaznavi ravne površine prikažeta tridimenzionalni model v resničnem okolju. Manipulacija z modelom je mogoča s premikanjem telefona ter upravljanjem preko zaslona. Tudi mobilna aplikacija Civilisations AR [4] deluje na enak način, vendar v tem primeru virtualni model našega planeta lebdi v zraku, na njem pa so označena najdišča artefaktov, ki si jih lahko s klikom na zaslon mobilne naprave tudi bolj natančno ogledamo ter nad njimi izvajamo osnovne geometrijske transformacije.

Aplikacije za ohranjanje kulturne dediščine s pomočjo obogatene resničnosti zelo uspešno vključujejo v turistično ponudbo tudi v Sloveniji, kjer lahko izpostavimo tri aplikacije. Travel AR Slovenia [5] sproži obogatitev okolice na prenosni napravi ob zaznavi markerja obogatene resničnosti in nam ob avdio vodenju omogoča ogled tridimenzionalnih rekonstrukcij kulturne dediščine Kočevja in Črnomlja. Na podoben način deluje tudi aplikacija AR Kranj [6], s pomočjo katere lahko spoznamo mesto Kranj in njegovo zgodovino. Kulturno dediščino lahko s pomočjo obogatene resničnosti spoznamo tudi v nekdanjem samostanu Žička Kartuzija, ki je danes v ruševinah, kjer s pomočjo pametnih očal in avdio vodnikov skozi tridimenzionalne modele vidimo, kako je samostan izgledal v vsej svoji veličini.

Kontinuum virtualnosti, katerega avtorja sta Paul Milgram in Fumio Kishino se osredotoča na definicijo mešane resničnosti. Po njuni definiciji mešano resničnost sestavljata obogatena resničnost, kjer virtualni elementi obogatijo resnični svet, ter obogatena virtualnost, kjer elementi resničnega sveta obogatijo virtualni svet. Tako lahko mešano resničnost predstavimo tudi kot nadmnožico obogatene in navidezne resničnosti.

Aplikacije mešane resničnosti se za ohranjanje kulturne dediščine v času pisanja tega članka uporabljajo zgolj v manjšem obsegu [5]. Možna razloga za to sta lahko visoka cena in relativno nova tehnologija.

HoloTour [7] je produkt podjetja Microsoft, ki nam omogoča ogled zgodovine Rima in skrivnosti Machu Picchua na napravi za prikazovanje mešane resničnosti, Microsoft HoloLens. Z aplikacijo upravljamo s pomočjo gest in glasovnih ukazov. Mešano resničnost vse pogosteje vključujejo tudi v muzeje, kjer lahko izpostavimo aplikaciji HoloMuse [8] in Holomuseum [9] (obe sta namenjeni za uporabo na napravi Microsoft HoloLens), ki uporabniku omogočata spoznavanje arheoloških zbirk artefaktov, s katerimi lahko poljubno manipuliramo, česar v pravem muzeju ne moremo doseči.

3 Načrtovanje in izdelava aplikacije

Pri snovanju aplikacije, nastajala je v času diplomskega dela, smo se zgledovali po obstoječih aplikacijah za prikazovanje mešane resničnosti. Pri tem pa smo se srečali s težavo, da gre pri očalih HoloLens za dokaj novo napravo, ki je cenovno težje dostopna. Ob tem je potrebno poudariti, da se knjižnice z novimi funkcionalnostmi še vedno razvijajo, zato je ustrezne literature dokaj malo, oziroma v njej avtorji opisujejo starejše verzije knjižnic, ki se več ne uporabljajo. Zato smo si zamislili enostavno, ampak še vedno vabljivo aplikacijo, skozi katero so predstavljene različne možnosti uporabe mešane resničnosti s pomočjo očal HoloLens.

Predstavljena aplikacija spada pod obogateno resničnost, ki pa bi lahko postala aplikacija mešane resničnosti v primeru, da bi se pojavila potreba po tem, tako da bi uporabljenim objektom dodali zavedanje okolice. Aplikacija namreč deluje na napravi za

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prikazovanje mešane resničnosti, Microsoft HoloLens, ki to v osnovi omogoča.
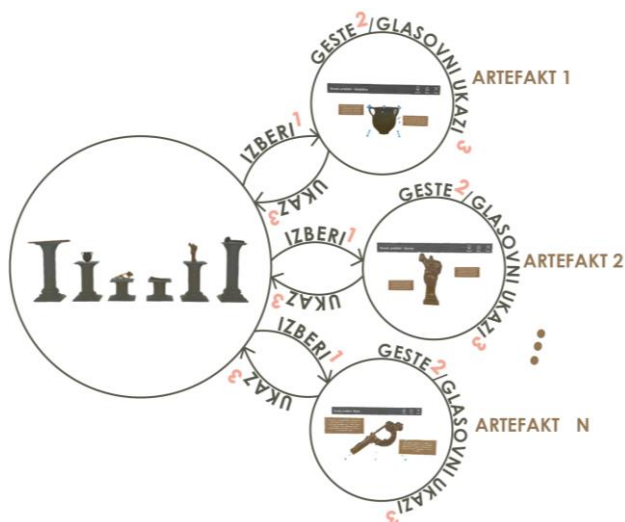
Slika 1: Shematski prikaz delovanja aplikacije
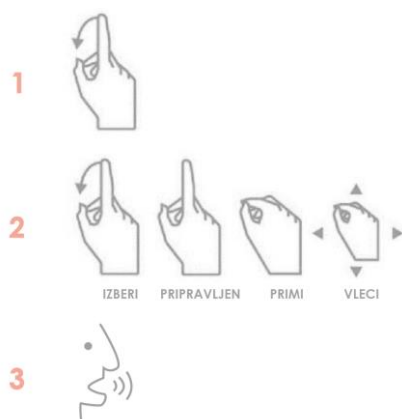
Slika 2: Osnovna načina interakcije z HoloLens, ki smo jih uporabili v aplikaciji (geste in glasovno upravljanje)

Aplikacijo smo razdelili na različne scene, kot prikazuje slika 1, med katerimi se lahko premikamo z uporabo osnovnih načinov interakcije s HoloLens, kot prikazuje slika 2.

3.1 Izdelava aplikacije

Prvi korak pri izdelavi aplikacije za razstavo muzejskih eksponatov s pomočjo mešane resničnosti, je priprava objektov. Osredje mesto na razstavi so zasedali eksponati s štirih nekdanjih rimskih naselbin: Viminacium in Municipium v Srbiji, Aquae v Bosni in Hercegovini ter Dyrrachium v Albaniji, ki smo jih dobili v elektronski obliki, vendar jih je bilo potrebno pred uporabo v naši aplikaciji obdelati. V ta namen smo uporabili animacijski paket Blender, v katerem smo zmanjšali število točk in mnogokotnikov, kot prikazuje tabela 1. Število točk je bilo potrebno zmanjšati zaradi procesorske moči in velikosti pomnilnika na napravi HoloLens.

Tabela 1: Število mnogokotnikov pred in po decimaciji

Objekt	Število mnogokotnikov pred decimacijo	Število mnogokotnikov po decimaciji
Artefakt 1	3.268.685	490.301
Artefakt 2	448.881	44.877
Artefakt 3	422.978	42.282
Artefakt 4	124.764	43.666
Artefakt 5	146.228	29.244
Artefakt 6	97.762	9.437

Za večjo atraktivnost aplikacije, smo dodatno zmodelirali še steber v slogu rimske arhitekture, na katere smo v predstavitvi nato postavili artefakte. Vse objekte smo nato izvozili v grafični pogon Unity.

V igralnem pogonu Unity smo ustvarili nov projekt ter namestili in konfigurirali orodje, ki omogoča razvoj aplikacij mešane in obogatene resničnosti, imenovano »Mixed Reality Toolkit«, oziroma krajše MRTK. Aplikacijo smo razdelili na posamezne dele imenovane scene, ki smo jih uporabili kot samostojne enote. V vsako izmed scen smo dodali izbrane objekte ter jim dodali interaktivne komponente, ki so nam omogočile interakcijo z artefakti. Interakcija s HoloLens je možna na tri osnovne načine: s pogledom, kretnjo ali glasovnim upravljanjem. Vse tri načine smo implementirali v našo aplikacijo.

4 Predstavitev rezultatov

Aplikacijo za ohranjanje kulturne dediščine s pomočjo navidezne in obogatene resničnosti smo razvili skozi različne stopnje, ki skupaj sestavljajo celoto; delujočo aplikacijo na napravi za prikaz mešane resničnosti Microsoft HoloLens, skozi katero lahko spoznamo artefakte iz časov Rimljanov.

Ob njenem zagonu se nam prikaže glavna scena, ki prikazuje šest stebrov, kot prikazuje slika 3. Na vsakega izmed stebrov je postavljen po en artefakt iz rimske dobe. Za izboljšano uporabniško izkušnjo izleta v preteklost, se v ozadju predvaja glasba s časa Rimskega imperija, kot si jo danes predstavljajo muzikologi.

Slika 3: Glavna scena s šestimi artefakti, ki so postavljeni na različno visoke stebre

Artefaktov pa si ni možno ogledovati zgolj od daleč, ampak si jih lahko ogledamo tudi natančneje. Za dostop do scene

posameznega artefakta usmerimo pogled v artefakt ter z gesto, ki ponazarja klik, preidemo na novo sceno, kot prikazuje slika 4.

Slika 4: Prikaz posamezne scene enega izmed artefaktov

Na tej sceni lahko nad artefaktom izvajamo osnovne geometrijske transformacije (spreminjanje velikosti, rotiranje in premikanje) s pomočjo prijemanja ročajev ob straneh artefakta. Na takšen način lahko artefakt pogledamo iz vseh smeri, česar v realnem muzeju ne moremo doseči. Ob straneh artefakta se prikažeta dve ploščici, na katerih sta zapisani zanimivosti o življenju Rimljanov. Po želji jih lahko z usmeritvijo pogleda in gesto, ki ponazarja klik, zapremo in vso pozornost usmerimo v artefakt.

Na sceni, ki prikazuje artefakte posamezno, se bo nad njimi pojavila nadzorna plošča, ki omogoča prekinitev predvajanja glasbe, vrnitev v glavno sceno; po želji pa lahko kontrolno ploščo tudi zapremo. Vse naštete ukaze izvedemo z usmeritvijo pogleda v izbrano akcijo (gumb) in gesto, ki ponazarja klik. Ob usmeritvi pogleda v želeni gumb se nam pod njim izpiše ključna beseda, s katero lahko izvedemo ukaz.

Sceno, ki prikazuje posamezen artefakt, lahko upravljamo tudi s štirimi glasovnimi ukazi. Prvi ukaz s ključno besedo »Menu« se uporablja v primeru, da smo pred tem nadzorno ploščo zaprli. Nadzorna plošča se bo ob zaznavi ukaza ponovno prikazala. Drugi ukaz s ključno besedo »Sound« se uporablja v primeru, ko smo pred tem predvajanje glasbe ustavili. Ob zaznavi ukaza se bo glasba predvajala naprej. Tretji ukaz s ključno besedo »Close« se uporablja kot nadomestilo klika na gumb Close in nam ob zaznavi ukaza zapre nadzorno ploščo. Zadnji, četrti ukaz, s ključno besedo »Back«, se uporablja kot nadomestek klika na gumb Back in nam ob zaznavi ukaza ponovno prikaže glavno sceno.

Aplikacijo smo želeli tudi testirati na testnih uporabnikih in pridobiti njihov odziv, vendar to zaradi epidemiološke situacije glede COVID-19 ni bilo mogoče. Pričakujemo, da bi bili rezultati podobni rezultatom, predstavljenim v članku [6], saj avtorji tam med drugim opisujejo uporabniške izkušnje s podobno aplikacijo kot je naša.

5 Zaključek

V tem projektu smo izpostavili problem izginjanja kulturne dediščine, ki je posledica različnih dejavnikov (naravnih in človeških) ter želeli preveriti možnosti ohranjanja naše preteklosti s pomočjo sodobne tehnologije, mešane resničnosti. Razvili smo aplikacijo, ki nam omogoča ogled artefaktov iz časov Rimljanov s pomočjo naprave za prikazovanje mešane resničnosti Microsoft HoloLens.

Čeprav smo uspešno razvili aplikacijo, kot smo si jo zamislili, smo mnenja, da imata tako aplikacija kot tehnologija mešane ter obogatene resničnosti veliko možnost nadgradnje v prihodnosti. Največjo omejitev pri razvoju trenutno predstavlja naprava HoloLens in njene tehnične zmogljivosti, kot je npr. slabša ločljivost in majhno vidno polje na vizirju. Druga generacija Microsoftove naprave bi naj izboljšala vse slabosti naprave prejšnje generacije in omogočila bolj naravno interakcijo s hologrami.

Če smo v preteklosti razmišljali, kako prilagoditi objekte, da bodo lahko sprejeli več obiskovalcev, bomo v prihodnosti morali več pozornosti nameniti uporabi sodobnih tehnologij na različnih področjih, tudi ohranjanju kulturne dediščine. Obogatena in mešana resničnost sta vsekakor tehnologiji, ki ju lahko uporabimo na kateremkoli področju. Potrebujemo zgolj tridimenzionalne modele in zgodbo, ki bo pritegnila uporabnike, zgodbo, ki je sestavni del naše preteklosti, preteklosti, ki jo želimo ohraniti za prihodnje generacije.

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Predmetnik: oprijemljiv uporabniški vmesnik za informiranje turistov

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Slika 1: Vmesnik Predmetnika.

POVZETEK

Namen dela je zasnovati in raziskati možne vloge oprijemljivega uporabniškega vmesnika za informiranje turistov, ki bi dopolnjeval obstoječe oblike informiranja v turistično informacijskih centrih, nadomestil njihove pomanjkljivosti, a hkrati uporabil njihove prednosti. Vmesnik smo zasnovali na podlagi predhodnih raziskav in lastnih izkušenj ter ga poimenovali Predmetnik. Uporabniški vmesnik vsebuje posamezne enote - predmete, ki predstavljajo določeno turistično ponudbo. Ob dvigu predmeta uporabnik sproži prikaz vsebine na zaslonu. Opravljena uporabniška študija je pokazala, da je lahko Predmetnik prva točka informiranja v turistično informacijskih centrih, njegova prednost pa je v tem, da na enostaven in preprost način v kratkem času podaja informacije o doživetju posamezne turistične ponudbe.

KEYWORDS

oprijemljivi uporabniški vmesnik, turizem, informiranje turistov, turistični informacijski center, TIC

1 UVOD

Informiranje turistov v turistično informacijskih centrih (TIC) je omejeno na nekaj medijev ali virov, kot so turistični informator, tiskovine (letaki, prospekti, zemljevidi, brošure in zgibanke), zasloni, ki predvajajo videoposnetke, in računalniki (npr. zasloni na dotik). Težave tiskanih medijev so

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enosmerna komunikacija, težko posodabljanje, različna grafična razporeditev, poleg tega težko omogočajo nadaljnje iskanje informacij (npr. preko URL naslovov, ki jih je potrebno prepisati v brskalnik). Tiskovine imajo tudi prednosti, saj ne potrebujejo dodatne energije in so zelo prenosljive.

Težave zaslonov na dotik so zahtevano znanje za uporabo, čas, ki ga porabimo pri iskanju informacij, potrebno napajanje z energijo in nezmožnost odnesti informacije s seboj. Podobno kot tiskani mediji tudi neinteraktivni zasloni (angl. *public displays*) omogočajo povečini enosmerno komunikacijo s predvajanjem videoposnetkov turistične ponudbe. Ti so zelo dobrodošli za prvi vtis o ponudbi, vendar teh informacij obiskovalec ne more upravljati in lahko le čaka, da se vse informacije predvajajo.

Za raziskavo informiranja o turistični ponudbi smo zasnovali in izdelali oprijemljiv uporabniški vmesnik, imenovan Predmetnik. Sistem odpravlja težavno interakcijo z zasloni na dotik in nezmožnost interakcije z javnimi zasloni. Vmesnik je sestavljen iz predmetov, s katerimi lahko uporabnik rokuje in preko tega upravlja večpredstavnostne vsebine o določenem turističnem cilju, aktivnosti ali ponudbi na povezanem zaslonu. Za predmete našega vmesnika lahko izberemo lokalne izdelke, pridelke, spominke in različne predmete, ki so povezani z aktivnostmi. Predmeti, s katerimi uporabnik rokuje, preko zaslona predstavljajo določeno zgodbo, ki obogati turistično izkušnjo. Predmeti s tem postanejo "vstopna točka" in preko podanih zgodb spodbudijo željo po iskanju nadaljnjih informacij, ki so na voljo v TIC-u, kot na primer, kako priti do želene posamezne ponudbe ali cilja, zgodovino, ipd. Vse dodatne informacije so torej dosegljive preko tiskovin, spleta in turističnih informatirjev, ki so že na voljo v TIC-u.

2 PREGLED PODROČJA

Skupnost je že pred tremi desetletji izpostavila, da računalniki preprečujejo stik z okoljem [26], kar je spodbudilo ideje za uporavljanje digitalnih vsebin s pomočjo fizičnih predmetov [7]. Nekateri raziskovalci so šli še dlje in predstavili vizijo uporabe fizičnega sveta kot vmesnika za povezovanje objektov in površin z digitalnimi vsebinami [12]. Na osnovi teh del so oprijemljivi uporabniški vmesniki postali nova oblika interakcije [18], ki se uporablja na vse več področijih in za raznovrstne naloge [21], kot so: (i) shranjevanje, pridobivanje in rokovanje s podatki [1, 5, 19, 22], (ii) vizualizacija informacij preko oprijemljivih uporabniških vmesnikov [10, 23, 24], (iii) modeliranje in simulacije [2–4, 8, 11], (iv) upravljanje sistemov, kontrola in konfiguracija [3, 5, 14, 15, 22] in (v) izobraževanje, zabava in programski sistemi [3, 9, 13, 16, 17].

Tudi na področju turizma so že bile narejene raziskave, ki so za informiranje turistov uporabile koncepte oprijemljivih uporabniških vmesnikov. Sistem *Mementos* [6] je uporabnike preko žetonov (spominkov), ki so predtsavljali turistične znamenitosti ali infrastrukturo (restavracije, javni prevoz, ipd.),

na po mestu postavljenih kiosk računalnikih, ki so žetone prepoznali, vodil do želenih ciljev. *Tangible user Interface within Projector-based Mixed Reality* je s sledenjem figure, ki jo je uporabnik premikal po zemljevidu, na zaslonu prikazoval pripadajoči 3D prizor [27]. Pri drugi izvedbi je fizično figuro zamenjal uporabnik sam, ki je s premikanjem po na tleh projicirani maketi parka, upravljal prikaz lokacije. Oprijemljivi vmesniki so pogosto dostopni v muzejih. Na primer v [25] je oprijemljiv vmesnik za pridobitev informacij o določenem geološkem vzorcu kar vzorec sam, ki ob rokovanju poda zvočne in vizualne informacije o njem na projekciji. Vzorec je hkrati tudi bogat vir informacij o barvi, teži, trdoti in teksturi.

Dosedanje raziskave so se osredotočale na prikaz poti do želene turistične znamenitosti, prikaz pokrajine glede na položaj in rokovanje s predmeti za prikaz podrobnejših (video) vsebin. Nobena nam znana raziskava se ni ukvarjala s podajanjem predstave o turističnih doživetjih preko različnih predmetov kot so spominki, lokalni pridelki ali izdelki in predmeti, ki predstavljajo turistične aktivnosti (pohodi, kolesarjenje, ipd.) Osnovna ideja je tako omogočiti upravljanje in izbiro aktivnosti ali ciljev potovanja iz predhodnega nabora fizičnih predmetov, ki predstavljajo asociacijo na določeno turistično izkušnjo, s tem pa omogočiti pridobitev možnega doživetja turistične ponudbe preko večpredstavnostnih vsebin, ki so drugače dosegljive le na spletu in javnih zaslonih. Naše raziskovalno vprašanje se tako glasi: Ali je fizični vmesnik Predmetnik primeren kot vstopna točka za informiranje o turističnih doživetjih oziroma o ponudbi v turistično informacijskih centrih?

3 OPIS SISTEMA

Predmetnik je sestavljen iz treh delov (Slika 2): uporabniškega vmesnika, mikroračunalnika (Raspberry Pi 3B) kot računske enote in naprave za predvajanje zvočnih in video vsebin (zaslon ali projektor). Komunikacija poteka v smeri od oprijemljivega vmesnika preko senzorjev do mikroračunalnika, ki prejme informacijo o dvignjenem predmetu, predvaja temu primerno vsebino in preko svetlobnih signalov podaja informacije o aktivnih in neaktivnih predmetih vmesnika (če so vsi predmeti odloženi, pri vseh gori lučka; če je pa posamezen predmet dvignjen, gori lučka le pri tem). Polica predmetnika ima za posamezen predmet izrezan relief v obliki predmeta, kar omogoča (poleg svetlobnega signala) lažje odlaganje. Če noben predmet ni aktiven (se z njim ne rokuje), se na zaslonu predvaja kratek video posnetek, ki prikazuje rokovanje s Predmetnikom in vabi uporabnika, da dvigne enega od njih. Podrobnejši opis uporabljene strojne in programke opreme je na voljo v [20].

Sistem zbira naslednje podatke: število rokovanj z določenim predmetom, čas rokovanja s posameznim predmetom in čas predvajanja posameznega posnetka s čimer beležimo,
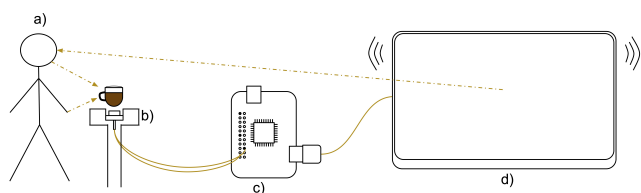
Slika 2: Prikaz sheme sistema: a) uporabnik, b) uporabniški vmesnik s predmeti, c) računska enota in d) zaslon, ki predvaja večpredstavnostne vsebine.

koliko je bila posamezna ponudba zanimiva in koliko je bil določen predmet vmesnika informativen ali zanimiv za interakcijo.

4   RAZISKAVA

V raziskavi smo izvedli nadzorovano uporabniško študijo (angl. *controlled user study*). Opazovalne študije (angl. *observational study*) nismo mogli izvesti zaradi epidemije. Na TIC-u v Izoli so vse predmete odmaknili, saj jih turisti zaradi možnosti okužbe ne smejo prijemati; lahko jih dobijo le, če vprašajo zaposlenega informatorja. Zaradi tega tudi niso dovolili postaviti Predmetnik v njihove prostore.

Slika 3: Simulacija TIC-a: zaslon na dotik, Predmetnik in tiskovine.

Študijo smo izvedli v simuliranem TIC-u (Slika 3). Na voljo so bile tri oblike informacij, ki so predstavljale turistično ponudbo slovenske Istre: tiskovine, zaslon na dotik (tablica s spletno stranjo *I Feel Slovenia: Mediterranean & Karst Slovenia*[1]) in Predmetnik (s štirimi predmeti – pedal, vponka, sol in kamen s pohodniško markacijo), ki je prikazoval video vsebine s spletnih strani turističnih zavodov Kopra, Izole in Pirana. Video vsebine so bile dolge med 12 in 19 sekund.

Udeležence smo pridobili s priročnim vzorčenjem (angl. *convenience sampling*). V danem trenutku in položaju je bila to edina možnost pridobitve uporabnikov. Pri testiranju je

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[1]https://www.slovenia.info/en/places-to-go/regions/mediterranean-karst-slovenia

sodelovalo devet udeležencev v razponu od devet do 66 let, od tega je bilo sedem žensk in dva moška.

Po privolitvi smo jim predstavili potek raziskave: (i) izpolnjevanje pred-vprašalnika, (ii) opravljanje dveh nalog (iskanje informacij o kolesarjenju in pregled ostalih možnih doživetij) brez časovnih omejitev, kjer so imeli na voljo tiskovine, zaslon na dotik in Predmetnik ter (iii) izpolnjevanje drugega dela vprašalnika. Vrstni red opravljanja nalog ni bil naključen, saj smo najprej želeli videti rokovanje za točno določen namen (najti informacije o kolesarjenju) in nato opazovati splošno rokovanje (pregled možnih doživetij).

Med raziskovanjem smo opazovali interakcijo z vsako od oblik informiranja (obračanje, tipanje ...) Opazovali smo tudi vrstni red interakcije med raznimi oblikami oziroma predmeti informiranja, porabljen čas na posameznem viru interakcije, čas gledanja pri video predstavitvah in skupen čas iskanja informacij.

5   REZULTATI IN RAZPRAVA

V povprečju so udeleženci prvo nalogo reševali osem minut in 16 sekund, drugo pa pet minut in 31 sekund, čeprav je slednja od njih zahtevala pregled več informacij. Tiskovinam so pri drugi nalogi v povprečju namenili dobro minuto in pol manj časa v primerjavi s prvo nalogo, posamezna tiskovina pa se je v povprečju gledala enako dolgo, čeprav niso vsi iz prve naloge po tiskovinah posegli tudi v drugi. Pri tablici se je število uporabnikov pri drugi nalogi v primerjavi s prvo zmanjšalo, predvsem zaradi začetne slabe izkušnje z njenim rokovanjem. Ravno tako se je zmanjšal čas povprečne porabe za skoraj dve minuti. Le pri Predmetniku se je čas uporabe podaljšal iz 32 sekund na 53 sekund. To je bilo za pričakovati, saj so imeli možnost pogledati še tri preostale posnetke. Čas se je podaljašal tudi za ogled posameznega videoposnetka v povprečju za tri sekunde, vendar k temu prispeva tudi dejstvo, da so drugi trije videi za nekaj sekund daljši od videa, predvidenega za prvo nalogo. Povečalo se je zanimanje za Predmetnik, saj ga je po tem, ko so ga v prvi nalogi šele spoznali, v drugi nalogi kot prvo obliko informiranja izbralo več uporabnikov. Vrstni red nalog je deloma tudi vplival na čas opravljanja: slabe izkušnje iz prve naloge so vplivale na neuporabo tablice, domačnost s Predmetnikom pa na opustitev uvodnega videa.

Poleg tega se je v drugi nalogi v primerjavi s prvo povečalo število uporabnikov, ki so si začeli ogledovati predmete ali se z njimi igrati, vendar je bilo število manjše od pričakovanega. Previdevamo, da imajo tiskovine in tablica prednost, ker so jih udeleženci že poznali ali vsaj vedeli, kakšna je njihova funkcionalnost. Prišlo je tudi do določenih sprememb pri izvajanju obeh nalog, kot je povečanje prehajanja med oblikami informiranja oziroma vračanja k že obiskani obliki znotraj iste naloge. Še posebno pri prvi nalogi smo opazili, da so udeleženci najprej uporabili tisto obliko informiranja, ki

jim je bila fizično najbližje. Tako so pri prvi nalogi večinoma začeli z uporabo tiskovin, ki so bile prva oblika informiranja glede na smer prihoda v prostor. Pri drugi nalogi pa je to že bil Predmetnik.

Predmetnik, ne nadomešča drugih virov saj sta namen in učinek različnih načinov pridobivanja informacij različen. (i) Predmetnik je privlačen in nudi maloštevilno izbiro informacij brez podrobnejšega usmerjanja znotraj področja zanimanja, (ii) tablica (zasloni na dotik) je manj privlačna a omogoča bolj podrobno usmerjanje k želenim informacijam z več nivojsko izbiro, (iii) tiskovine pa so edine izmed treh, ki jih obiskovalci lahko vzamejo s seboj in informacije iz njih prebirajo tudi kasneje, a ne nudijo večpredstavnostnih vsebin. Rezultate bi težko primerjali z drugimi raziskavami saj niso dovolj sorodne. Rezultati vprašalnikov so predstavljeni v [20].

6 ZAKLJUČEK

V članku je predstavljen oprijemljivi uporabniški vmesnik Predmetnik, ki bi turistom v TIC na hiter in enostaven način prikazal doživljajske informacije kot osnovo za raziskovanje turistične ponudbe. Vmesnik smo izdelali kot nadgradnjo obstoječih zaslonov na dotik in javnih zaslonov (angl. *public displays*), ki le prikazujejo videoposnetke. Namen vmesnika je tako postati vstopna točka informiranja za turiste, ki bi lahko preko tiskovin, turističnega informatorja in spleta nato naprej raziskovali turistično ponudbo, ki bi jih na Predmetniku pritegnila.

S Predmetnikom smo izvedli nadzorovano uporabniško študijo. Povečan čas uporabe in večkratnega rokovanja s predmeti pri drugi nalogi deloma odgovori na zastavljeno vprašanje o vlogi Predmetnika, ki lahko predstavlja vstopno točko pri informiranju, vendar bi bilo v prihodnosti treba izvesti obširnejšo študijo v realnem okolju TIC-a s turisti, kar v danem trenutku zaradi pandemije ni bilo mogoče. Poleg tega bi bilo potrebno razširiti ponudbo Predmetnika ter dodati druge funcionalnosti (ponujanje nadaljnjega raziskovanja (QR kode, povezovanje z drugimi viri v enotno izkušnjo), sledenje pogledu, priporočilni sistem, sledenje predmetom ...). Bolj podrobno je vse opisano v [20].

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Razvoj in Ocenjevanje Prototipa Mobilne Aplikacije z Elementi Igrifikacije in Mešane Resničnosti

Development and Assessment of the Mobile Application Prototype with Elements of Gamification and Mixed Reality

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ABSTRACT / POVZETEK

Učinkovito oglaševanje je eden od ključnih ciljev snovalcev oglasov in njihovih naročnikov. Prav zato si prizadevajo, da njihovi oglasi izstopajo od konkurence, pogosto pa je pri tem spregledan vidik uporabnika. V raziskovalni študiji smo tako izdelali prototip aplikacije, ki vključuje elemente igrifikacije in mešane resničnosti. Zaradi omejitev osebnih stikov v času pandemije COVID-19 smo izdelali video posnetke, ki so prikazovali uporabo prototipa. Nato smo ocenjevali uporabniško izkušnjo prototipa in uporabnost uporabniškega vmesnika. Uporabili smo SUS in UEQ metodo. S priložnostnim vzorčenjem smo v raziskavo vključili 80 oseb. Statistična analiza je razkrila tri ključne ugotovitve. Oglas, ki vsebuje mešano resničnost in igrifikacijo, nekoliko izstopa od ostalega načina oglaševanja. Prav tako lahko taka vrsta oglasa poveča stopnjo namena nakupa oglaševanega izdelka. Kot zadnje se je pokazalo, da ni povezave med starostjo uporabnika in razumevanjem aplikacije. Naši rezultati lahko služijo tako oglaševalcem, kot tudi raziskovalcem na področju uporabe sodobnih tehnologij in oglaševanja.

KEYWORDS / KLJUČNE BESEDE

uporabniška izkušnja, uporabnost, oglaševanje, igrifikacija, mešana resničnost

OPTIONAL: ABSTRACT

Effective advertising is one of the key goals of ad creators and their target groups. This is why they strive to make their ads stand out from the competition, while the user aspect is regularly overlooked. In the current study, we thus produced a prototype application that includes elements of gamification and mixed reality. Due to the limitations of personal contact during the COVID-19 pandemic, we produced videos showing the use of the prototype. We then evaluated the user experience of the prototype and the usability of the user interface. We used the SUS and UEQ method. 80 people were included in the survey by random sampling. Statistical analysis revealed three key findings. An ad that contains mixed reality and gamification stands out slightly from the rest of the advertising method. This type of ad can also increase the level of intent to purchase the advertised product. Lastly, the analysis revealed that there is no association between users' age and the understanding of the application. Our results can serve both advertisers and researchers in the use of modern technologies and advertising.

OPTIONAL: KEYWORDS

User experience, usability, advertising, gamification, mixed reality

1 UVOD

Vsakodnevno smo izpostavljeni številnim oglasom, kar vodi oglaševalce v vse večja vlaganja v zagotavljanje učinkovitosti oglaševanja in razlikovanja od konkurence. Sodobna tehnologija daje oglaševalcem številne možnosti za inovativne pristope v komuniciranju s ciljnimi javnostmi. Primera takih pristopov sta vpeljava igrifikacije in mešane resničnosti v oglaševanje. Oboje se je izkazalo kot pozitiven dejavnik v priklicu blagovne znamke s strani potrošnika [1].

Namen pričujoče študije je tako raziskati neizkoriščen potencial, ki ga prinaša oglaševanje s pomočjo kombinacije igrifikacije in mešane resničnosti. Natančneje, zanima nas zaznana stopnja vidljivosti oglasa, ki vpeljuje igrifikacijo in mešano resničnost v zgodbo komuniciranja s potrošnikom. Prav tako raziskujemo vplive na odločitve za nakup s tovrstnimi oglasi oglaševanih izdelkov. Ker se v procesu oblikovanja tovrstnih oglasov pojavljajo tudi izzivi v smislu zagotavljanja ustrezne uporabniške izkušnje in uporabnosti uporabniškega vmesnika, je predmet te študije raziskati tudi to.

2 IGRIFIKACIJA, RAZŠIRJENA RESNIČNOST IN OGLAŠEVANJE

Pri igrifikaciji gre za uporabo izkušnje zabave, ki »z notranjo motivacijo in sistemom nagrajevanja uporabnike privlači in jih vključi v različne aktivnosti« [2]. Tipični elementi igrifikacije so

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[*]Article Title Footnote needs to be captured as Title Note
[†]Author Footnote to be captured as Author Note

točke, značke, lestvice, grafi uspešnosti, zgodbe s pomenom, avatarji in soigralci [4].

Mešana resničnost je del razširjene resničnosti, kamor jo uvrščamo skupaj z navidezno resničnostjo in obogateno resničnostjo. Mešano resničnost lahko opišemo kot tehnologijo med povsem resničnim okoljem in povsem navideznim okoljem [5]. Gre za okolje, kjer sta navidezni in resnični svet v enem samem zaslonu. Za njeno delovanje se uporablja dovolj zmogljiva tehnologija, kar zajema ustrezen senzor, procesor in zaslon.

3 PREGLED SORODNIH DEL

Obstoječe raziskave se intenzivno ukvarjajo z vprašanjem učinkovitosti vpeljave igrifikacije kot inovativnega orodja v oglaševanje [6]-[8]. In sicer, Nobre in Ferreira [6] v svoji študiji ugotavljata, da je s pomočjo igrifikacije mogoče na inovativen način soustvarjati blagovno znamko, vplivati na vpletenost uporabnika in občutek povezanosti z blagovno znamko. Teotónio in Reis [7] ugotavljata, da porabniki iščejo zabavo, nagrade, rivalstvo, socialno vključenost – vse, kar jim ponuja igrifikacija.

Prav tako se številni raziskovalci [9][10] ukvarjajo z elementi obogatene resničnosti v oglaševanju. Tako ugotavljajo, da se z uporabo tovrstne aplikacije poveča interakcija kupca in prodajalca, zviša ugled podjetja ter nenazadnje poviša tudi prodaja izdelkov [3],[10].

4 METODOLOGIJA

4.1 Raziskovalna vprašanja

Raziskovalna vprašanja smo oblikovali na osnovi pregleda obstoječe literature.

RV1: Kakšna je zaznana stopnja vidljivosti oglasa s hkratno vpeljavo igrifikacije in mešane resničnosti v mobilno aplikacijo za oglaševanje?

Prvo raziskovalno vprašanje smo zastavili, saj se je vpeljava interaktivne igre v oglaševanje izkazala kot učinkovita in za uporabnika zanimiva metoda oglaševanja [8].

RV2: Kakšna je zaznana stopnja odločitve za nakup izdelka ob hkratni vpeljavi igrifikacije in mešane resničnosti v mobilno aplikacijo za oglaševanje?

Drugo raziskovalno vprašanje smo zastavili, saj so pretekle raziskave pokazale, da se z uporabo mešane resničnosti lahko poveča stopnja prenosa informacij, sodelovanja ter pospeši odločanje [9]. Prav tako raziskave kažejo, da se z uporabo aplikacije, ki vsebuje obogateno resničnost, poveča interakcija kupca in prodajalca, zviša ugled podjetja in tudi poveča prodaja izdelkov [10].

RV3: Ali starost uporabnika vpliva na razumevanje uporabe mobilne aplikacije za oglaševanje, ki vključuje igrifikacijo in mešano resničnost?

Zadnje raziskovalno vprašanje smo zastavili, saj so v eni od študij [11] ugotovili, da obstaja razlika v razumevanju aplikacij z obogateno resničnostjo med šolarji višjih razredov in študenti. Glavna razlika se je pokazala v načinu razmišljanja, izkušnjah in načinu reševanja problemov.

4.2 Razvoj prototipa aplikacije in predstavitvenih video posnetkov

Prototip smo izdelali s pomočjo programa Adobe XD. Na osnovi izdelanega prototipa smo ustvarili tri videoposnetke, ki so prikazovali vsak po en scenarij primera uporabe aplikacije. Prvi video posnetek je prikazoval osnovno delovanje aplikacije in prvi primer uporabe – nakupovanje v nakupovalnem centru in ujetje željenega popusta. Drugi videoposnetek je prikazoval prejem potisnega sporočila, ki ga uporabnik dobi ob novem popustu za izdelek, ki si ga želi. Tretji videoposnetek pa je prikazoval primer časovno omejenega popusta, ki ga uporabnik mora ujeti v določenem časovnem obdobju ter ga shrani med svoje popuste ter unovči kadar je naslednjič v izbrani poslovalnici. Slika 1 prikazuje zaslonski posnetek iz predstavitvenega video posnetka omenjenega primera.
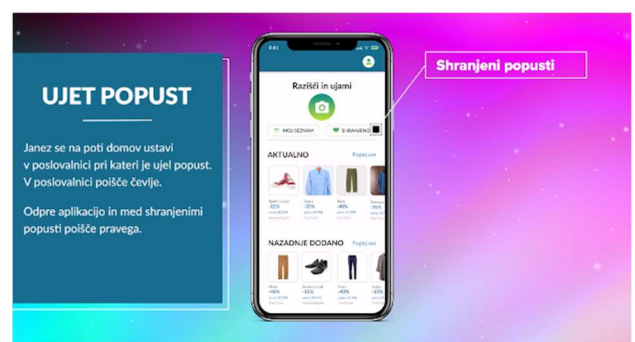
Slika 1: Slika zaslona predstavitvenega video posnetka.

4.3 Vzorčenje in udeleženci raziskave

Pogoji za vključitev udeležencev v raziskavo so bili naslednji:
- osebe so starejše od 18. leta,
- osebe, ki (vsaj enkrat na mesec) nakupujejo v vsaj eni trgovski verigi,
- osebe, ki imajo v lasti pametni mobilni telefon,

Za vključitev potencialnih udeležencev v raziskavo smo uporabili priložnostno vzorčenje. V raziskavi je sodelovalo 33 udeležencev.

4.4 Merski instrument

Merski instrument, ki smo ga uporabili, je bil spletni anketni vprašalnik. Sestavljen je bil iz treh delov. Prvi del je bil splošnejši in je zajemal vprašanja o sami aplikaciji ter zajemal po eno vprašanje, ki se je navezovalo na eno izmed raziskovalnih vprašanj. Pri RV3 smo navezujoče se vprašanje povezali z demografskim vprašanjem o starosti uporabnika. Drugi del vprašalnika je meril uporabniško izkušnjo – uporabili smo User Experience Questionnaire (UEQ) [12]. Tretji del vprašalnika je meril uporabnost uporabniškega vmesnika – uporabili smo System Usability Scale (SUS) [13].

4.5 Postopek raziskave

Pri načrtovanju in izvedbi raziskave smo sledili Evropskemu kodeksu ravnanja za ohranjanje raziskovalne poštenosti, s čimer smo se zavezali načelu spoštovanja udeležencev raziskave [14]. Prav tako smo upoštevali načela Kodeksa etike in integritete za

raziskovalce na Univerzi v Mariboru (Univerza v Mariboru, 2014 - 2020), kodeksa Ameriškega združenja psihologov in kodeksa združenja spletnih raziskovalcev. Spoštovali pa smo tudi Zakon o varstvu osebnih podatkov [15].

Testiranje prototipa je zaradi omejitev osebnih stikov v času pandemije COVID-19 potekalo na daljavo. Udeležencem raziskave smo poslali elektronsko pošto z navodili za izvedbo testiranja. Udeleženci so si v vnaprej določenem zaporedju ogledali tri videoposnetke in na koncu izpolnili tri spletne vprašalnike.

4.6 Statistična obdelava podatkov

Za analizo zbranih podatkov o udeležencih raziskave smo uporabili opisno statistiko, med tem ko smo za analizo podatkov, s pomočjo katerih smo želeli odgovoriti na raziskovalna vprašanja, uporabili tako opisno, kot tudi inferenčno statistiko. Natančneje, odgovore na prvi dve raziskovalni vprašanji smo iskali z opisno statistiko, odgovor na zadnje raziskovalno vprašanje pa z neparametričnim statističnim testom Kruskal-Wallis H Testom. Podatke smo analizirali s programom IBM SPSS Statistics.

4.7 Rezultati

Prvo raziskovalno vprašanje je spraševalo, kakšna je zaznana stopnja vidljivosti oglasa s hkratno vpeljavo igrifikacije in mešane resničnosti v mobilno aplikacijo za oglaševanje. Rezultati deskriptivne statistike so pokazali, da 51,5 % vseh udeležencev meni, da bi oglas nekoliko izstopal, 27,3 % udeležencev pa meni, da bi oglas zelo izstopal. Več kot polovica udeležencev raziskave tako meni, da bi oglas, ki je pripravljen na način kot so ga videli v videoposnetkih, nekoliko izstopal od ostalih načinov oglaševanja.

Drugo raziskovalno vprašanje je spraševalo, kakšna je zaznana stopnja odločitve za nakup izdelka ob hkratni vpeljavi igrifikacije in mešane resničnosti v mobilno aplikacijo za oglaševanje. Udeležence smo spraševali, kako ocenjujejo, da bi jih prikazana aplikacija motivirala k nakupu določenega oglaševanega izdelka [3]. Udeleženci raziskave so lahko izbirali med petimi različnimi odgovori (1 – uporaba bi me zelo motivirala k nakupu, 5 – uporaba me nikakor ne bi motivirala). 57,6 % udeležencev meni, da bi jih uporaba aplikacije nekoliko motivirala k nakupu, 30,3 % pa jih pravi, da jih uporaba ne bi niti bolj, niti manj motivirala [3]. Več kot polovica udeležencev raziskave tako meni, da bi jih uporaba aplikacije nekoliko motivirala k nakupu.

Tretje raziskovalno vprašanje je spraševalo, ali starost uporabnika vpliva na razumevanje uporabe mobilne aplikacije za oglaševanje, ki vključuje igrifikacijo in mešano resničnost. Uporabnike smo razvrstili v štiri starostne skupine: 1 – od 18 do 29 let (19 uporabnikov), 2 – od 30 do 49 let (8 uporabnikov), 3 – od 50 do 64 let (6 uporabnikov), 4 - več kot 65 let (1 uporabnik). Glede na zastopanost v vsaki starostni skupini, smo v analizo vključili prve tri starostne skupine. Rezultati Kruskal-Wallis H testa so pokazali statistično neznačilen rezultat, p > .05. S tem lahko sklepamo, da starost uporabnika ne vpliva na razumevanje aplikacije, ki vsebuje igrifikacijo in mešano resničnost [3].

Ocenjevali smo tudi uporabniško izkušnjo razvitega prototipa z UEQ vprašalnikom, kjer so udeleženci ocenjevali svojo

uporabniško izkušnjo s pomočjo 26 nasprotujočih si lastnosti. Tabela 1 prikazuje rezultate UEQ lestvice. Razpon lestvice je med -3 in 3, kar označuje izjemno dobro aplikacijo.

Tabela 1: Rezultati UEQ lestvice

Lastnosti	Povprečje	Varianca
Atraktivnost	1,482	0,93
Preglednost	1,508	1,18
Učinkovitost	1,076	0,78
Vodljivost	0,765	0,65
Stimulativnost	0,886	0,84
Originalnost	1,326	0,86

Kot zadnje smo ocenili še uporabnost uporabniškega vmesnika z metodo SUS. Faktor SUS se prikaže na lestvici od 0 do 100. V našem primeru smo izračunali kot povprečno SUS oceno vrednost 71,52. Udeleženci so uporabniški vmesnik prototipa tako ocenili kot dobrega. Slika 2 prikazuje rezultate SUS ocenjevanja.
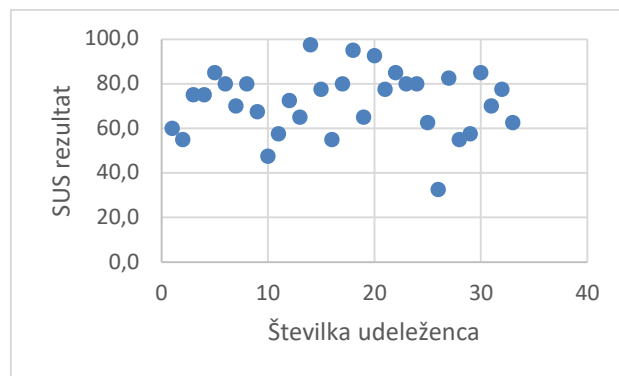
Slika 2: Rezultati SUS ocenjevanja.

5 DISKUSIJA IN ZAKLJUČEK

Izsledki pričujoče študije se ujemajo z ugotovitvami preteklih raziskav. Tako na primer naši rezultati podpirajo rezultate pretekle študije [8], kjer avtorji ugotavljajo, da je takšen način promocije zanimiv za uporabnika. Prav tako naši rezultati podpirajo rezultate drugih študij [9][10]. V omenjenih študijah namreč ugotavljajo, da se z uporabo mešane ali obogatene resničnosti dviga stopnja zanimanja za nakup iz strani uporabnika.

Omejitve pričujoče raziskovalne študije so v izvedbi testiranja prototipa. Le-ta namreč ni bil testiran na eni lokaciji z več udeleženci.

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StreetGamez: detection of feet movements on the projected gaming surface on the floor

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ABSTRACT

We implemented a software solution for a video game platform that is capable of detecting movement of players' feet on the floor. The solution is a part of a wider project of using a drone as a platform that could project the game board on the floor as well as track movements and scores of different players. The whole system is composed of three parts: a drone, a mini projector, a depth camera and a computational device for running the software. For the latter two we used Google Tango to run spatial recognition, detect 3D shapes and obtain the device's orientation in space. The system was implemented to the point where it can detect the player's feet, transform the detected feet to a gaming surface and correct the projection distortion.

KEYWORDS

exergaming, human-drone interaction, drones, pervasive computing

1 INTRODUCTION

Exercise games or exergames can be divided into three categories: location based games (e.g. [5]), games with motion tracking (e.g. [6]) and projection based games (e.g. [3]). In [4] we proposed a new gaming concept that combines projection based games with drones and user tracking creating a novel gaming platform that is (i) independent of location and (ii) offers a new gaming abilities that can facilitate various types
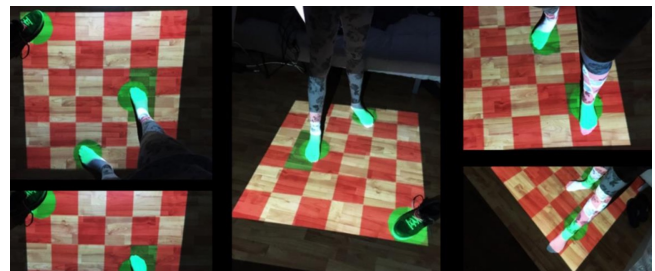
Figure 1: Complete detection system with projection.

of novel street and chalk games. In this paper we present the software solution for a proposed game platform that is capable of detecting movement of players' feet on the floor.

2 SYSTEM DESIGN

The minimal set of functional requirements was: (i) Track player's feet on a projected grid where each grid unit measures 30x30 cm to support games such as "whack the mall". A particular unit activates when player steps on it. (ii) Provide quick feedback whilst correctly detecting fast movements, which is vital for an exregaming platform. (iii) The projected surface should be always mapped as a rectangle. To avoid accidents, the drone should hover on the side of the projected surface, which would in this case be distorted and should be corrected. (iv) The platform should support multiple players to increase motivation – an important element of exergaming.

We decided to use the Google Tango device, which is capable of detecting player's movement and control the projection. A variety of other devices could be used to achieve the same. However, at the time when the implementation begun (2016), this was one of the rare devices with such functionalities and light enough for drone carrying. For implementation and testing of the software solution we planned to use the

device in a static environment, placed 2m high of the floor facing the playing field under an angle of 45-70 degrees.

Google Tango integrates three main functionalities. Motion tracking of the device by using visual features of its surroundings in combination with the accelerometer and gyroscope. Area learning by recording the visual features and the measuring the distances. Depth perception by scanning and building a point cloud image of the room. From this point cloud, a room meshes can be made and used as 3D models for further processing. This feature is of particular interest to us, as we planed to utilise the depth cloud in order to detect players movement over the ground plane.

To appeal to a wider community of game developers, we decided to use Unity together with Google Tango's SDK to obtain the callback calls and events from the C library used for processing signals in the Tango device itself.

For projection we used the 200 lumens ASUS S3 connected to Google Tango via mini HDMI port. S3 has a wide projection angle capable to project a large playing area from relatively short distance. The image projected has a trapezoidal distortion called keystone distortion caused by the projector projecting at an angle to the projection surface.

3 PROTOTYPE IMPLEMENTATION

The software is built of four (4) components: (i) *floor plane detection* — detecting the ground plane and initialisation; (ii) *point cloud processing and player detection* — searching for players feet position using information from depth camera; (iii) *RGB optimisation* — player identification and optimisation of tracking performance; and (iv) *rendering — projector alignment correction* — removing perspective distortions from the projection.

Floor plane detection

There are three common methods for generating depth information: Stereo method using two cameras, Time of Flight casting rays into the space and timing the bounces, and Structured Light. Tango uses the latter using IR projector, which beams a grid pattern of dots where each sample group of the dots is uniquely identified. This way the IR projector and IR camera are able to determine the exact position of the detected point group.

The first step of tracking players is to estimate where ground plane lies. This is done by *floor plane detection* algorithm. After obtaining point cloud data, we start by mapping points into buckets where the Y axis is kept in small deviation groups. At each new point cloud frame the points are added into group and once the threshold is reached, the algorithm marks that Y coordinate as a ground plane. Since the Tango device can localise itself in the space, the ground plane needs to be detected only once at the initialization stage.

Point cloud processing

Once we know the position of the ground plane, we move to *Point cloud processing*, which starts by obtaining point cloud data. Then a simple min max filter on the Y axis can be applied to isolate 3D points that are likely to be feet. We set the filtering threshold to 20 cm distance from the ground plane. Points that fall out of this threshold are discarded. The results of the filtering can be seen in Figure 2.
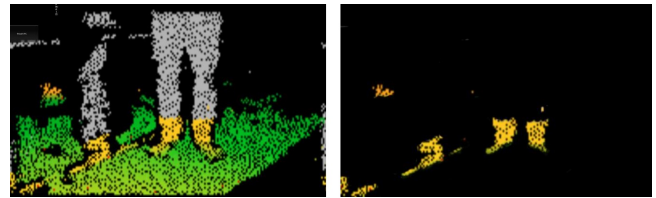
Figure 2: Left — green coloured points are on the floor level, orange points are objects that are within the 20 cm threshold; Right — filtered image after min max filtering.

After filtering, the remaining points are grouped into spherical geometric shapes. This is done by processing every point and trying to fit it into a nearby sphere. The radius of the sphere was manually set to the default diameter of 30 cm. To simplify the grouping process, we ignore the Y coordinate of the feedback mapping placing all feedback points to a single plane. Using a 2D image, we can generate distinct groups by using a simple grouping algorithm. Our algorithm starts the grouping process by randomly selecting a feedback point. Then we check if there is any group defined within the threshold proximity of this point. If not, we create a new point group, set its rank to 1 and set the location of the group to this point. If the point is found in the diameter of an existing group, it is added to the nearest one. The group position is then updated by weighted average as such:

$$GroupPos = \frac{N_items \times GroupPos + FeedbackPosition}{N_items + 1}$$

After processing all the points, the transformation from 2D group coordinates back to 3D coordinates occurs by averaging the Y coordinate of group points. At this stage we remove groups which consist of insufficient number of detected points. This value can be changed though game engine configuration. The result of this step is an averaged group of strong feedbacks (Figure 3).

RGB optimization

Since the Tango depth camera has a relatively low refresh rate of 10Hz, we planned a fine grain tracking by analysing captured images from RGB camera. To obtain data from the camera the SDK callbacks varied across different versions of
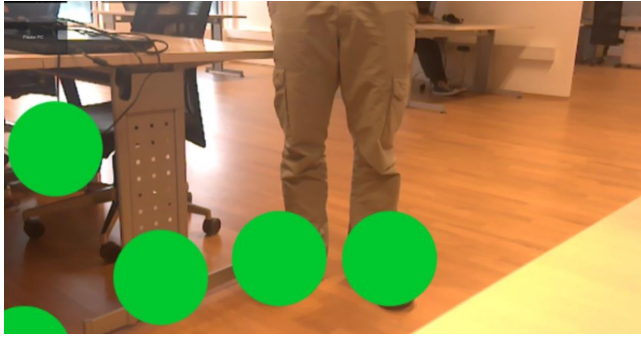
Figure 3: Groups are being rendered back to the scene in form of spheres that cover a certain area in the virtual world.

Tango Core. In Ikariotikos (Version 1.54, June 2017), an event needs to be registered that signals when a new camera image has been rendered to the buffer and is available for reading. Unfortunately, we were not able to obtain the RGB stream whilst depth camera was in operation. The reason for this is still not fully understood and the lack of documentation made it impossible to find the solution within the timeframe of this project. Nevertheless, we present the intended approach for optimising player tracking using color detection.
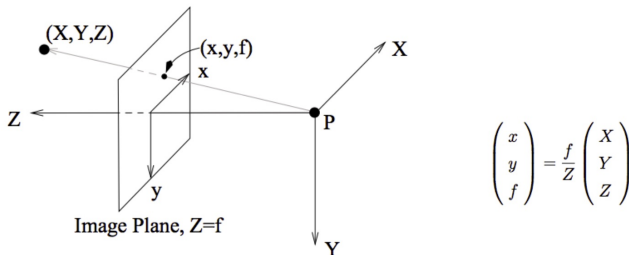
Figure 4: Pinhole camera model showing how 3D pint is transformed to 2D image.

We planned to perform the colour based tracking within the regions detected by the depth camera whilst waiting for its next frame. The first step was to perform a transformation of detected 3D points from the depth cloud to the screen coordinate system in the step we call "Transformation of points to view port frame". This would allow us to create a mask with regions of interest. Such transformation can be done using a pinhole camera model (Figure 4) [2]. The projection of 3D point cloud to the screen can be therefore formulated as $[xz]_{pixel} = K \times [XZY]_{3DPoint}$ where (i) x, y is location of point in image coordinate system, (ii) X, Y, Z is location of points in world coordinate system in which the data is provided, and (iii) K is a matrix of intrinsic camera parameters $\begin{pmatrix} F_x & 0 & F_x \\ 0 & F_z & F_y \\ 0 & 0 & 1 \end{pmatrix}$. To obtain the pixel coordinates within the view port frame, we need to multiply the 3D point

with intrinsic camera parameters. These are defined through camera calibration process done by the developer of the device resulting in the coordinate system of the depth camera almost perfectly aligned with the device screen. As such we can ignore extrinsic camera parameters.

After we receive 2D points, we clip the point groups into detection masks for the next step we call "Use the circles as masks to fine track Colour image". In practice we map a 3D vector to camera view port by using Unity WorldToViewPortPoint method call. To proceed, we need to map colour image to the mask by scaling the 2D point so that it corresponds with the captured image. We are then able to cut the detection area from the colour image. To enable adjusting the performance of the detection, the size of the detection square is possible to be manipulated via GUI.
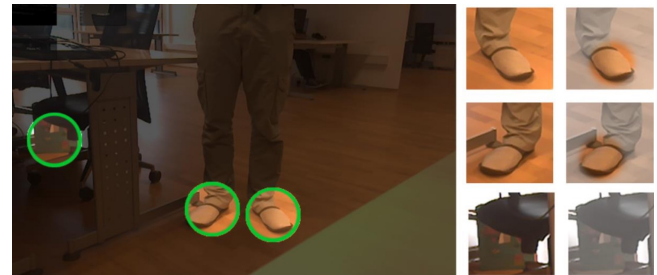
Figure 5: Concept sketch of detecting player feets in RGB image with higher refresh rate.

Using the mask the segments of detection image are cropped out (Figure 5) and the colour group detection is ran over using OpenCV contours finding method, allowing us to filter the colour groups and detect centre and radius [1]. After detecting 2D point groups, we apply Unity methods to transform 2D location on the image to the world coordinates. Since our 3D point detection is also detecting the playing plane, it is possible to calculate the correct point of contact. Mapping the detected centres of the feedback back to the detected floor is an easy task. The points are transformed with an inverse of the mapping of 3D point to the 2D screen space. We simply raycast the screen coordinate of the point to the floor and obtain the group position.

Rendering

Projector alignment correction. Projecting an image to a non perpendicular surface in respect to the light source will produce a distorted image commonly called a keystone effect. This distortion can be approximated by $cos(\varepsilon - \alpha/2)/cos(\varepsilon + \alpha/2)$, where ε is the angle of the surface being projected on, and α is the width of the focus. Because the projector is mounted in the same space as the Tango device, and the device is spatially aware of its orientation in respect to the ground plane, we can calculate the required adjustments to

the projected image and project the proper square to the floor. Two rotations that cause the keystone effect are rotation Rz and Rx. Since the depth camera will be pointed at the players, the drone will need to be equipped with a gimbal maintaining the rotation Rx. To successfully correct the distortion caused by Rz we need to know the parameters of the projector's field of view (FOV), lense parameters and Rz in relation to the ground surface.

We created a virtual scene with a single texture we call a Render Texture and a virtual camera to which we assign FOV and aspect ratio that matches our projector. We place the virtual camera at a fixed distance and rotate the plane around the z-axis in the opposite direction of tilt detected by the Tango tracking system. In this way we render graphics where perspective distortions from rotation around the z-axis are removed as seen in Figure 6.
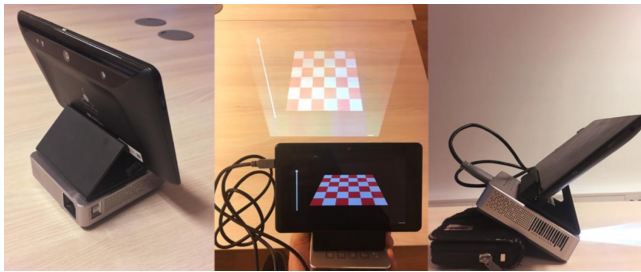
Figure 6: Example of perspective mapping of square onto a flat surface. The internal camera mimics projectors field of view and inverts the projection angle.

This solution only corrects for one rotation, but as Tango device is capable of 6 DOF camera pose tracking, the rotation around x could be accounted for. We could also use tracking information to fix the playing field onto a position in the real world. The playing field would thus stay at the same place regardless of the position and orientation of the drone. A more advanced solution would be to use inverse transformation using game shaders or other transformations possible in Unity. A possible approach would be to apply the correct inverse trapezoid transformation to the image received from Unity.

Mapping feedbacks to a 6x6 playing plane. In the initialization step, a ray is casted from the centre of the camera to the detected floor plane. The intersection of the ray and the plane represents the centre of the detection matrix. Its centre point is used for syncing the display grid with the detection grid. The latter is defined in the engine with default values of 6 columns and 6 rows. This setting can be additionally adjusted to allow more precise feedbacks. However, this may cause performance issues. After the grid is initialised, its fields are updated according to the sphere positions that

are being calculated by the point cloud detection algorithm. When a square is overlapped with the sphere it becomes active.

4 PROTOTYPE GAME

Implementing the above, a simple game was created. The detection runs at 10-15 FPS with some lag spikes that additionally occur because of point cloud detection instability. Once the system is initialised (the ground plane is recognised) it starts tracking feet. Where these are tracked green spheres are rendered and segments of the checker box pattern that intersect with the spares are coloured in green (see Figure 1). The playing area in the figure is of size 1,7x1,7 m, meaning that the projected squares were approximately 27x27 cm. The area could be increased by putting the projector and Tango further away. Because the playing field was relatively small, only 2 players could be on it at the same time. The player tracking would fail if there would be more players because of the excessive density of the detected points.

5 CONCLUSIONS

It is important to note that the system is currently limited to projections on horizontal planar surfaces. The optimisation utilising colour tracking of players feet needs to be implemented. Thus, in order to support multiplayer games a unique footwear colour is required for each player. Despite these limitations and the fact that the Tango platform has been deprecated and integrated into Google ARCore, the concepts presented can be utilised for a solution using another platform. More information on the system is available in [7].

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Anamorfična projekcija na poljubno neravno površino

Anamorphic projection on an arbitrary uneven surface

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POVZETEK

Razvili smo metodo, ki omogoča anamorfično projekcijo na neravno, razbrazdano površino. Sliko, ki jo projeciramo v tem primeru, ni dovolj le v celoti perspektivno deformirati. Neravna površina je namreč sestavljena iz velikega števila majhnih ploskev različnih orientacij in za vsako od teh ploskev bi morali izračunati ustrezno perspektivno deformacijo. To najlažje storimo tako, da za vsak slikovni element projecirane slike izračunamo ustrezno deformacijo. To pa zahteva, da imamo 3D model površine, na katero se slika projecira, kar pridobimo s pomočjo senzorja "Kinect".

KLJUČNE BESEDE

Anamorfoza, Kinect, globinski senzor, optična iluzija

ABSTRACT

This report describes the creation of a distorted image or video that looks perfect when projected onto a given uneven surface and viewed from a predetermined angle. It utilizes the depth sensor Kinect and a projector. The program is written in C++ and it starts off by recreating the projection surface in 3D. It then uses the surface model to create an anamorphic projection. If the Kinect and the projector are properly aligned, the projected image or video creates an anamorphic illusion in real life.

KEYWORDS

Anamorphosis, Kinect, depth sensor, optical illusion

1 UVOD

Ljudje lahko dokaj zanesljivo interpretiramo slike, ki jih ne gledamo frontalno, ampak pod določenim kotom, saj zna naš zaznavni sistem podzavestno razstaviti informacijo na vsebino slike in na njeno perspektivno deformacijo. Še posebej dobro ta princip deluje, če lahko zanesljivo zaznamo, kako je slikovna ploskev orientirana v prostoru. Pri tem igra pomembno vlogo tudi koherenca med premikanjem opazovalca in perspektivno deformacijo. Majhen premik opazovalca povzroči le majhno spremembo perspektivne deformacije. Pri anamorfičnih slikah pa ta koherenca ne obstaja. Anamorfična podoba se tipično razkrije le iz točno določene smeri opazovalčevega pogleda. Odvisno od vrste

anamorfoze, je ta smer pogleda lahko bolj ali manj natančno določena.

1.1 Vrste anamorfoz

Anamorfozo so odkrili v času renesanse, ko so umetniki in znanstveniki odkrivali zakone perspektive [2, 3]. Prva vrsta anamorfoze, ki so jo uporabljali, je bila **perspektivna anamorfoza**. Perspektivno deformirana podoba je naslikana na ravno ploskev. Da bi se ta anamorfična podoba razkrila, jo je potrebno pogledati z določenega zornega kota, običajno je to dokaj oster kot glede na ravnino, ki nosi deformirano podobo (Slika 1).

Katoprične ali zrcalne anamorfoze za razkritje prave podobe potrebujejo ogledalo, običajno cilindrične ali konične oblike. Če tako ogledalo postavimo na pravo mesto, se deformirana podoba razkrije kot odsev v ogledalu (Slika 2).

Med anamorfične upodobitve štejemo tudi **iluzionistično slikarstvo**, kjer lahko na predvidenem mestu opazovanja pridobimo izrazit občutek prostorske dimenzije. V umetnostni zgodovini so znane predvsem poslikave stropov, kjer se nam dozdeva, da se prostor odpira proti nebu (Slika 3), danes pa podoben prostorski učinek uporabljajo potujoči umetniki, ki s kredo rišejo podobe na ulicah (Slika 4).

Sodobni umetniki, kot je npr. švicarski slikar Felice Varini [11], anamorfozo uporabljajo pri poslikavi notranjih prostorov ali celih urbanih scen tako, da se z določenega zornega kota razkrije nek pravilen geometrijski vzorec, kot da bi lebdel v prostoru (Slika 5). Anamorfični princip se uporablja tudi pri slikanju prometnih označb na cestišča, da bi bila bolj jasno berljiva in razločna pod ostrim kotom opazovanja, kot ga imajo vozniki in drugi udeleženci v prometu. Tudi razni reklamni napisi, ki jih pravilno vidimo v zrcalih ali pod določenim kotom opazovanja sodijo v kategorijo anamorfičnih poslikav.

S pojavom multimedijske tehnologije se je pojavila možnost, da za prikaz anamorfičnih upodobitev uporabimo video projekcijo. Na primer, reklamne napise je možno perspektivno deformirati, tako da njihova projekcija iz notranjosti trgovin na pločnik pred trgovino ni deformirana in je zato lažje berljiva.

V Laboratoriju za računalniški vid smo celo razvili princip **dinamične anamorfoze**, ki perspektivno deformacijo projecirane slike stalno stalno prilagajajo poziciji opazovalca, tako da je z opazovalčevega zornega kota slika stalno izgleda nedeformirana oziroma tako, kot če bi jo gledali frontalno [8].

2 MOTIVACIJA

Če uporabljamo video projektor, je projecirana slika brez vsakršne perspektivne deformacije le, če jo gledamo natanko iz točke projeciranja. Ker ima projektor svoje fizične dimenzije, to v praksi seveda ni možno in zato je projecirana slika, ki jo gledamo vedno

Slika 1: Ena od najbolj znanih slik iz zgodovine umetnosti, ki upodablja perspektivno anamorfozo, sta *Ambasadorja* Hansa Holbeina iz leta 1533. Lobanja, ki se v frontalnem pogledu (levo) vidi kot eliptičen madež na sredini slike spodaj, pa se v pogledu od desno zgoraj (v sredini), razkrije kot lobanja (desno). Umetniki so tako ekstremno popačenje običajno uporabili, da bi skrili določene kontroverzne elemente na sliki (vir: Wikimedia Commons).

Slika 2: Zrcalna anamorfoza: popačena 3D skulptura se v odsevu cilindričnega zrcala razkrije kot žaba (avtor: Jonty Hurwitz, vir: Wikimedia Commons).
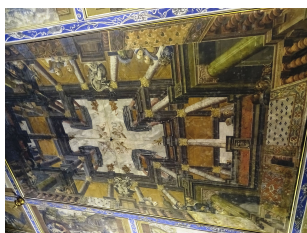
Slika 3: Primer iluzionistične poslikave stropa je v celjski Stari grofiji, ki ga umeščajo na prehod iz renesanse v zgodnji barok (vir: Wikimedia Commons).

Slika 4: Uporaba perspektivne anamorfoze v uličnem slikarstvu (avtor: Julian Beever, 1990-ta). Na levi se vidi izrazit prostorski učinek, gledano z nasprotne strani, pa se vidi kako popačena je na tlaku dejanska podoba, še posebej izrazito noga kopalke, ki v 3D iluziji sega najdlje iz slikovne ploskve (vir: Wikimedia Commons).

Slika 5: Ploskovna grafika superponirana na razgibano urbano sceno, se v celoti razkrije le s točno določenega zornega kota: Felice Varini, Port de St-Nazaire, Francija, za razstavo "Estuaire 2007" (vir: Wikimedia Commons).

nekoliko deformirana. Kot smo že v uvodu razložili, to običajno ni problem, saj človeška zaznava z lahkoto loči med informacijo na sliki in zmerno perspektivno deformacijo te iste slike. Če pa je kot med osjo projekcije in smerjo našega pogleda zelo velik, pa že lahko nastopijo težave pri interpretaciji slike. Pri anamorfozi pa na ta način pravzaprav želimo skriti pravi pomen slike ali vsaj dela slike. Še večji problem pri interpretaciji slike nastane, če projekcijska površina ni ravna. Zato je naš raziskovalni motiv naslednji – *ali lahko projecirano sliko vnaprej deformiramo tako, da bo izgledala nedeformirana iz vnaprej določenega zornega kota, neglede na to, kakšna je površina, na katero projeciramo sliko?* Z

drugimi besedami, kako lahko izračunamo inverzno anamorfično deformacijo slike, da bo izgledala pravilno na poljubni neravni površini?

Že pri običajni perspektivni anamorfozi moramo vedeti, kako je slikovna ploskev orientirana v prostoru. Če pa želimo sliko projecirati na poljubno neravno površino, moramo imeti 3D model

te površine. Sodobna tehnika ima za odčitavanje 3D oblik številne odgovore. Cenovno ugodna in za naše potrebe je smiselna uporaba senzorja Microsoft Kinect. Kinect smo v našem laboratoriju že uporabili za odčitavanje 3D površine v sorodnem projektu *Svetlobni vodnjak* [9], kjer smo klasični kamniti skulpturi dodali še virtualno dimenzijo v obliki polzečih vodnih kapljic, ki smo jih z video projektorjem projecirali v obliki svetlobnih pik [10].

3 SORODNA DELA

Na prvi pogled je naš cilj najbolj podoben tehnikam, ki s pomočjo video projekcije na 3D predmete (angl. projection mapping [12]) ustvarijo obogateno resničnost in tako omogočijo povsem novo in dodatno dimenzijo dojemanja tudi gibajočih se predmetov, npr. [4]. Vendar se naš problem razlikuje od zgoraj opisanega v dveh bistvenih elementih:

(1) Nam ni potrebno video projekcije poravnati z neko vnaprej določeno 3D obliko oziroma predmetom. Zato kompleksna geometrijska kalibracija med 3D površino, na katero se projecira in katere obliko zajema globinski senzor, ter video projekcijo ni potrebna [5].

(2) V večini sistemov za video obogateno resničnost je smer gledanja uporabnika v grobem poravnana s smerjo video projekcije in zato do potrebe ali pojava perspektivne anamorfoze niti ne pride, čeprav s sledenjem položaja uporabnika nekateri sistemi tudi ustrezno korigirajo pespektivno deformacijo v video projekciji [6].

V komercialnih sistemih za video obogateno resničnost, npr. [7], so tudi integrirani globinski senzorji, vendar ti služijo predvsem avtomatični segmentaciji scene na osnovi oddaljenost od projektorja, da zamudna ročna segmentacija slike ni več potrebna. Zato smo se odločili za razvoj lastnega sistema za anamorfno projekcijo na neravno površino, ki je namenjen opazovanju projekcije iz nekega vnaprej določenega zornega kota.

4 OPREMA

Za anamorfično projekcijo na poljubno neravno površino potrebujemo dve zunanji napravi: Microsoft Kinect in video projektor. Kinect meri razdalje med 0,5m in 4,5m, kar narekuje tudi naš delovni prostor za projekcijo anamorfoze.

Programsko opremo za deformacijo slike smo zaradi hitrosti izvajanja razvili v jeziku C++, čeprav bi po funkcionalnosti bila primerna tudi visokonivojska jezika kot sta Processing in Python. Uporabili smo naslednje knjižnice:

- **OpenGL**: Aplikacijski programski vmesnik (API) za grafiko
  - **GLFW**: kreiranje okolja OpenGL
  - **GLEW**: nalaganje razširitev OpenGL
  - **GLM**: matrične in vektorske aplikacije
- **Kinect SDK**: API za Kinect
- **FFmpeg**: dekodiranje video zapisov
- **stb_image**: branje slikovnih datotek

5 PERSPEKTIVNA ANAMORFOZA NA NERAVNO POVRŠINO

Postopek za inverzijo anamorfične deformacije slike smo razdelil na več korakov.

Pridobivanje globinske slike. Globinske slike, ki jih pridobiva Kinect imajo dimenzijo 512×424, slikovne pike pa imajo celoštevilske vrednosti, ki so predstavljene s 16 biti. Vsaka od teh vrednosti predstavlja razdaljo izraženo v milimetrih. Če te vrednosti preslikamo v sivinsko sliko, dobimo globinsko sliko, kjer so v našem primeru svetle točke bolj oddaljene od senzorja. Kjer Kinect ni mogel zajeti globine, so točke črne barve.

Aproksimacija manjkajočih globinskih podatkov. Ker Kinect ne more zajeti globine v vsaki točki bodisi zato, ker je bodisi točka preveč oddaljena, ker se infrardeča svetloba, ki jo Kinect uporablja, odbije od površine ali zaradi šuma. Manjkajoče vrednosti določimo z aproksimacijo na osnovi sosednih točk.

Konverzija globinske slike v oblak 3D točk. Vrednosti posameznih slikovnih točk v globinski sliki spremenimo v koordinate 3D točk z naslednjo enačbo:

$$\vec{position} = depth * \begin{bmatrix} (\frac{2x}{width-1} - 1) * tan(\frac{fov_x}{2}) \\ (\frac{2y}{height-1} - 1) * tan(\frac{fov_y}{2}) \\ 1 \end{bmatrix} \quad (1)$$

kjer je:

$depth$ = globina

x, y = indeks točke v globinski sliki

$width, height$ = resolucija senzorja v hor. in vert. smeri

fov_x, fov_y = zorni kot Kinecta v hor. in vert. smeri v radianih

Ker ima Kinect tudi barvno kamero, lahko poveže globinske točke s ustreznimi barvnimi vrednostmi iz barvne kamere. Zato lahko te barve pripišemo tudi 3D točkam. Na sliki 6 je pogled na oblak 3D pobarvanih točk z različnih zornih kotov.
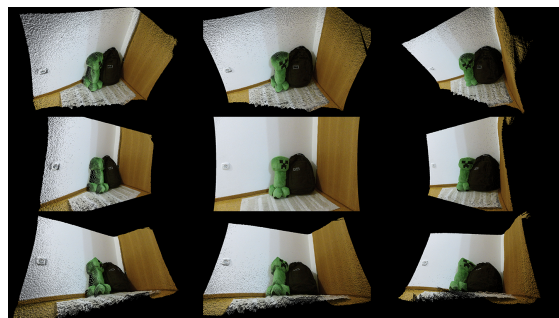
Slika 6: Pogled na oblak točk z različnih zornih kotov.

Virtualna anamorfoza. Najprej bomo izračunali virtualno anamorfozo v virtualnem prostoru, preden to naredimo v realnem prostoru. Najprej predpostavimo, da imamo virtualnega opazovalca, ki gleda v smeri pravokotno na smer projekcijskega snopa. Nato si predstavljajmo, da ta opazovalec projecira sliko na razgibano projekcijsko površino. Ta slika bo za opazovalca izgledala povsem pravilno, toda iz smeri projektorja bo popačena. Za vsako točko v oblaku 3D točk, ki predstavlja projekcijsko površino, izračunamo smer med opazovalcem in to točko in ugotovimo, kje ta premica prebada projecirano sliko. Na ta način določimo korespondenco med vsako točko v oblaku 3D točk in ustreznim pikslom projecirane slike. Ko 3D točkam pripišemo korespondenčno teksturo iz slike, se v oblaku 3D točk pojavi popačena slika, vendar če na oblak pogledamo iz smeri virtualnega opazovalca, dobimo nepopačeno sliko (slika 7).

Prava anamorfoza. Da bi dosegli isti učinek tudi v realnem svetu, moramo sedaj izračunati sliko, ki naj jo projecira projektor, da bi opazovalec videl nepopačeno sliko. Za vsak piksel
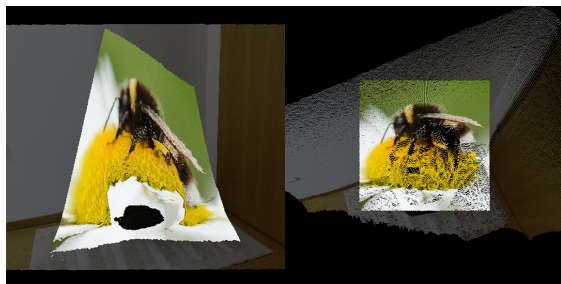
Slika 7: Virtualna anamorfoza: pogled iz smeri projektorja (levo) in pogled iz smeri virtualnega opazovalca (desno).

projecirane slike izračunamo smer v katero se ta piksel projecira v 3D prostoru. Zanima nas, kje je presečišče med to smerjo in projekcijsko površino, ki pa je predstavljena kot oblak 3D točk. Dodaten problem povzroča še različna resolucija projecirane slike, ki je veliko višja od resolucije globinskega senzorja (Kinecta), ki definira oblak 3D točk. Zato večina pikslov projecirane slike ni imela direktne korespondenčne 3D točke, ampak smo morali iz štirih najbližjih 3D točk izračunati približek presečišča. Za vsako presečiščno točko smo nato, upoštevaje pozicijo virtualnega opazovalca, lahko povezali piksle projecirane slike z ustreznim pikslom na sliki.

Ker je ta postopek dokaj zamuden, smo uporabili večnitno procesiranje, saj je določanje vrednosti posameznih pikslov v projecirani sliki, neodvisno drug od drugega. Primer tako izračunane projecirane slike je na sliki 8.

Slika 8: Anamorfoza v oblaku 3D točk (levo) in projecirana anamorfično deformirana slika (desno).

Kalibracija. Preden posnamemo 3D model površine za projeciranje ga moramo kalibrirati z video projektorjem. Implementirali smo funkcijo, ki na oblak 3D točk nariše rdeč pravokotnik, ki predstavlja področje, za katerega Kinect pričakuje, da bo nanj projecirana slika. Uporabnik mora nato ročno poravnati pozicijo Kinecta ali video projektorja tako, da se rdeči pravokotnik poravna s projecirano sliko.

6 REZULTATI IN ZAKLJUČEK

Slika 9 prikazuje projekcijo fotografije v horizontalni smeri na nagnjeno razbrazdano kamnito površino in pogled na to projekcijo navpično navzdol, kjer se anamorfoza razkrije — proporci slike so enaki kot na originalni fotografiji. Program na zmogljivem osebnem računalniku teče dovolj hitro, da lahko v realnem času procesiramo tudi video [1].

Zaradi nenatančnosti pri zajemu globinske slike je v anamorfični sliki še nekaj nenatančnosti, kar bi bilo možno preseči z bolj
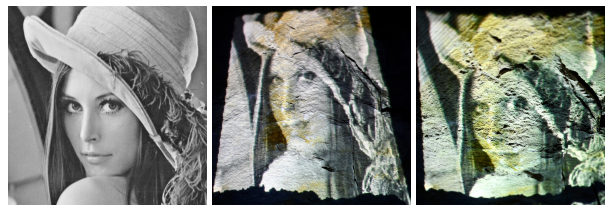
Slika 9: Levo: originalna slika; Sredina: projecirana slika na nagnjeno, neravno površino; Desno: pogled na projecirano sliko navpično navzdol.

natančnim globinskim senzorjem. Vseeno pa je tak način video projekcije na poljubno neravno površino možno uporabiti za številne aplikacije. Če bi v živo zajemali globinsko sliko, kar Kinect nenazadnje omogoča, bi bilo možno projecirati nedeformirane slike in video tudi na gibajoče se tarče.

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Učinkovita predstavitev slovarskih jezikovnih virov
pri govornih tehnologijah

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POVZETEK

Končni pretvorniki predstavljajo kompakten način za predstavitev slovarjev izgovarjav, ki jih potrebujemo pri sintezi ali prepoznavi govora. V članku je predstavljena nadgradnja končnih pretvornikov, t.i. končni super pretvorniki, s katerimi lahko razširjeni slovar izgovarjav predstavimo z manjšim številom stanj in prehodov kot s pomočjo minimalnega determinističnega končnega pretvornika. Končni super pretvornik ohranja determinističnost, poleg besed iz slovarja lahko dodatno sprejme tudi nekatere druge, neznane besede. Pri tem so lahko oddani izhodni alofonski prepisi za določene neznane besede napačni, vendar se izkaže, da je napaka primerljiva s trenutno najboljšimi metodami za določanje grafemsko-alofonske pretvorbe.

KLJUČNE BESEDE

govorne tehnologije, jezikovni viri, sinteza govora, slovarji izgovarjav

1 Uvod

Govorno podprti uporabniški vmesniki omogočajo uporabniško prijazno interaktivno komunikacijo, še posebej v okolju mobilnih komunikacij. Sodobni koncepti sistemov govorne komunikacije se v praksi prenašajo na majhne prenosne naprave, ki so zasnovane na vgrajenih sistemih (angl. embedded systems), za katere sta značilna omejena procesorska moč ter pomnilniška zmogljivost. Za uspešen razvoj in uporabo govorno podprtih aplikacij na prenosnih napravah je potrebno zagotoviti učinkovite in visoko kakovostne komponente sistema govornega dialoga, to je uspešnost avtomatskega razpoznavanja govora in kakovostno, razumljivo in naravno zvenečo sintezo govora.

Implementacija predstavitve leksikalnih jezikovnih virov v celovitih sistemih za prepoznavanje ali sintezo govora na vgrajenih platformah predstavlja netrivialen problem, ki ga še dodatno otežujejo omejitve zaradi uporabljene strojne opreme.

Pregled znanstvene literature pokaže, da pri izgradnji govornih tehnologij za jezike z velikim številom pregibnih oblik uporaba postopkov, ki so bili razviti za angleški jezik, ni učinkovita (Golob, 2012). Zaradi velikega števila pregibnih oblik besed pri istem številu leksemov se obsežnost prepoznavalnika slovenskega govora v primerjavi s primerljivim prepoznavalnikom angleškega govora vsaj podeseteri. Zato je potrebno posebno pozornost posvetiti prav optimizaciji uporabljenih modelov in njihovi adaptaciji na morfološke posebnosti pregibno bogatih jezikov.

Pomemben del govorno tehnološke aplikacije, kot je denimo sintetizator govora, predstavlja sistem za pretvorbo grafemskega zapisa besed v alofonski prepis. Samodejno določanje alofonskega prepisa v slovenščini temelji na množici kontekstno odvisnih pravil, pri čemer moramo poznati besedni naglas (Gros in Mihelič, 1999). Samodejno določanje besednega naglasa slovenskih besed zaradi nepredvidljivosti naglasnega mesta predstavlja zahtevno nalogo (Golob, 2009), zato je za kvalitetno sintezo slovenskega govora nujna uporaba obsežnih slovarjev izgovarjav.

Slovar izgovarjav predstavlja preslikavo grafemskih zapisov besed v alofonske prepise. Pri pregibno bogatih jezikih, kot je slovenščina, lahko slovarji vsebujejo več milijonov slovarskih vnosov, zaradi česar je lahko njihova uporaba v pomnilniško manj zmogljivih sistemih, kot so npr. vgrajeni sistemi, problematična. V teh primerih je nujna uporaba postopkov, ki omogočajo pomnilniško učinkovito predstavitev slovarjev.

Zato smo želeli poiskati in preizkusiti učinkovite postopke za zmanjševanje odvečnosti pri predstavitvi in računalniškem zapisu jezikovnih virov za pregibno bogate jezikovne skupine, ki bodo omogočali hitro, pomnilniško čim manj zahtevno ter visokokakovostno pretvorbo grafemskega zapisa besed v fonetični prepis in obratno.

V literaturi je mogoče zaslediti predvsem tri metode, ki omogočajo pomnilniško učinkovito predstavitev slovarjev izgovarjav, in sicer s pomočjo oštevilčenih *končnih avtomatov* (Lucchesi in Kowaltowski, 1993; Daciuk in Piskorski, 2011), dreves predpon (Ristov, 2005) ter *končnih pretvornikov* (odslej kratko *KP*) (Mohri, 1994; Golob at al., 2012). V tem delu bomo predstavili nov način predstavitve s pomočjo *končnih super pretvornikov* (odslej kratko *KSP*), ki predstavljajo nadgradnjo KP. Poleg manjše predstavitve slovarjev v primerjavi s KP, lahko s KSP z visoko točnostjo določimo alofonski prepis tudi nekaterim neznanim besedam oz. besedam, ki niso vsebovane v izvirnem slovarju izgovarjav.

V članku bomo najprej na kratko predstavili KP ter prikazali, kako lahko z njimi predstavimo slovar izgovarjav. Nadalje bomo pokazali, da zastopanost pregibnih oblik v slovarju močno vpliva na velikost KP. Sledi predstavitev KSP, ki predstavljajo nov način predstavitve slovarjev. Rezultate bomo predstavili na jezikovnih virih, ki so bili nadgrajeni v okviru projekta OptiLEX.

2 Končni pretvorniki (KP) ter predstavitev slovarjev izgovarjav

KP sestavljajo stanja ter prehodi med stanji. Vsak prehod ima vhodno in izhodno oznako. Ko se na vhodu KP pojavi določen vhodni niz, se ta nahaja v začetnem stanju. KP nato po vrsti sprejema vhodne simbole. Pri vsakem sprejetju vhodnega simbola odda izhodni niz simbolov, ki ga določa izhodna oznaka pripadajočega prehoda, ter se premakne v naslednje stanje. Če za poljuben vhodni simbol v trenutnem stanju ne obstaja prehod, ki ima vhodno oznako enako temu simbolu, pravimo, da KP vhodnega niza ne sprejema. Če se KP po prejetju vseh simbolov vhodnega niza nahaja v končnem stanju, pravimo, da vhodni niz sprejema, pri tem pa postane oddan izhodni niz veljaven. Omenimo še to, da je lahko vhodna ali/in izhodna oznaka enaka praznemu simbolu oziroma nizu.

KP, ki imajo v poljubnem stanju največ en prehod z določeno vhodno oznako, pravimo deterministični KP. Za takšne KP je hitrost pretvorbe vhodnega niza v izhodni niz zelo hitra in ob primerni izvedbi odvisna samo od dolžine vhodnega niza. Druga prednost determinističnih KP je ta, da obstajajo učinkoviti algoritmi za njihovo minimizacijo. Tako dobimo minimalni KP, ki ima najmanjše število prehodov in stanj med vsemi ekvivalentnimi KP (Mohri, 1997), torej KP, ki za poljuben sprejet vhodni niz oddajo enak izhodni niz.
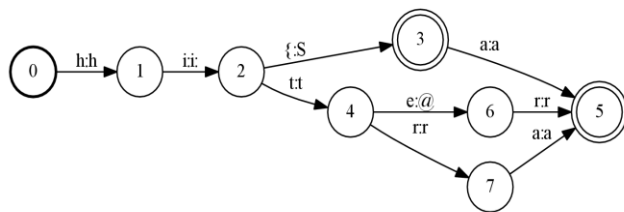
Slika 1: Primer KP, ki predstavlja slovar izgovarjav za štiri slovenske besede: *hiš*, *hiša*, *hiter* in *hitra*. **Krogi predstavljajo stanja, puščice pa prehode med stanji. Vsak prehod je označen z vhodno in izhodno oznako, ki sta ločeni z dvopičjem. Začetno stanje je označeno z odebeljenim krogom, končna stanja pa z dvojnim krogom.**

Vseh KP ni mogoče determinizirati, saj imajo deterministični KP manjšo izrazno moč kot nedeterministični (Hellis, 2004). KP, ki predstavlja slovar izgovarjav, lahko vedno determiniziramo, če iz slovarja odstranimo enakopisnice. Slika 1 prikazuje primer *minimiziranega in determiniziranega KP* (odslej kratko *MDKP*), ki predstavlja slovar za štiri slovenske besede.

3 Vpliv velikosti slovarja izgovarjav na velikost končnega pretvornika KP

V tem eksperimentu smo želeli preveriti odvisnost velikosti KP od velikosti slovarja, ki ga želimo predstaviti. Na voljo smo imeli slovar SI-PRON za slovenski jezik, ki vsebuje več kot milijon različnih slovarskih vnosov (Žganec-Gros et al., 2006). Slovar smo razširili z dodatnimi leksikalnimi enotami, ki smo jih razvili v okviru projekta OptiLEX.

Z naključnim izbiranjem slovarskih vnosov smo zgradili več pod-slovarjev različnih velikosti in za vse pod-slovarje zgradili MDKP.

Velikost MDKP, je podobno kot v eksperimentu, izvedenemu na manj obsežnih jezikovnih virih (Golob et al., 2012), dosegla vrh pri 78% do 83% velikosti prvotnega slovarja. To pomeni, da začne velikost MDKP pri določeni velikosti z dodajanjem novih besed oz. slovarskih vnosov iz slovarja upadati. To opažanje je bilo motivacija za razvoj nove vrste končnih pretvornikov, ki jim pravimo končni super pretvorniki., in jih opisujemo v naslednjem razdelku.
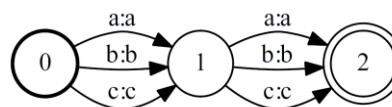
Slika 2: MDKP za izmišljen slovar, katerega ključi so sestavljeni iz vseh možnih izborov dveh črk od treh možnih – *a*, b **in *c*. Pri tem so vrednosti enake ključem.**

Da bi si ta pojav lahko lažje predstavljali, poglejmo minimalni primer, ki prikazuje mehanizem tega zmanjšanja velikosti MDKP. Slovarski vnosi so sestavljeni iz para ključ, vrednost. Pri slovarju izgovarjav tako grafemski zapis predstavlja ključ, alofonski prepis pa vrednost.

Kot primer vzemimo vzorčni slovar, katerega ključi so sestavljeni iz vseh možnih izborov dveh črk od treh možni, npr. črk *a*,b in *c*. Na ta način dobimo 9 različnih ključev, in sicer: *aa*, *ab*, *ac*, *ba*, *bb*… Zaradi enostavnosti naj bodo pripadajoče vrednosti enake ključem. MDKP za ta slovar prikazuje slika 2.
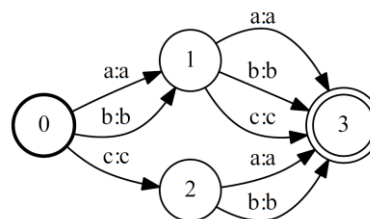
Slika 3: MDKP za enak slovar, kot ga predstavlja MDKP na sliki 2, pri čemer mu manjka slovarski vnos *cc* : *cc*.

Sedaj iz omenjenega slovarja odstranimo slovarski vnos *cc* : *cc* ter ponovno zgradimo MDKP. Rezultat prikazuje slika 3. Opazimo lahko, da se je pri odstranitvi slovarskega vnosa iz slovarja kompleksnost MDKP povečala, saj je za predstavitev slovarja potrebno eno dodatno stanje ter dva dodatna prehoda. V (Golob et al., 2012) in (Golob et al., 2016) smo podrobneje raziskali vzroke,

ki vplivajo na zmanjšanje MDKP pri predstavitvi slovarja pri dodajanju novih slovarskih vnosov.

3.1 Vpliv množičnosti pregibnih oblik na velikost slovarja izgovarjav

Preverili smo vpliv množičnosti pregibnih oblik lem besed iz slovarja na velikost MDKP. Pri tem z množičnostjo pregibnih oblik mislimo na število različnih pregibnih oblik za določeno lemo. Za primer smo vzeli besedo *skopati* ter v slovarju poiskali vse slovarske vnose, katerih grafemski zapisi predstavljajo pregibne oblike leme izbrane besede. Dobili smo 27 različnih slovarskih vnosov, iz katerih smo s pomočjo naključnega izbiranja vnosov tvorili še štiri različno velike pod-slovarje. Za vsak pod-slovar smo zgradili MDKP. Iz rezultatov je razvidno, da hitrost naraščanja velikosti MDKP z večanjem slovarja rahlo pada, vendar pa ni opaziti obrata trenda povečevanja MDKP (Golob et al., 2012).

3.2 Vpliv množičnosti pregibnih oblik na velikost slovarja izgovarjav

Poglejmo sedaj, kako na velikost MDKP vpliva zastopanost pregibnih oblik v slovarju, sestavljenem iz večih besed, ki se podobno pregibajo. Iz slovarja SI-PRON smo izbrali 28 grafemskih zapisov besed, katerih pregibne oblike imajo 9 različnih končnic ter pripadajo štirim različnim lemam - *potop, osmod, zasp, natoč*. Izbrane leme ter pripadajoče končnice so prikazane v tabeli 1. Lema *zasp* pri tem predstavlja izjemo, ki se pregiba nekoliko drugače kot ostale tri.

Tabela 1: Tabela prikazuje postopek za tvorjenje vseh besed, ki so vsebovane v slovarju. V levem stolpcu so navedene leme besed, v desnem pa možne končnice.

MOŽNE LEME	MOŽNE KONČNICE
potop, osmod, zasp, natoč	iš,im,imo,ite,ijo
potop, osmod,natoč	i+l,i+li
zasp	a+l, a+li

Iz teh besed smo nato tvorili slovar, pri čemer smo zaradi enostavnosti vrednosti ključev izenačili s ključi. Nato smo z naključnim izbiranjem iz tega slovarja tvorili še štiri različno velike pod-slovarje. Za vse tako zgrajene slovarje smo zgradili MDKP.

Velikost MDKP, ki predstavlja vseh 28 vnosov slovarja, manjša od MDKP, ki predstavljata slovarja s 23 in 17 vnosi, število stanj pa je večje celo pri MDKP, ki predstavlja slovar z 9 vnosi. Rezultati nakazujejo, da zastopanost pregibnih oblik močno vpliva na kompleksnost pridobljenega MDKP ter lahko vpliva na obrat trenda rasti velikosti MDKP.

Slika 4 prikazuje shematski prikaz dela MDKP, ki predstavlja končnice besed za slovar z 28 vnosi. Kompleksnost MDKP, ki predstavlja slovar z manj vnosi, je precej večja. Zato je smiselno, da so v slovarju, ki ga želimo realizirati s KP, prisotne vse možne

pregibne oblike, saj si lahko v tem primeru leme, ki se enako pregibajo, del končnega pretvornika, ki pretvarja končnice, v celoti delijo. Kompleksnost pri tem še vedno povečujejo besede oz. leme besed, ki imajo med pregibnimi oblikami kakšno izjemo, ki se pregiba nekoliko drugače. V našem izmišljenem slovarju je to lema *zasp*, katere dve pregibni obliki imata nekoliko drugačno končnico, in sicer končnico *al* ter *ali* namesto *il* ter *ili*.
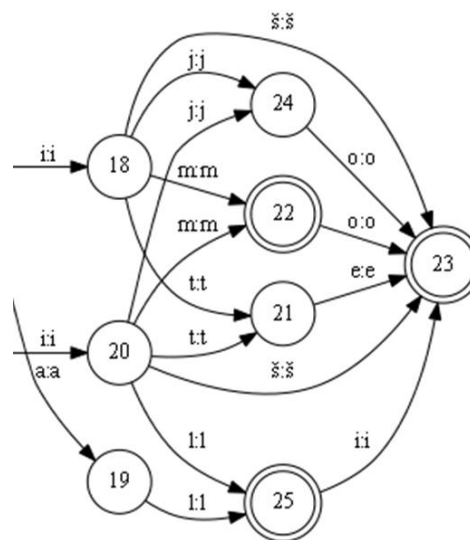
Slika 4: Del MDKP, ki predstavlja celoten slovar z vsemi 28 vnosi. Prikazan je le del, ki pretvarja končnice vnosov.

MDKP sprejme samo vnose, ki so vsebovani v slovarju. Če za določeno aplikacijo tako stroga zahteva ni potrebna in je dovolj, da MDKP sprejme vse vnose iz slovarja, ga lahko naprej poenostavimo. Še enostavnejšo obliko bi namreč dobili, če bi za vse štiri leme iz slovarja obstajale pregibne oblike za vseh 9 možnih končnic. V slovar lahko tako dodamo dodatne vnose in sicer vnose z lemami *potop*, *osmod*, *natoč* ter končnicama *al* ter *ali*, ter vnosa z lemo *zasp* in končnicama *il* ter *ili*. Pridobljeni slovar ima tako 36 vnosov, MDKP pa se poenostavi na 23 stanj in 30 prehodov.

4 Končni super pretvornik (KSP)

V prejšnjem razdelku smo pokazali, da lahko s pomočjo dodatnih, izbranih slovarskih vnosov v slovar zmanjšamo kompleksnost MDKP. Problem predstavlja iskanje takšnih slovarskih vnosov, ki bi zmanjšali kompleksnost, še posebej v primeru realnih slovarjev, kot so npr. slovarji izgovarjav, ki so prvič večji, drugič pa se ključ in vrednost posameznih slovarskih vnosov razlikujeta, s čimer je iskanje primernih slovarskih vnosov težja naloga.

Problema smo se zato lotili na drugačen način, in sicer tako, da smo združevali določena stanja, pri čemer smo želeli zadostiti naslednjima dvema pogojema:

• Pridobljeni KP mora ostati determinističen.

• Pridobljeni KP mora sprejemati vse ključe prvotnega slovarja ter za sprejete ključe oddati pravilne pripadajoče vrednosti.

Tako smo lahko združevali samo stanja, ki so imela določene lastnosti. Takšna stanja smo poimenovali združljiva stanja. Dve stanji sta združljivi, če zadoščata naslednjim pogojem:

• Če je eno od stanj končno stanje, stanji ne smeta imeti izhodnih prehodov s praznimi vhodnimi simboli oz. ε simboli. Rezultat združevanja takšnih stanj je lahko nedeterministični KP.

• Stanji nimata izhodnih prehodov z enakimi vhodnimi simboli ter različnimi izhodnimi simboli.

• Stanji nimata izhodnih prehodov z enakimi vhodnimi simboli ter enakimi izhodnimi simboli, ki prehajajo v različna naslednja stanja, ki so nezdružljiva.

Da bi lahko določili združljiva stanja, je potrebno preveriti zgornje pogoje, kar pa je v praksi lahko problematično, saj je preverjanje združljivosti stanj zaradi rekurzivnosti, ki je lahko ciklična, zahtevno. V ta namen smo zadnji pogoj poenostavili:

• Stanji nimata izhodnih prehodov z enakimi vhodnimi simboli ter enakimi izhodnimi simboli, ki prehajajo v različna naslednja stanja.

Zaradi poenostavitve pogoja za združljivost stanj nekaterih združljivih stanj nismo mogli zaznati. KSP smo zgradili tako, da smo najprej zgradili MDKP, nato pa smo nadalje združili vsa stanja, ki so združljiva. Za vsako stanje je bilo potrebno preveriti, ali je združljivo s katerim koli drugim stanjem. Ker nekatera stanja postanejo združljiva šele, ko združimo neka druga stanja, je bilo potrebno to storiti v več iteracijah.

5 Predstavitev slovarja izgovorjav s končnimi super pretvorniki KSP

Za razširjeni slovar izgovorjav iz razdelka 3 smo najprej zgradili MDKP s pomočjo odprtokodnega orodja OpenFST (Cyril at al., 2007), nato pa smo s postopkom, ki smo ga opisali v razdelku 4, zgradili še KSP. Tabela 2 prikazuje število stanj in prehodov MDKP in KSP.

Tabela 2: Zmanjšanje števila stanj in prehodov pri gradnji KSP iz MDKP.

		MDKP	KSP	Sprememba
1 izhodni simbol	*Stanja*	246.262	186.476	24.3%
	Prehodi	556.723	441.234	20.7%

Opazimo lahko, da smo velikost KSP v primerjavi z velikostjo MDKP uspeli zmanjšati za več kot 20%.

Čeprav lahko s KSP vnose v slovarju predstavimo z manjšim KP kot v primeru MDKP, pri tem izgubimo informacijo o tem, katere besede so vsebovane v slovarju. Tako se lahko zgodi, da KSP sprejme določeno besedo, ki je slovnično pravilna, vendar ni bila vsebovana v slovarju. V tem primeru je lahko oddan alofonski prepis napačen.

6 Zaključek

V članku je predstavljen nov tip KP, ki smo jih poimenovali končni super pretvorniki (KSP), ki poleg želenih besed sprejemajo še nekatere druge z namenom, da lahko pretvorbo želenih besed predstavimo bolj kompaktno.

Pokazali smo, da lahko pri predstavitvi slovarja izgovorjav s pomočjo KSP število stanj in prehodov zmanjšamo za več kot 20%, ko so za vsebovane leme v slovarju izgovorjav prisotne tudi vse pripadajoče pregibne oblike besed.

Ker KSP sprejemajo še druge, neznane besede, za katere lahko oddajo napačen izhodni niz, so KSP uporabni predvsem v aplikacijah, kje ne potrebujemo informacije o tem, katere besede so vsebovane v KP ampak le informacijo o pravilni pretvorbi danih besed oz. besed, iz katerih smo zgradili KSP.

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The Fundamentals of Sound Field Reproduction Using a Higher Order Ambisonics System

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ABSTRACT

Conventional sound recording methods are based on recording the sound pressure level with a microphone which is after some signal processing reproduced by loudspeakers. In spatial audio, more than one microphone and loudspeaker are required to provide the sound source location information to the listener. Several spatial audio formats have been developed and some have successfully entered our homes, such as the the multichannel 5.1 surround system. Among spatial audio formats, Ambisonics stands out due to its capability of capturing and reproducing the whole sound field and is not limited to predefined loudspeaker setups. In the paper, the InnoRenew CoE's Ambisonics system is introduced and some of its underlying principles are explained. Furthermore, practical examples of the use of Ambisonics, also in relation to Virtual reality applications, are presented.

KEYWORDS

higher order Ambisonics, sound field reproduction

Figure 1: The higher order Ambisonics reproduction system with 64 loudspeakers (top) and the Ambisonics microphone [2] (bottom) which are part of the InnoRenew CoE's acoustic laboratory equipment.

1 INTRODUCTION

Michael Gerzon [1] invented Ambisonics in the 1970s, and since it has mainly been a research topic in acoustics. It's higher order version was developed twenty years later but only recently it has become a commercially available recording system [2]. Currently, more and more user applications of Ambisonics are emerging since Ambisonicsis is being positioned as the audio framework of choice for virtual reality [3, 4].

The acoustic laboratory of InnoRenew CoE has currently been equipped with a higher order Ambisonics system. The system is composed of a 32 channel microphone [2], a set of 64 full range loudspeakers, a dedicated low frequency loudspeaker, all the required AD/DA converters and accessories, such as stands and cables. The equipment in shown on Figure 1.

The system will be used for perceptual acoustic experiments, mainly by exposing test subjects to different acoustic conditions and investigating their response. In fact, room acoustic conditions are essential for a healthy and creative working environment – one of the important research topics at InnoRenew CoE. Another use of Ambisonics is in combination with virtual reality systems (e.g. [7]) that can provide a multi-sensoric immersion experience to users.

2 RECORDING AND ENCODING

Ambisonics is a method of recording and reproducing a sound field and preserving its directional properties. The signal is coded, which is different in comparison with traditional multichannel audio formats (e.g., stereo, and 5.1 surround). In those, each channel contains the signal corresponding to a loudspeaker while in Ambisonics each channel contains derivatives of the pressure field. The encoded signals are known as B format.

In Ambisonics we record with several microphones spherically arranged on a (virtual) sphere. Summing properly weighted signals from each microphone is equivalent to recording with a microphone of a certain directional characteristic. Such processing is the basis of Ambisonics encoding [2], in which case the chosen directional patterns correspond to spherical harmonic functions (see figure 2).
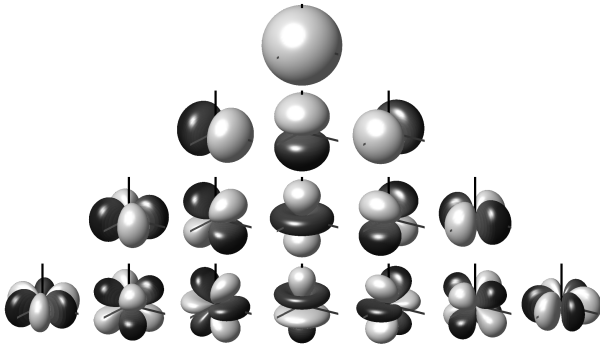
Figure 2: Polar patterns of spherical harmonics $Y_n^m(\theta, \varphi)$ of zero, first, second, third and fourth order (from top to bottom) (figure from [5]).

Figure 3: Example of a cardioid (left) and super-cardioid (right) microphone polar pattern (figure from [8]).

Spherical harmonic functions are grouped by their order number n and particular coefficient $m = -n, ...n$. Mathematically, each spherical harmonic corresponds to the angular portion of the solution of the wave equation. This way it is possible to capture the whole sound filed as it can be, in fact, decomposed into spherical harmonic functions

$$p(k, \mathbf{r}, \theta, \varphi) = \sum_{n=0}^{\infty} \sum_{m=-n}^{n} 4\pi i^n j_n(kr) A_{n,m} Y_n^m(\theta, \varphi) \qquad (1)$$

where φ and θ are the azimuth and elevation, $\mathbf{r}$ is the spatial coordinate and k is the wavenumber.

The general idea of a higher order Ambisonics encoding is to record sound with directionality patterns that correspond to polar patterns of spherical harmonics. As such, it is possible to encode the sound field in form of spherical harmonic decomposition factors instead of the sound pressure level at each microphone position.

The maximum order N at which we perform the expansion defines the order of the Ambisonic system. Each order contains $2N + 1$ channels, meaning that in total the ambisonics system of order N has $(N + 1)^2$ channels that have to be stored. Increasing the order to which the decomposition is done improves the directionality of the recording.

An important limiting factor for increasing the Ambisonic order is the number of microphones positioned on the sphere: the pressure is discretely sampled, which leads to artifacts, such as aliasing. Issues related to low frequency noise and several other technical limitations have been studied [3]. Generally, increasing the number of microphones is favored, although this obviously increases the cost of the system.

It is important to understand that the B format encoded signals can be as well manipulated with proper signal processing. For example, the sound field can be easily rotated for a certain angle, and it is also possible to focus to a certain direction of the sound field [6].

3   REPRODUCING THE SOUND FILED

The biggest advantage of Ambisonics over conventional multichannel spatial audio techniques (e.g. stereo, 5.1 and 7.1
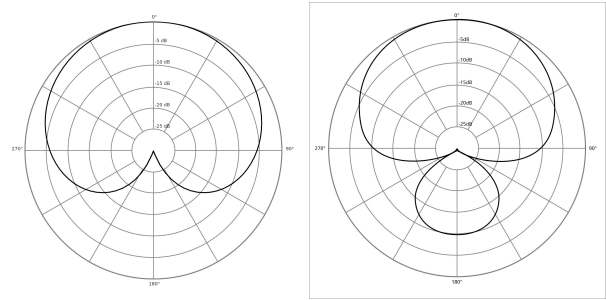
surround) that consider fixed loudspeakers position is independence on the loudspeaker setup. In Ambisonics, the decoding from the B format takes into account the actual position of the available loudspeakers, which can be arbitrary chosen. Nevertheless, a high number of loudspeakers spatially distributed around the listener are required to provide a full and precise spatial impression.

The number of loudspeakers required is as well dependent on the order of the system. The $N-$th order requires a minimum $(N+1)^2$ loudspeakers, meaning that 9 loudspeakers are required for the 2nd order, 16 for the 3rd and 25 for the 4th.

There are several strategies for decoding the B format to be reproduced on a setup of loudspeakers. The basic idea is to directionally filter the recorded signals by virtual microphones pointing in the direction of each loudspeaker.

Setting the proper directionality patterns (see Fig 3) is the important part of the decoding process. In a regular layout, the signal emitted by a loudspeaker is the same as it would be recorded by a supercardioid microphone pointing towards that direction [6]. This means almost all loudspeakers emit sound at the same time, and for a given sound source position, loudspeakers in the opposite direction emit in opposite phase.

4   THE AMBISONICS SYSTEM IN USE

Ambisonics systems are an useful research tool in acoustics, mainly because they enable to reproduce sound emitted by sources together with the acoustic environment in which they are located. An important example of such use are the investigations carried out by Tapio Lokki [9] with his group who have been investigating perceptually relevant acoustic properties of concert halls. In their research, listeners have been asked about their preferences about the acoustics of different concert halls in which the same orchestra was performing. As an individual's acoustic memory is strongly affected by the time that has passed since each concert experience, it is required for such research to migrate the listener and orchestra between concert halls immediately. This can be achieved by an Ambisonics system in which recordings can be switched by a push of a button.

Figure 4: Photo of a listener in the Ambisonics loudspeakers ring at the InnoRenew CoE's Acoustic lab. The control over the system and perceptual response is based on a tablet PC as an interface.

Currently at InnoRenew CoE, we are setting up the Ambisonics system for the listener to rate different acoustic environments. The research is not limited to a specific environment type, such as concert halls, but includes acoustic environments to which we are exposed on a daily basis (commonly referred to as soundscape [12]). The recording will be performed on several different locations that include noisy and pleasant environments, such as high-traffic roads, busy workspaces and nature.

The interaction of the user with the system can be designed in various ways. Firstly, we are relying on a tablet PC as shown in Fig. 4. Using the tablet, the playback is controlled and the response from individuals is gathered. The system can be upgraded with more advanced response tracking options, such as performing eye-tracking or tracking the electrodermal activity of the test subject.

Spatial sound can be incorporated into virtual reality (VR) interfaces, such as VR headsets. The most accessible approach is to use headphones for which the signals have to be processed based on Head-related transfer functions [10]. The main drawback in this case is that wearing headphones is not natural to users and can produce discomfort. It is well known [11] that the listener does not localize the sound source as being external, but rather positions it in between the ears. This phenomenon of using headphones is known as lateralization of sound sources [11].

Generally, the relative position/orientation of the sound source in relation to the listener's ears changes over time, meaning that Head-related transfer functions applied to process the audio content have to adopt accordingly. Therefore, when using headphones in VR head tracking and real time audio processing are required.

In this perspective, the use of Ambisonics advantageous as the full sound field is reproduced and the listener can freely rotate his head while localization clues are correctly perceived. Additionally, in Ambisonics the ears are free from

wearable equipment, which is a more natural condition for the user.

A relevant use of Ambisonics in relation to VR is also recording the sound field using an Ambisonics microphone and reproducing it over headphones instead of an Ambisonics reproduction system composed of a high number of loudspeakers. In fact, the B format encoded signals can be processed for a binaural playback for any arbitrarily chosen head rotation. Recently, many commercial second order Ambisonics microphones containing four microphones have become available on the market together with dedicated digital audio work station plug-ins for binaural decoding.

5 ACKNOWLEDGMENTS

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The use of eCare services among informal carers of older people and psychological outcomes of their use

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ABSTRACT

With increasing age and longevity, the need for informal care will increase significantly in the coming decades. The use of eCare services has potential benefits in meeting some of informal carer's needs. However, there is only a limited understanding of the psychological outcomes of using eCare services for informal carers of older people. The aim of this study is to identify positive and negative psychological outcomes of the use of eCare services for employed informal carers of older people, and to review the psychological outcomes of the use of different functionalities of eCare services. We have conducted a four-month intervention study among 22 dyads of informal carers and older people. The preliminary results showed a prevalent pattern of positive outcomes of eCare services for employed informal carers. Further research is needed on the relationship between the use of different functionalities, psychological outcomes and care situations.

KEYWORDS

psychological outcomes, employed informal carers, telecare, ageing in place

1 INTRODUCTION

The growing pressure on families to provide informal care, due to demographic aging of the population, leads to a search for new and innovative solutions to meet those challenges. An increasing attention is being paid to the role of technology and its potentials in supporting older people in their own homes and their informal carers. However, understanding the psychological outcomes of the use of eCare services is limited for informal carers of older people and even more so for working informal carers [1, 4, 6, 11, 14, 18].

Informal carers provide not just physical support, but also social and emotional, as well as making sure that the older people are safe and healthy, so informal care is very demanding and dynamic [17]. Informal carers are spending a lot of time at the home of the care receiver and the demands of providing care can be high, especially to those who are employed. Because of caring duties, some informal carers addressed different issues, such as work interruptions, absences and reduced productivity [3, 17, 20]. Combining employment and care is a challenge to many carers and it can have an influence of informal carers' physical health, social relationships, as well as the work situations [17]. Many are having troubles being understood by their employers or co-workers and to some the career opportunities cannot be obtained [17].

ECare services have a potential to address those needs, such as decrease the demand on carers and stress alleviation [1, 4, 11, 17]. Many studies are studying the link between psychological outcomes and the functionalities of eCare services, but these studies are very disease-specific, such as dementia [2, 12, 19]. Informal carers of people with dementia have specific needs, and these needs cannot be fully transferred to the needs of informal carers providing a different type of care, therefore there is a gap in understanding which functionalities of eCare services can help informal carers in general to better combine work and care. In addition, many studies examined different outcomes and models of eCare services use and acceptance among the older people [8, 15], living aside informal carers of older people.

The aim of the study was to fill this gap and to identify the positive and negative psychological outcomes of the use of eCare services on employed informal carers and to review the psychological outcomes of the use of different functionalities of eCare services.

2 METHODS

Study design

A four-month qualitative intervention study was performed in 2018 and 2019 in Central Slovenia region. In accordance with the aim of the study, surveys and interviews were conducted with employed informal carers only. The intervention

study included a dyad of an informal carer and an older person (65+). A total of 26 dyads, including older care receivers and their primary informal carers, were recruited. The final sample included 22 dyads.

Apparatus

Older people had one of the two eCare equipment installed in their homes. Their informal carers used the mobile application, which allowed them to monitor certain activities in the older person's home and receive notifications in case of unexpected event. Both services tested had motion and door sensors, a pendant alarm, a smoke detector and a mobile application for the carers, with alarms in the form of push notifications and activity monitoring. The second service also offered two additional functionalities, a 24/7 call center and fall detection, and was used by 7 out of 22 carers.

Participants

Purposive sample was used. Eligibility criteria for informal carers were: (i) primary carers, (ii) family members of older person, (iii) providers of a long-term care to older person (providing at least 5 hours of help per week and minimum 1 year), (iv) owned a smartphone, (v) interested in study participation. Care receiver's eligibility criteria were as follows: (i) interested in study participation, (ii) old 65 years or more, (iii) need help with activities of daily living, (iv) use also formal care, (v) live alone in their own household.

Informal carers ranged in age from 35 to 67 (M = 53.9, SD = 7.56). More than half of them were female (n = 14). On average they provided 8.5 hours of care per week (SD = 12.15), on average for 6.1 years (SD = 5.89). A great majority of carers were care receiver's children (n = 20) and two were daughters-in-law.

Care receivers were on average 83 years old (SD = 6.04), ranging from 73 to 92 years. All but two were females and all but one fell in the last five years, with 14 of them needed medical assistance afterwards. Five of them were severely dependent, eight moderately dependent, eight slightly dependent and one needing some help only occasionally.

Procedure

During the intervention, quantitative (screening questionnaire) and qualitative (semi-structured interviews) data were collected, with qualitative methodology playing a fundamental role. The survey at the beginning of the intervention collected basic social, health, care and demographic data. Two semi-structured interviews per informal carer were then conducted (the first after 3 weeks of use and the fourth month), each lasting about one hour. They were asked about their caregiving situation, their experience with new technology, their use of the tested eCare services and the psychological outcomes of eCare services. The in-depth interviews were

recorded and completely transcribed. Personal information was made anonymous. All participants received gift vouchers in recognition of their time and were not charged for their use of the eCare services. The study was approved by the Slovenian Commission for Medical Ethics (0120-193/2018/15).

Analysis

A descriptive analysis of the quantitative data, comprising 755 pages of transcribed interview recordings, was carried out. The qualitative data were subjected to a thematic analysis using the programme Atlas.ti 8 for qualitative data analysis. A structural coding was used. This is question-based code that "acts as a labelling and indexing device, allowing researchers to quickly access data likely to be relevant to a particular analysis from larger data set" [13, 16]. Deductive and inductive approaches were combined for data coding and analysis [7].

3 RESULTS

We examined psychological outcomes of five eCare services functionalities: motion detection on the App, Push notifications and alarms on the App, Emergency pendant, Smoke detector, Call center and Fall detector. The most frequently reported positive psychological outcome was reassurance, followed by peace of mind and reduced anxiety. In addition, the informal carers mentioned several other positive psychological outcomes of using eCare services, including an increased sense of control, less stress, the feeling of being less burdened, having positive feelings, a feeling of relief and satisfaction (Table 1).

	Push notifications and alarms on the app	Sensor-based motion detection on the app	Call centre assistance	Fall detector	Emergency pendant	Total
Reassurance	8	18	7	2	8	43
Peace of mind	8	12	4	1	6	31
Reduced anxiety	5	12	2	0	3	22
Reduced stress	3	6	1	0	1	11
Feeling less burdened	2	4	2	0	1	9
Positive feelings	0	2	1	0	1	4
A sense of relief	0	3	0	0	0	3
Satisfaction	0	0	1	0	1	2
Total	26	57	18	3	21	

Table 1: Positive psychological outcomes of eCare services use on the employed informal carers

"Yes, yes, that gives you the feeling of reassurance that they will inform you, if you are not around when he presses the button. And then you go on vacation or somewhere else, as I say, even if something would happen, you organize other family members to make an action." (Carer 15)
"I will say it, if I did not reach mum over the phone call because of her bad hearing, then I looked at this application and saw that mom is inside doing something. If something was wrong, there is also an option for an emergency pendant, which she could activate, right ..." (Carer 6)

In our study, informal carers recognized that the emergency pendant and sensor-based motion detection are two of the most helpful functionalities of eCare services, as they are the most common contributors to positive psychological outcomes. The most useful functionality for those who cared for people with severe disabilities was an emergency pendant, while sensor-based motion detection was more useful for those carers who cared for people with mild or moderate dependency.

The few negative psychological outcomes in our study were mostly caused by technical failure and false alarms, although some participants were less disturbed than others. The most frequently mentioned negative outcome was anxiety, followed by distrust and stress. Other reasons for negative psychological outcomes were mentioned: feelings of false security, invasion into older person's privacy, feelings of guilt because they do not help enough, increased worries because they know the everyday patterns of older person (Table 2).

"Hm, yes, it caused me more stress personally because I was worried, under other circumstances I would not do that. Under other circumstances, I would not think about whether she was still cooking or not." (Carer 2)

	Push notifications and alarms on the app	Sensor-based motion detection on the app	Call centre assistance	Fall detector	Emergency pendant	Total
Anxiety	6	3	1	0	0	10
Hesitant	0	0	7	0	0	7
Distrust	1	3	1	1	0	6
Stress	2	2	0	0	0	4
Feeling burdened	1	3	0	0	0	4
Lack of relief	0	1	0	0	2	3
Doubts	0	1	0	0	2	3
Discomfort	0	2	0	0	0	2
Less peace of mind	0	2	0	0	0	2
Additional problem	1	1	0	0	0	2
No reduced burden	0	1	0	0	0	1
Feeling a moral obligation	0	1	0	0	0	1
Sense of guilt	0	1	0	0	0	1
Bothered	1	0	0	0	0	1
Unpleasant feeling	1	0	0	0	0	1
Total	13	21	9	1	4	

Table 2: Negative psychological outcomes of eCare services use on the employed informal carers

"Even more, because she does not want to wear this neckless, then it seems to me to be useless. You do not need it for anything, it will not be very functional, because then it will not matter if she only has a mobile phone." (Carer 2)

In the present study, all call center users mentioned positive psychological outcomes in relation to it. They mostly felt reassured by their service. However, a few participants who did not have access to the call center service felt reluctant to use it because they said that they might not have enough information about the older person to be able to react well, that they would not feel comfortable talking to a "stranger" and that their situation was too specific for a call center to be helpful. They were worried that the call center would approach to older person too technically rather than attentively.

"… I know, even when mom falls, she is always very confused. It is much easier when she says, "daughter, I fell," opposing to explain it to them. Well, "lady, this and that". I do not know, I am absolutely for an option that one of the family members has it." (Carer 4)

"It would not help much. It would not help us, because if mum is alone when she falls (…). I can assume that she is able to say something on her own, maybe not, right." (Carer 8)

For some carers, eCare services contributed to their ability to be in paid employment and was useful in reconciling care and work obligations. They mentioned that eCare services supported their work and increased their labor productivity by making it easier for them to concentrate on their work.

"Yes, I can concentrate at work. I do not have to think about what if … It helps, and it relieves you, but still, if she falls, and her phone is ten feet away and she cannot use it, then it's useless …" (Carer 9)

4 DISCUSSION

Our study yielded several important findings. We found that positive psychological outcomes of eCare services use for employed informal carers were much more common than negative ones. This finding supports the findings of previous limited studies of informal carers [1, 9, 14]. Despite the prevalence of positive psychological outcomes, the negative should not be ignored. In particular studies show that unreliable and/or inappropriate technology, which in our study was the main cause of negative psychological outcomes, can be harmful to both older people and their informal carers [5, 10]. In addition, a difference was also observed in the perceived usefulness of individual functionalities in relation to the degree of dependence. However, due to the small number of participants in different dependency groups, further empirical and conceptual studies are needed. Our study also confirmed the complex relationship between the functionalities of eCare services and the psychological outcomes for employed informal carers.

We also demonstrated that reassurance was the most frequently identified positive psychological outcome. It was mainly related to sensor-based motion detection on the application, the possibility of monitoring the activities of an older person from distance, e.g. to verify that he or she is moving around home safely. In addition, employed informal carers reported that reassurance makes it easier for them to go on business trips, work and concentrate on their work, as they are notified in case of an emergency. From this, we can conclude that eCare services can provide opportunities for employed informal carers of older people to reconcile work and care responsibilities.

This study examined under-researched aspect of eCare use in relation to informal care of older people. The methodology used allowed a detailed account of the experiences of employed informal carers' with eCare as well as their perceptions of it. However, there are some limitations to this study. The first is the duration of the intervention. When conducting an intervention study to investigate the detection and vigilance of a potentially harmful event, a longer duration of the intervention is usually advisable, but we were limited in time and resources. In addition, the incidence of a harmful or unexpected event during the testing phase in our study was low, so many participants had no real experience with the support and protocols for using eCare services. Moreover, one of the eCare services tested was still in the testing phase during the intervention study, so that several false alarms occurred, especially at the beginning of the study.

5 CONCLUSIONS

Our study confirmed the potential of eCare services to address challenges related to long-term care provision. There are many challenges that Slovenian society needs to address in order to realize the full potential of eCare technologies: (i) Public authorities must recognize the role and caring demands of informal carers and provide them with much needed support as soon as possible. (ii) Policy makers should promote a policy framework for the creation of eCare services for carers and beyond [19]. (iii) Affordable and accessible eCare services must be made available to informal carers and older people [18, 19]. At the same time, we must increase their acceptance of such technologies. Therefore, the design and usability of these technologies should be adapted and personalized to the needs of informal carers [2, 18]. End users should therefore be involved in the test phases [5, 18].

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