INFORMACIJSKA DRUŽBA
Zbornik 24. mednarodne multikonference

INFORMATION SOCIETY
Proceedings of the 24th International Multiconference

4.—8. oktober 2021
Ljubljana, Slovenija
4—8 October 2021
Ljubljana, Slovenia

IS 2021

Slovenska konferenca o umetni inteligenci
Slovenian Conference on Artificial Intelligence

Kognitivna znanost
Cognitive Science

Odkrivanje znanja in podatkovna skladišča • SiKDD
Data Mining and Data Warehouses • SiKDD

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14. mednarodna konferenca o prenosu tehnologij
14th International Technology Transfer Conference

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Vzgoja in izobraževanje v informacijski družbi
Education in Information Society

Delavnica URBANITE 2021
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50-letnica poučevanja računalništva v slovenskih srednjih šolah
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4.–8. oktober 2021 / 4–8 October 2021
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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2021

Štiriindvajseta multikonferenca *Informacijska družba* je preživela probleme zaradi korone v 2020. Odziv se povečuje, v 2021 imamo enajst konferenc, a pravo upanje je za 2022, ko naj bi dovolj velika precepljenost končno omogočila normalno delovanje. Tudi v 2021 gre zahvala za skoraj normalno delovanje konference tistim predsednikom konferenc, ki so kljub prvi pandemiji modernega sveta pogumno obdržali visok strokovni nivo.

Stagnacija določenih aktivnosti v 2020 in 2021 pa skoraj v ničemer ni omejila neverjetne rasti IKTja, informacijske družbe, umetne inteligence in znanosti nasploh, ampak nasprotno – rast znanja, računalništva in umetne inteligence se nadaljuje z že kar običajno nesluteno hitrostjo. Po drugi strani se je pospešil razpad družbenih vrednot, zaupanje v znanost in razvoj. Se pa zavedanje večine ljudi, da je potrebno podpreti stroko, čedalje bolj krepi, kar je bistvena sprememba glede na 2020.

Letos smo v multikonferenco povezali enajst odličnih neodvisnih konferenc. Zajema okoli 170 večinoma spletnih predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic ter 400 obiskovalcev. Prireditev so 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 45-letno tradicijo odlične znanstvene revije.

Multikonferenco Informacijska družba 2021 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Odkrivanje znanja in podatkovna skladišča
- Kognitivna znanost
- Ljudje in okolje
- 50-letnica poučevanja računalništva v slovenskih srednjih šolah
- Delavnica projekta Batman
- Delavnica projekta Insieme Interreg
- Delavnica projekta Urbanite
- Študentska konferenca o računalniškem raziskovanju 2021
- Mednarodna konferenca o prenosu tehnologij
- Vzgoja in izobraževanje v informacijski družbi

Soorganizatorji in podporniki multikonference so različne raziskovalne institucije in združenja, med njimi 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.

S podelitvijo nagrad, še posebej z nagrado Michie-Turing, se avtonomna stroka s področja opredeli do najbolj izstopajočih dosežkov. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Jernej Kozak. Priznanje za dosežek leta pripada ekipi Odseka za inteligentne sisteme Instituta "Jožef Stefan" za osvojeno drugo mesto na tekmovanju XPrize Pandemic Response Challenge za iskanje najboljših ukrepov proti koroni. »Informacijsko limono« za najmanj primerno informacijsko potezo je prejela trditev, da je aplikacija za sledenje stikom problematična za zasebnost, »informacijsko jagodo« kot najboljšo potezo pa COVID-19 Sledilnik, tj. sistem za zbiranje podatkov o koroni. Čestitke nagrajencem!

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

FOREWORD - INFORMATION SOCIETY 2021

The 24th *Information Society Multiconference* survived the COVID-19 problems. In 2021, there are eleven conferences with a growing trend and real hopes that 2022 will be better due to successful vaccination. The multiconference survived due to the conference chairs who bravely decided to continue with their conferences despite the first pandemic in the modern era.

The COVID-19 pandemic did not decrease the growth of ICT, information society, artificial intelligence and science overall, quite on the contrary – the progress of computers, knowledge and artificial intelligence continued with the fascinating growth rate. However, COVID-19 did increase the downfall of societal norms, trust in science and progress. On the other hand, the awareness of the majority, that science and development are the only perspectives for a prosperous future, substantially grows.

The Multiconference is running parallel sessions with 170 presentations of scientific papers at eleven conferences, many round tables, workshops and award ceremonies, and 400 attendees. Selected papers will be published in the Informatica journal with its 45-years tradition of excellent research publishing.

The Information Society 2021 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Data Mining and Data Warehouses
- Cognitive Science
- People and Environment
- 50-years of High-school Computer Education in Slovenia
- Batman Project Workshop
- Insieme Interreg Project Workshop
- URBANITE Project Workshop
- Student Computer Science Research Conference 2021
- International Conference of Transfer of Technologies
- Education in Information Society

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 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.

The award for lifelong outstanding contributions is presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Dr. Jernej Kozak for his lifelong outstanding contribution to the development and promotion of the information society in our country. In addition, the yearly recognition for current achievements was awarded to the team from the Department of Intelligent systems, Jožef Stefan Institute for the second place at the XPrize Pandemic Response Challenge for proposing best counter-measures against COVID-19. The information lemon goes to the claim that the mobile application for tracking COVID-19 contacts will harm information privacy. The information strawberry as the best information service last year went to COVID-19 Sledilnik, a program to regularly report all data related to COVID-19 in Slovenia. Congratulations!

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

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INFORMATION SOCIETY – IS 2021

Volume A

Slovenska konferenca o umetni inteligenci
Slovenian Conference on Artificial Intelligence

Uredniki / Editors

Mitja Luštrek, Matjaž Gams, Rok Piltaver

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8. oktober 2021 / 8 October 2021
Ljubljana, Slovenia

PREDGOVOR

Po zaslugi pandemije COVID-19 še vedno živimo v bolj zanimivih časih, kot bi si želeli, vendar umetne inteligence to ne moti in napreduje s podobnim tempom kot pretekla leta. Računalniški vid in obdelava naravnega jezika sta še vedno vroči področji, pred nedavnim pa nam je OpenAI postregel s parom navdušujočih kombinacij obojega. Prva je DALL-E, globoka nevronska mreža, izpeljana iz OpenAIjeve slavne mreže za generiranje besedila GPT-3, ki je sposobna »razumeti« opis slike in nato takšno sliko generirati. Pri tem je kos slikam, na kakršne prej ni naletela – generirati zna denimo prav čedno sliko redkve daikon v baletnem krilcu, ki sprehaja psa. Druga, CLIP, deluje obratno in generira besedilne opise slik. Še en viden dosežek zadnjega časa prihaja s področje biologije in medicine, ki sta zelo plodni področji za uporabo umetne inteligence. Algoritem AlphaFold 2, ki – podobno kot večina pomembnih dosežkov umetne inteligence zadnjih let – temelji na globokih nevronskih mrežah, je dosegel dramatičen napredek pri določanju strukture beljakovin, kar je težaven problem, pomemben za razvoj zdravil.

Posebej odmeven nedaven dosežek umetne inteligence iz domačih logov je metoda za priporočanje optimalnih ukrepov zoper COVID-19, ki jo je razvila ekipa Odseka za inteligentne sisteme na Institutu Jožef Stefan. Pri tej sodbi avtorji predgovora sicer nismo povsem nepristranski, saj sva k dosežku dva prispevala, a drugo mesto ne tekmovanju XPrize Pandemic Response Challenge s polmilijonskim nagradnim skladom našo trditev potrjuje. Za uspeh tokrat ni bila potrebna globoka nevronska mreža – metoda kombinira epidemiološki model SEIR, klasično strojno učenje in večkriterijsko optimizacijo z evolucijskim algoritmom. Na Slovenski konferenci o umetni inteligenci je predstavljen le delček tega dela, več o njem pa je moč izvedeti na Delavnici projekta Insieme Interreg, ki prav tako poteka v okviru Informacijske družbe.

Posebej veliko število drugih delavnic in konferenc na Informacijski družbi letos je sicer dobro za multikonferenco kot celoto, našo konferenco pa je bržkone prikrajšalo za kak prispevek. K tej težavi moramo dodati še naveličanost raziskovalne srenje nezmožnosti žive udeležbe na konferencah, tako da smo se morali na koncu zadovoljiti s 13 prispevki. Večino je kot po navadi prispeval Institut Jožef Stefan, dobro je zastopana tudi Fakulteta za računalništvo in informatiko Univerze v Ljubljani, druge ustanove pa žal ne. Kljub temu smo poskrbeli, da so prispevki kakovostni, in smo jih zavrnili več kot pretekla leta. Bomo pa prihodnje leta napeli moči, da privabimo več prispevkov iz širšega nabora ustanov.

FOREWORD

Thanks to the COVID-19 pandemic we still live in more interesting time than we would like, but artificial intelligence is not much bothered by this and is progressing as rapidly as in the recent years. Computer vision and natural language processing are still hot topics, and OpenAI recently provided a pair of exciting combinations of the two. The first is DALL-E, a deep neural network derived from OpenAI's famous language generation network GPT-3. It can »understand« a description of an image and then generate such an image. It can handle images never encountered before – for instance, it can generate a nice image of a daikon radish in a tutu walking a dog. The second is CLIP, which works in reverse and generates descriptions of images. Another prominent recent achievement comes from biology and medicine, which is fruitful ground for applications of artificial intelligence. The AlphaGo 2 algorithm, which – like most main achievements of artificial intelligence in the recent years – is based on deep neural networks, achieved a breakthrough in protein folding. This is a hard problem important for drug discovery.

A prominent recent Slovenian achievement of artificial intelligence is a method for recommending optimal interventions against COVID-19, which was developed by a team from the Department of Intelligence Systems at Jožef Stefan Institute. The authors of this foreword are not entirely unbiased when we say this, because two of us contributed to the achievement, but second placed at the XPrize Pandemic Response Challenge with a prize purse of half a million lends credence to our claim. This success did not require a deep neural network – the method combines a SEIR epidemiological model, classical machine learning and multi-objective optimisation with an evolutionary algorithm. The Slovenian Conference of Artificial Intelligence presents only a small part of this work, while more can be learned in the Insieme Interreg project workshop.

A particularly large number of other workshops and conference at Information Society this year are good for the multi-conference as a whole, but probably deprived our conference for a few papers. Another problem is that the research community is getting tired of the inability to attend conferences live, which is why we ended up with only 13 papers. Most of them, as usual, come from Jožef Stefan Institute. The Faculty of Computer and Information Science of the University of Ljubljana is also well represented, while other institutions less so. Despite this we made sure that the papers are high-quality, and we turned away more than usual. But our goal for the following years is of course to secure more papers from a wider range or institutions.

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Estimating Client's Job-search Process Duration

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ABSTRACT

Modelling the labour market, analysing ways to reduce unemployment, and creating decision support tools are becoming more popular topics with the rise in digital data and computational power. The paper aims to analyse a Machine Learning (ML) approach for estimating the time duration until a job-seeker finds a job, i.e. leaves the Public Employment Service (PES), after the initial entering. The dataset that we use from PES is complex, and there is almost no correlation between most of the features in it, which makes it challenging for modelling. We used statistical analysis and visualisations to understand the problem better and form a basis for further modelling. As a result, we developed several ML models, including basic multivariate linear regression used for performance comparison with other more specifically designed models.

1 INTRODUCTION

The research field of creating tools for supporting the decision-making process for employment services has attracted significant interest lately. One can track such efforts for more than 20 years [1]. Different variants of tools and systems have been developed and implemented with varying success in different countries. PES is willing to move away from the traditional role of servicing the job-seekers and take a more systematic approach by implementing data-driven solutions in their toolbox. Here, the goal is to create a model that uses available data that describes the job-seekers that have entered the PES and outputs the approximate time (in days) needed for the individual to leave the PES as an employed person.

These factors can be assessed either by introducing experts' knowledge or by extracting the corresponding dynamics directly from the available data. What was (or is) available determines how the models are built and their effectiveness.

The biggest issue when dealing with any modelling, for that matter, is the quality of data. Typically models of the labour flow are built on top of statistical surveys [2]. These data sets comprise a series of snapshots of an individual labour force status observed at discrete time points. Such discrete sampling might be with low frequency in order to truly capture the changing dynamics.

Several methods for approaching similar labour market modelling problems have been implemented in other countries. Finland's Statistical profiling tool, introduced in 2007, consists of a simple logit model [3]. It predicts the probability of long-term unemployment and categorises job seekers into two groups, risk or high-risk of long-term unemployment. In 2012 Ireland implemented a PEX (probability of exit) model using data collected on job-seekers who entered the PES as unemployed during 13 weeks [4]. The PEX tool is a probit model for measuring the job-seeker's probability of exiting unemployment in one year.

As a result of our work, we have developed an ML model that can be used in a PES as a part of their decision toolbox, which can serve as a filtering method that prioritises job-seekers and recognises ones who do not necessarily need PES resources and services, as they will get employed soon regardless of the interventions by the organisation.

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2 DATA

The data used for the paper is provided by a public organisation engaged in the HECAT project [4], which aims at investigation, demonstration and pilotting a profiling tool to support labour market decision making by unemployed citizens and case workers in PES.

2.1 Data description

The dataset consists of 74086 instances, each representing a client enrolled in the PES, described with 16 sociological, demographic and time-related characteristics, known as features or attributes. The data were obtained during one year. The dataset is complex in a way that its attributes come in a different form (categorical, numerical, date and time), and most of them need to undergo some transformation for the aim of input suitability for different ML models. The general structure of the client's attributes is described by dividing the attributes into several prominent groups: socioeconomic variables (gender, age, nationality), information on job readiness (education, health limitations, care responsibilities), and opportunities (regional labour market development), and all available labour market history information, such as prior work experience. Most of the categorical features are given with numbers, where each number represents a unique category, described in a separate CSV file. The target variable is in numeric form, and it is a counter of days that a person stays in the process before exiting the PES. Some of the features in the dataset contain weird values (such as the negative number for clients age), which are a mistake or a result of noise in the data. This indicates the necessity of performing data cleaning and preprocessing before using the dataset to input various ML models. Figure 1 gives an overview of the attributes of the dataset.

```
Data columns (total 16 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   Age                           74086 non-null  int64
 1   Months of work experience     74086 non-null  int64
 2   Gender                        74086 non-null  int64
 3   Education category            74086 non-null  int64
 4   Specific profession category  74086 non-null  int64
 5   Profession program            74086 non-null  int64
 6   Employment plan ready         74086 non-null  int64
 7   Municipality                  74086 non-null  int64
 8   Country                       74086 non-null  int64
 9   Profession (ESCO)             74086 non-null  int64
 10  Dissabilities                 74086 non-null  int64
 11  Entry date                    74086 non-null  object
 12  Reason for PES entry          74086 non-null  int64
 13  eApplication                  74086 non-null  object
 14  Employment plan status        74086 non-null  int64
 15  Employability assessment      74086 non-null  int64
dtypes: int64(14), object(2)
memory usage: 9.0+ MB
```

Figure 1: General information on the dataset features

2.2 Data understanding

The target variable, 'duration', is a numerical count variable. In order to gain a better understanding of the target variable, the probability distribution was plotted on a graph. Figure 2 shows the probability distribution of 'duration'.

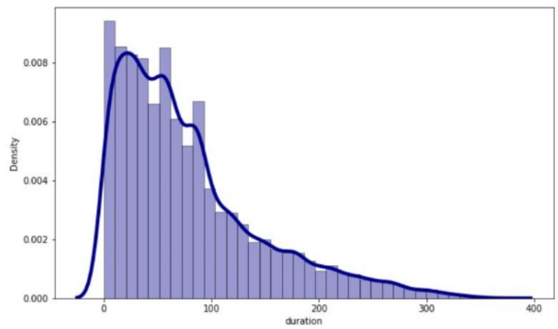

Figure 2: Probability distribution of the target variable

The information for the probability distribution of the target variable directly influences the predictive model selection. By looking at Figure 2, it can be assumed that that the target variable is following the Poisson distribution. We also plotted the distributions of the features. Figure 3 illustrates a grid of distributions of each feature of the dataset.

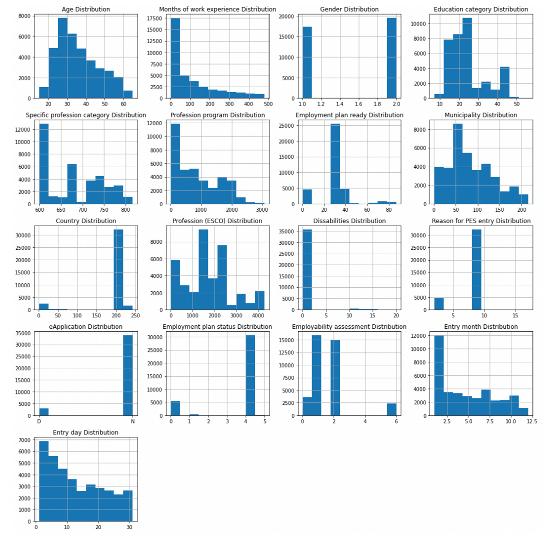

Figure 3: Grid of distributions of the dataset features

2.3 Data preprocessing

It is estimated that in most data mining and knowledge discovery pipelines, 75 to 85% of the time is dedicated to preprocessing the data [5]. Cleaning and transforming samples are the cornerstone of a reliable and robust pattern recognition system. The first step of the data preprocessing part was data cleaning. The dataset included values for some of the attributes, which were an obvious result of a noise or a mistake. For example, some of the instances had negative values for the target variable, which is impossible because of the nature of that attribute, which is a count-based variable.

Most of the classical ML algorithms require the input data to be in numerical form. We used one-hot-encoding for the categorical features with at most 20 different categories. High-cardinality features were encoded using the Binary Encoding technique. Frequently used techniques like label-encoding do not work in high-cardinality because of the inclusion of artificial numerical relative distance between the instances or overfitting in the case of one-hot-encoding [6].

The 'Entry Date' feature was used to extract the day and month of entry separately. As those are cyclical features, we performed a transformation in order to better represent the cyclical phenomenon, for instance to avoid the artificial large difference between month 1 and month 12. The best way to handle this is to calculate the *sin()* and *cos()* component so that this cyclical feature is represented as (x, y) coordinates of a circle.

The normalisation of the attributes' values was applied to scale the attributes in a way that their mean value is zero, and their variance is retained with the use of their own standard deviation. It allows equality of opportunity for each attribute. By this, no attribute gives more value to itself regarding the range of values it has. Several normalisation techniques are commonly used, but the most popular one is the standard scaler, defined as:

$$z = \frac{x - \mu}{s} \tag{2.1}$$

where x is the actual value, μ is the mean, and s is the standard deviation.

All the calculations and transformations were performed in Python programming language, by making use of modules like pandas, NumPy and sci-kit learn.

3 METHODOLOGY

Since the target variable is numerical, the task should be treated as a regression problem. Regression analysis describes methods whose goal is to estimate the relationship between a dependent (target) variable and one or more independent variables. In formal terms, the goal is to specify the following general model

$$Y_i = f(X_i, \beta) + e_i \quad (3.1)$$

where i denotes the i^{th} observed input-output data set, the vector X represents the input (independent) variables, β is the set of model parameters, $f(\cdot)$ is the function, and e_i is the modelling error. The goal is to find the proper function f and its parameters β so the error term is as close to zero as possible.
In its simplest form, the function $f(\cdot)$ can represent a linear model. For example, the univariate linear model of (3.1) would be:

$$Y_i = \beta_0 + \beta_1 X_i + e_i \quad (3.2)$$

Generally, the function f can describe much more complex dynamics. The multivariate linear regression model is used as a base model and will be used to help with the assessment of the performance of other more specific and complex models simply by comparing them to the base model. The aim is to develop such models that will significantly outperform the base model. In order to construct a model that generalises well to the data, a decision tree is used as a base learning algorithm for the ensembles.

3.1 Ensemble learning

The idea of ensemble learning is based on the theoretical foundations that the generalization ability of an ensemble is usually much stronger than the one of a single learner. Ensemble learning is mainly implemented as two subprocedures: training weak component learners and selectively combine the member learners into a stronger learner [7]. Two ensemble models based on different techniques were developed, Random Forest Regressor [8] and boosting algorithm - CatBoost Regressor.

Bagging is used to reduce the variance of a decision tree classifier. The objective is to create several subsets of data from the training sample chosen randomly with replacement. Each collection of subset data is used to train their corresponding decision trees. The result is the average of all the predictions from different trees, which is more robust than a single decision tree classifier.

Based on the shape of the probability distribution given in Figure 2, we assume that the target variable comes from Poisson distribution. Therefore, we design our model to maximise the log-likelihood for Poisson distribution [9]. The probability mass function of the Poisson distribution is given with the following expression:

$$P(k) = \frac{e^{-\lambda}(\lambda)^k}{k!} \quad (3.3)$$

where $P(k)$ is the probability of seeing k events during time unit given event rate λ. Let X, y be our dataset for the Poisson regression task. The log-likelihood function that needs to be maximised is:

$$\sum_{i=1}^{N} log\left(P_x(y)\right) = \sum_{i=1}^{N} log\left(\frac{e^{-\lambda(X_i)}\left(\lambda(X_i)\right)^{y_i}}{y_i!}\right) \quad (3.4)$$

After the expression is simplified, the final equation for the Poisson loss has the following form:

$$L_{poisson} = \sum_{i=1}^{N}\left(\lambda(X_i) - y_i log\left(\lambda(X_i)\right)\right) \quad (3.5)$$

CatBoost Regressor is optimised with regard to this objective function.

4 EVALUATION

The model performance on the test set is evaluated with Root Mean Squared Error (RMSE) as a metric. RMSE is frequently used in regression problems, and it is a measure of the difference between the values predicted by a model or an estimator and the actual values of the instances. RMSE is given with the following expression:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N}(y_i - pv_i)^2}{N}} \quad (3.6)$$

where y_i is the original value of the instance, and pv_i is the predicted value by the model. The hyper-parameters of the models were tuned using RandomizedSearchCV. This method optimises the hyper-parameters by cross-validated search over given parameter settings. A fixed number of parameter settings was sampled from the specified distributions.

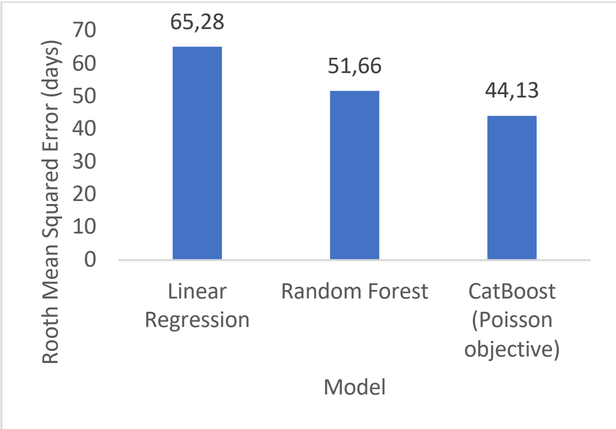

Figure 4: Comparison of the model performance

Figure 4 shows the diagram for comparison of the models' performances. The results show that both Random Forest and CatBoost significantly outperform the base linear regression model. Also, optimising the mean Poisson deviance as a loss function results in significant improvement in the performance of the boosting model. The final score that the CatBoost Regressor optimised with regards to mean Poisson deviance evaluated on RMSE is 44.13 days.

5 CONCLUSION

Achieving desirable results using machine learning models requires a significant amount of quality data and a deep understanding of the problem. Feature engineering is one of the key concepts here, which, if it is appropriately done, enables the generation of new features that give helpful, previously unknown insights about the data. The paper proposes an approach that emphasises the engineering of optimisation function concerning the probability distribution of the target variable, which results in developing a specific model for approaching the problem. Including the Poisson objective function in the boosting model resulted in significant improvement in its performance. There is still space for improvement in the results. Using modern end-to-end deep learning architectures have the potential to provide better results than the proposed models, which leaves space for future work on this topic. Having a tool that can roughly estimate the time a new client stays in the job-search process by having the standard data formation about himself is beneficial for the PES. The creation of decision-making tools for organisations dealing with employment services supports the process of reducing unemployment in the countries, which is a massive benefit for the global economy.

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Some Experimental Results in Evolutionary Multitasking

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ABSTRACT

Transfer learning and multitask learning have shown that, in machine learning, common information in two problems can be used to build more effective models. Inspired by this finding, attempts in evolutionary computation have also been made to solve multiple optimization problems simultaneously. This new approach is called evolutionary multitasking (EMT).

In this work, we show how EMT extends ordinary evolutionary algorithms and present the results that we obtained in solving multiple optimization problems simultaneously. We also compare them with the results of algorithms that solve one optimization problem at a time. Finally, we provide visualizations and explanations of why and when EMT is beneficial.

KEYWORDS

evolutionary algorithms, numerical optimization, multifactorial optimization, evolutionary multitasking

1 INTRODUCTION

In optimization the task is to find one or more solutions that best solve a given problem. To determine which of the possible solutions gives the best result, we use the objective function. This can be the cost of fabrication, the efficiency of a process, the quality of a product, etc. The mathematical formulation of such problems is given as follows:

$$\begin{array}{rlr} \text{Minimize/Maximize} & f(x) & \\ \text{subject to} & g_j(x) \geq 0, & j = 1, 2, .., J; \\ & h_k(x) = 0, & k = 1, 2, .., K; \\ & x_i^{(L)} \leq x_i \leq x_i^{(U)}, & i = 1, 2, .., n. \end{array} \tag{1}$$

Here, a solution $x = [x_1, x_2, .., x_n]^{\mathrm{T}}$ is a vector of n decision variables. The objective $f(x)$ can be either maximized or minimized, but since many optimization algorithms are designed to solve minimization problems, we usually convert maximization objectives to minimization ones by multiplying the objective functions by -1. $h_k(x)$ are equality constraints, $g_j(x)$ inequality constraints, and $x_i^{(L)}$ and $x_i^{(U)}$ are boundary constraints [3]. In this paper, we consider problems that include only boundary constraints.

When the optimization problem can not be solved using mathematical methods, the usual alternative is to use randomized optimization algorithms such as evolutionary algorithms (EAs). These algorithms are characterized by a population of solutions that change with generations and to which techniques resembling natural selection and genetic variation are applied. These techniques ensure that the fittest individuals (solutions) from the population are passed to the next generation. The algorithm begins by initializing a population of solutions. Then, a selection operator is used to select the fittest individuals as parents. After that, a reproduction operator is utilized to create offspring from the parents. The next step is to select a subset of individuals from the combined set of parents and children and replace the old population with the selected subset. The new population is then used for the next generation. The cycle of selection, reproduction, and replacement is repeated until a stopping criterion is satisfied. The stopping criterion can be defined in various ways, for example, by the maximum number of generations.

Until recently, most EAs focused on solving only one optimization problem at a time. To exploit the parallelism of population-based search, Gupta et al. introduced a new category of optimization approach called multifactorial optimization or evolutionary multitasking (EMT) [8]. The goal of EMT is to develop EAs that are able to simultaneously solve multiple optimization problems without sacrificing the quality of the obtained solutions and the algorithm efficiency.

A practical motivation for the development of EMT algorithms is the rapidly growing cloud computing. In cloud computing, multiple users can simultaneously send optimization problems to the server. These problems may either have similar characteristics or they may belong to completely different domains. Previously, the servers solved these problems sequentially, but with the introduction of EMT, they can solve the problems in parallel.

After the introduction of EMT by Gupta et al., many other works followed that also introduced methodologies specialized in solving multiple optimization problems simultaneously [1, 4, 5, 6, 9, 10].

In this paper, we present our experimental results in solving multiple optimization problems simultaneously and discuss the results from the point of view of EMT performance. We do this by applying the EMT methodology as proposed by Gupta et al. to test optimization problems and analyzing the results.

The paper is further organized as follows. In Section 2, we introduce the basic concepts of EMT. In Section 3, we first present our results in EMT with visualizations that explain why and when EMT performs well, and then report the results in evolutionary many-task optimization. Finally, in Section 4, we give a conclusion and present the ideas for future work.

2 EVOLUTIONARY MULTITASKING

Evolutionary multitasking is characterized by the simultaneous existence of multiple decision spaces corresponding to different problems, which may or may not be independent, each with a unique decision space landscape. In order for EMT to have cross-domain optimization properties, Gupta et al. proposed to use a

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uniform genetic code in which each decision variable is encoded with a random number from $[0, 1]$. Decoding such a representation in continuous problems is done by using the following equation for each decision variable:

$$u_i = u_i^{(L)} + (u_i^{(U)} - u_i^{(L)}) \cdot v_i, \quad (2)$$

where u_i is the decision variable in the original space, and v_i is the decision variable in the encoded space. The dimensionality of the solution vector is equal to $\max_j\{D_j\}$, where D_j represents the dimensionality of a single optimization problem. This type of encoding allows problems to share decision variables at the beginning of the genetic code, which contributes to the transfer of useful genetic material from one problem to another.

Since EMT attempts to solve multiple problems simultaneously using a single population, it is necessary to formulate a new technique for comparing population members. To this end, a set of additional properties is defined for each individual x_i in the population as follows.

- **Skill factor:** The skill factor τ_i of x_i is the one problem, among all problems in EMT, for which the individual is specialized. This skill factor can be assigned in a complex way by selecting the best individuals for each task or by randomly assigning each individual one task for which it is specialized. In our case, we will use the later, simpler method for assigning the skill factor.
- **Scalar fitness:** The scalar fitness is the fitness of an individual for the problem it is specialized.

To compare two solutions, we use the scalar fitness and the skill factor. The scalar fitness shows how good a solution is for a given problem, and the skill factor shows for which problem the solution performs best. A solution x_a is better than x_b if and only if both have the same skill factor and x_a has a higher scalar fitness than x_b. If the solutions have different skill factors, they are incomparable.

2.1 Assortative Mating

To produce offspring, the authors of EMT [8] used assortative mating as a reproduction mechanism. In assortative mating, two randomly selected parents can undergo crossover if they have the same skill factor. If, on the other hand, their skill factors differ, crossover occurs only with a given random mating probability *rmp*, otherwise, mutation takes place. A value of *rmp* close to 0 means that only culturally identical individuals are allowed to perform crossover, while a value close to 1 allows completely random mating.

2.2 Selective Imitation

Evaluating each individual for each problem is computationally expensive. For this reason, each child is evaluated only on one problem, which is the skill factor that one of its parents has. In this way, the total number of function evaluations is reduced, while the solution is still evaluated on the problem on which it most likely performs well. The procedure is called selective imitation.

2.3 Landscape Analysis

In multitask machine learning, it is well known that useful information cannot always be found for two problems. Therefore, to enable further success in the field of evolutionary multitasking, it is important to develop a meaningful theoretical explanation of when and why implicit genetic transfer can lead to improved performance. In particular, it is important to develop a measure of the inter-task complementarity used during the process of multitasking. To this end, a synergy metric that captures and quantifies how similar two problems are has been proposed [7]. The main idea behind the synergy metric is to use the dot product between the gradient of a given solution in one problem, and the vector pointing to the global optimum of another problem. If the dot product of a given solution is larger than 0, the solution of the first problem is pushing the candidate solution in the direction of the global optimum of the second problem. If the dot product is smaller than 0, the solution is pushed in the opposite direction.

3 EXPERIMENTS AND RESULTS

EMT is a novel concept in evolutionary optimization, and thus, a limited number of experiments were carried out so far. We present some experiments performed and results obtained using EMT in both multi- and many-task optimization.

3.1 Multitask Optimization

In the multitask optimization experiments, we took two frequently used optimization problems, i.e., 50-dimensional (50D) Sphere and Ackley. We solved them using EMT and a genetic algorithm (GA). To be able to compare the results, we used the same population size and the same number of function evaluations per problem. The *rmp* parameter in EMT was set to 0.3, and for GA we used the default parameter values as defined in pymoo [2]. We monitored the difference between EMT and GA over time. If the difference is positive, EMT performs better than GA, while if it is negative, GA performs better than EMT. Because the fitness values vary between different problems, we normalized the difference between EMT and GA in each problem by dividing the values with the highest absolute difference.

In the first experiment, the optima of the two problems were placed at the opposite ends of the search space. Because of this, the problems have very little common information, and the synergy function mostly takes negative values. This is visualized for a 2D Sphere function in Figure 1 and for a 2D Ackley function in Figure 2. The normalized difference between EMT and GA in optimizing 50D Sphere and Ackley functions is presented in Figure 3. From the results, we can see that GA performs better on these problems.

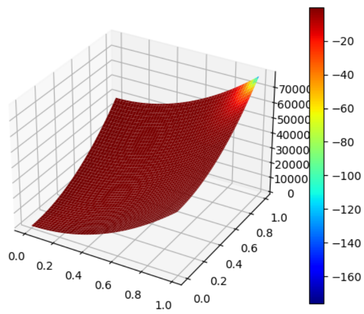

Figure 1: Synergy metric on the Sphere function solved together with the Ackley function when the optima are far away.

In Figure 4, we present the results from the second experiment where the optima of 50D Sphere and Ackley functions were placed closer together. Here, we can see that the optimization of the Sphere function does not show significant improvement

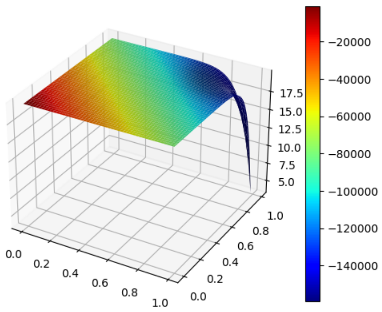

Figure 2: Synergy metric on the Ackley function solved together with the Sphere function when the optima are far away.

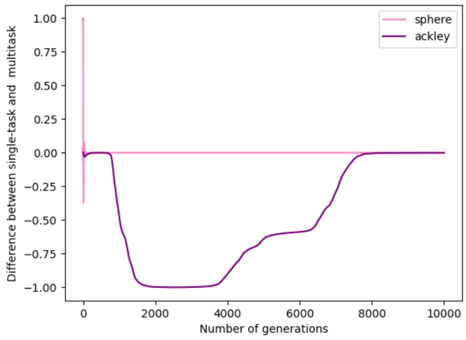

Figure 3: Normalized difference between multitask and single-task optimization on 50D Sphere and Ackley functions when the optima are far away.

when being performed together with the optimization of the Ackley function, but on the Ackley function EMT converges to the optimal solution much faster. An explanation for this is illustrated in 2D in Figures 5 and 6. Here we can see that the synergy in the Sphere space is mostly equal to 0, except for some small parts where it rises to +10 and falls to −10. Because both the positive and the negative parts of the synergy values of the Sphere problem are small, we can notice no difference in convergence on the Sphere problem.

In contrast, more than half of the space of the Ackley function has a positive synergy metric, indicating that this part of the space appoints the solutions in the right direction toward the global optimum. On the other hand, most of the decision space of the Ackley function has constant fitness values, which complicates the GA search for the global optimum. For this reason, the information transferred from the Sphere problem to the Ackley problem is useful, and thus we can see faster convergence when solving the two problems together using EMT.

3.2 Many-Task Optimization

When solving more than three tasks simultaneously, we are dealing with a many-task optimization. In Figure 7, we present the results obtained by randomly shifting (within a small, 10% range of the total space) the global optimum of both the Ackley and the Sphere function 25 times, resulting in 50 different 50D optimization problems. During the optimization process, we used the same algorithm parameter values for EMT and GA as reported in Section 3.1. In the results, we can notice similar patterns as when solving just two problems. This proves that increasing the number of problems we are trying to solve does not cause difficulties to EMT. If the problems are similar, we can solve many problems simultaneously without losing efficiency.

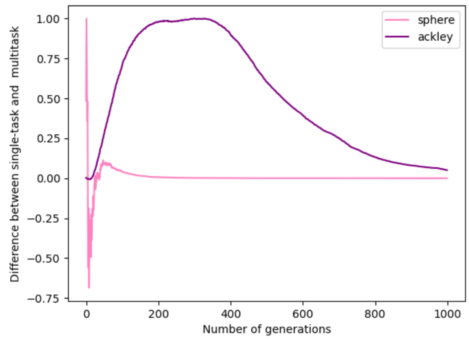

Figure 4: Normalized difference between multitask and single-task optimization on 50D Sphere and Ackley functions when the optima are close.

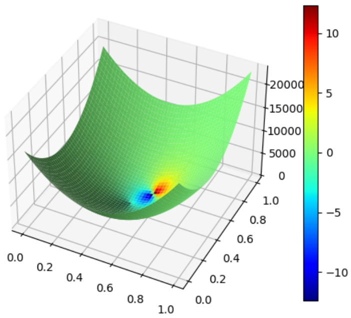

Figure 5: Synergy metric on the Sphere function solved together with the Ackley function when the optima are close.

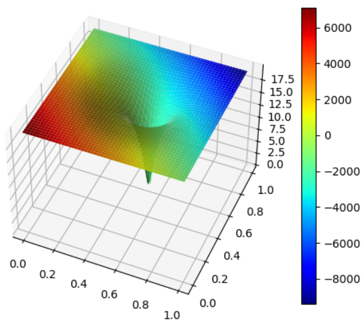

Figure 6: Synergy metric on the Ackley function solved together with the Sphere function when the optima are close.

Figure 8 shows the results obtained when solving six well-known optimization problems at the same time: Ackley, Sphere, Rastrigin, Rosenbrock, Schwefel, and Griewank, all 50D. From the results, we can notice that although the optimization procedure converges faster for most of the functions, for the Sphere and the Schwefel function the convergence speed of the optimization process drops. The same pattern can be noticed in Figure 9 where the optimum of each function is shifted 8 times, resulting in $6 * 8 = 48$ problems altogether.

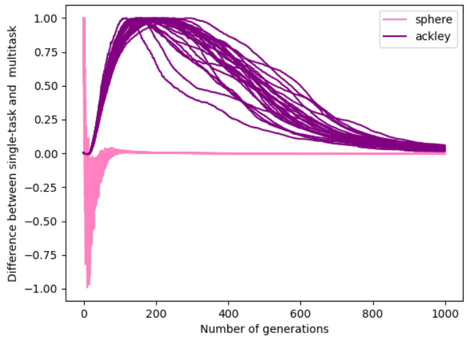

Figure 7: Normalized difference between multitask and single-task optimization on 50 problems originating from 50D Sphere and Ackley functions whose optima are shifted close to each other.

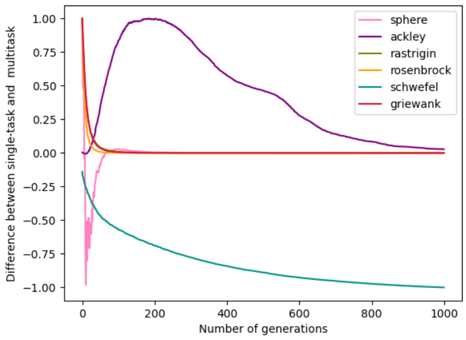

Figure 8: Normalized difference between multitask and single-task optimization on six well-known 50D optimization problems when the optima are shifted close to each other.

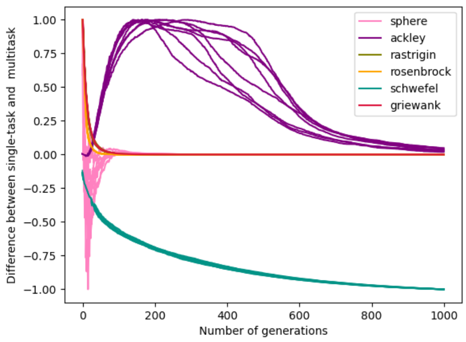

Figure 9: Normalized difference between multitask and single-task optimization on 48 problems originating from six well-known 50D optimization problems whose optima are shifted close to each other.

4 CONCLUSION AND FUTURE WORK

We presented our experimental results on solving multiple optimization problems simultaneously using a novel method called evolutionary multitasking. We were solving just two optimization problems, but also as many as 50 optimization problems at the same time. From the experimental results, we can conclude that there are some groups of problems for which EMT can improve the speed of convergence of the optimization process. However, if the problems are too different, the performance of the optimization drops. To explain why EMT works well on some problem pairs and why on some others it does not, we provided visualizations of the synergy metric.

We so far tested EMT on simple benchmark functions that are usually used for single-objective optimization. However, in future work, we plan to test it also on real-world scenarios with more complex functions and constraints. Furthermore, so far we have used the synergy metric to explain why some problems are solved Unfortunately, with this metric we can not strictly determine when solving two problems will be successful. Thus, one possible future direction is to develop machine learning methods that predict when multitasking a set of problems would be successful. This may be useful for cloud systems that could form several groups of similar problems and then solve them in a multitask manner.

5 ACKNOWLEDGMENTS

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Intent Recognition and Drinking Detection For Assisting Kitchen-based Activities

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ABSTRACT

We combine different computer-vision (pose estimation, object detection, image classification) and wearable based activity recognition methods to analyze the user's behaviour, and produce a series of context-based detections (detect locations, recognize activities) in order to provide real-time assistance to people with mild cognitive impairment (MCI) in the accomplishment of every day, kitchen-related activities.

KEYWORDS

computer vision, activity recognition, object detection, pose estimation

1 INTRODUCTION

Smart home technologies have been extensively adopted for measuring and decreasing the impact of Mild Cognitive Impairment (MCI) on everyday life [9]. In the scope of the CoachMyLife (CML) project we have been developing a system employing different machine learning techniques with the aim of assisting persons affected by MCI in performing activities in their apartments, with a particular focus on tasks related to the kitchen.

In a previous work, we presented one of the first components of this system, i.e. a computer vision pipeline which allows to detect the activity of drinking, by analyzing the video collected by an RGB camera through a 3D Convolutional Neural Network (3D-CNN) [12].

In the present paper, we present our work on extending said pipeline, by discussing (i) a drinking-detection algorithm based on motion data from a wristband, which can be used to further validate the one based on computer vision, and to replace it in situations where the activity is not performed in front of the camera; (ii) a method based on pose detection to identify interactions of the user with their environment, in order to perform intent recognition, and (iii) a possible new implementation of our previous computer-vision pipeline for drinking detection that can be deployed on edge devices.

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This paper is organized as follows. Section 2 discusses the related work. Section 3 presents the system architectures. Section 4 describes the recognition modules of the system. Section 5 shows the results of the recognition modules. Finally, Section 6 concludes the paper.

2 RELATED WORK

2.1 Drinking Detection From Wearables

Recent advances in the accuracy and accessibility of wearable sensing technology (e.g., commercial inertial sensors, fitness bands, and smartwatches) has allowed researchers and practitioners to utilize different types of wearable sensors to assess fluid intake in both laboratory and free-living conditions.

The necessity for fluid intake monitoring emerges as a result of people's lack of awareness of their hydration levels. Dehydration can lead to many severe health problems like organ and cognitive impairments. Therefore, a system that can continuously track the fluid intake and provide feedback to the user if useful.

In [1], the authors explored the possibility of recognizing drinking moments from wrist-mounted inertial sensors. They used adaptive segmentation to overcome the problem with variable length of the drinking gestures. They used random forest algorithm, trained with 45 features, and obtained an average precision of 90.3% and an average recall of 91.0%. In [5], the authors employed a two-step detection procedure, enabling them to detect drinking moments and estimate the fluid intake. They extracted 28 statistical features, from which only six were selected using backward feature selection. Finally, they trained a Conditional Random Field model, resulting in a precision of 81.7% and recall of 77.5%. In [4], the authors used a machine-learning based model to detect hand-to-mouth gestures. Similarly as the previous methods, they extracted 10 time-domain features and trained a random forest classifier. They validated their method in a free-living scenario and obtained precision of 84% and recall of 85%. Although remarkable results were achieved, the evaluation of the studies is limited and it is not showing the real-life performance.

2.2 Activity Recognition From Videos

In recent years, the problem of computer-based Human Activity Recognition (HAR) of daily living has been tackled by different computer-vision methods.

HAR can be performed directly on RGB images and videos by analyzing: (i) the spatial features in each frame, thus obtaining predictions for each frame that can then be extended to the whole video by pooling or by a recurrent-based neural networks [2], (ii) the temporal features related to motions and variations between frames [6], or (iii) some combination of the two [10].

The most recent approaches aimed at simultaneous evaluation of both spatial and temporal features involve the usage of 3D-CNN, i.e., convolutional models characterized by an additional third temporal dimension [12].

An alternative approach, not involving the direct analysis of the whole frames, consists in exploiting the information provided by human pose estimation, so that body keypoints coordinates, reconstructed in a 2D or 3D space, can be fed to deep-learning models to provide predictions [3].

3 ADOPTED HARDWARE

3.1 Wristband

The drinking-detection procedure is implemented on a wristband which is equipped with a nRF52840 System On Chip (SoC) module. The SoC offers a large amount of Flash and RAM, 1MB and 256 kB, respectively. Additionally, it has protocol support for Bluetooth Low Energy (BLE). The architecture of nRF52840 is based on 32-bit ARM® Cortex™-M4 CPU with floating point unit running at 64 MHz. The wristbands power supply source is a battery with a capacity of 500 mAh. The measurements of accelerations and angular velocities are performed by the system-in-package LSM6DSL, manufactured by STM. It is equipped with a 3D digital accelerometer and a 3D digital gyroscope based on MEMS technology that operates at 0.65 mA in high-performance mode and allows low power consumption with constant operation. The most prominent feature of the Inertial Measurement Unit (IMU) is a 4 kB FIFO (First In First Out) buffer, which stores the data of the accelerometer and gyroscope. This allows for very low power operation, as the SoC wakes up only when triggered by an "FIFO full" interrupt event.

3.2 Local Deployment of The Computer Vision System

The computer vision pipeline for drinking detection we previously developed for the project worked by retrieving the video stream collected by an IP camera in the user's apartment, and analyzing it on a remote server. This approach, however, presented issues related to the remote access to the camera, which can sometimes be blocked by the router's firewall functionalities, and raised safety and privacy concerns with the users.

For these reasons, we have been working on deploying the CML system on a local device. After some unsuccessful attempts to implement the system on Android devices by using frameworks such as Apache TVM [1] or Deep Java Library (DJL)[2], we opted for deployment on a Jetson NANO device[3].

Direct deployment of our system on the device was possible, although not immediate, but the resulting performance was sub-optimal in terms of the FPS reached by the various detection algorithms (≈2 FPS for the object detection). To overcome this, we optimized said algorithms by TensorRT, a library built on NVIDIA's CUDA library for parallel programming, thus improving inference performance for deep learning models (≈22 FPS for the object detection).

[1]https://tvm.apache.org/
[2]https://djl.ai/
[3]https://www.nvidia.com/en-us/autonomous-machines/embedded-systems/jetson-nano/

4 INTENT RECOGNITION

One of the main goals of the CML project is to provide users with real-time, context-based notifications to assist them in performing activities.

This is achieved in two steps. First, by combining computer-vision and the wearable device, the system detects real-time events, such as the position of the user, their interaction with the environment, the displacement of a mug the user is expected to drink from, the opening/closing of cabinet and fridge door, drinking and eating.

Then, these events are passed to the intent recognition module, which uses them to predict which activity the user is performing, and provide assistance if needed.

We adopted a Single Shot MultiBox Detector (SSD) [8] model, pre-trained on the 80 classes of the COCO dataset [7] for the detection of the user, and fine-tuned on a custom dataset we collected to locate the position of the mug. Pose estimation, which is used to track the movement of the user's hands and detect interactions with domestic appliances, is achieved by a SimpleNet model with a ResNet backbone [13].

4.1 Regions of Interest

During the initial setup, the user is asked to identify some regions of interest (ROIs) in the camera image, which can be either single or double-zoned.

In the first case, the ROI is "activated" when the user's feet are within the selected region (Fig. 1a), whereas double-zone ROIs are used to detect if the user is in the desired area and/or if their hands are in the selected upper area (Fig. 1b).

4.2 Intent Recognition

The events detected by the computer vision pipeline are passed to the intent recognition module, which predicts the activity the user is currently engaged on.

Currently, this prediction is based on a set of pre-determined rules. A number of possible activities is manually inserted, each formed by different steps, corresponding to possible events that can be detected by the computer vision system (Fig. 2a). Different activities can share one or more steps, and as the system detects the completion of the various steps, the list of possible ongoing activities gets reduced (Fig. 2b, 2c), until only one activity is identified and followed until its completion (Fig. 2d).

If too long of a time interval passes between the completion of two steps, the activity is classified as "interrupted", and the system can show a notification to the user, asking if they require assistance.

4.3 Drinking Detection From Computer Vision on the Jetson NANO

The model we previously adopted to perform activity recognition from videos is particularly computationally expensive and so, although it proved to be very effective in the detection of drinking events, it was not possible to implement it on the Jetson NANO.

For this reason, we are currently collecting a dataset of short video clips, passing them through a pose estimation model, in order to obtain the 2D position of 18 body parts across a time series of frames, with an associated class label for the frame series. Then, this will be analyzed through an LSTM-based model to perform HAR.

(a) (b)

Figure 1: Triggers based on user's location and their interaction with the environment.

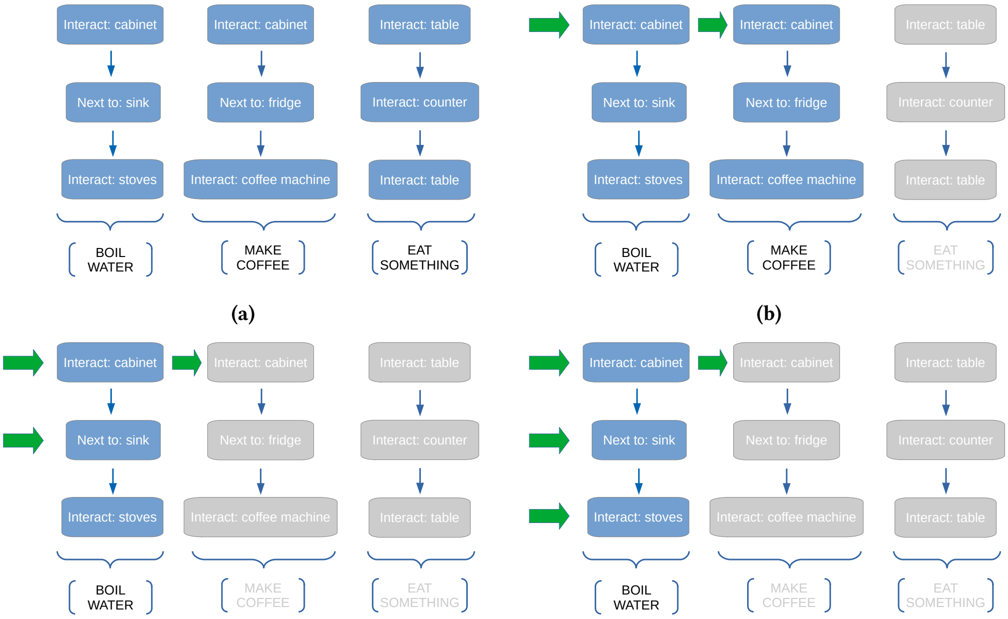

Figure 2: As the computer vision system detects the completion of various steps, the list of possible ongoing activities gets reduced, until one of them is completed or interrupted.

4.4 Drinking Detection Using a Wearable device

Due to the desired minimum power consumption, the drinking detection was implemented directly on the wristband. This is preferable as it eliminates the need to transfer all the raw sensor data to a smartphone or some sort of central device. Raw sensor data transmission is clearly undesirable due to high power consumption and it is not possible if the central device is not nearby.

The first step of drinking detection using the wristband is to enable the IMU in activity/inactivity recognition mode. This allows the IMU to be in a low power state for the most part of the day.

When activity is recognized the IMU enables absolute wrist detection (AWT) which checks if the angle between the horizontal plane and the Y axis of the IMU is larger than 30 degrees. If the condition is met the IMU is enabled in batching mode, storing accelerometer and gyroscope data in the FIFO buffer. Every time the FIFO buffer is full, data is transferred to the SoC, where we directly start the machine learning pipeline. This procedure is repeated for three batches of IMU readings. If all three predictions from the machine learning model are non drinking, we disable the gyroscope, we stop the machine learning procedure and we wait for the next AWT event. Otherwise, if at least one prediction is positive, the machine-learning procedure continues to work for another three new batches of data.

The machine-learning method for detection of drinking gestures is based on time- and frequency-domain features. The raw data is segmented into 5-second windows and 216 features are extracted in total. We used a relatively simple approach due to the memory limitation of the wristband. The deployed model was trained using the drinking dataset described in Section 4.4.1 and additional non-drinking data collected in real-life scenario [11].

4.4.1 Drinking Dataset. For the aim of this study, we recruited 19 subjects (11 males and 8 females). Each subject was equipped with the wristband described in Section 3.1. We developed a custom application that ran on the wristband and collected three-axis accelerometer and three-axis gyroscope data at a sampling frequency of 50 Hz. The dataset [4] is publicly available and we hope that it will serve researchers in future studies.

We developed a general procedure for the participants to follow during the data collection process. The ground truth was registered manually by participants pressing a button on the wristband before performing the gesture and after finishing the

[4]https://github.com/simon2706/DrinkingDetectionIJS

gesture. The data collection procedure included drinking from six different container types—namely, bottle, coffee cup, coffee mug, glass, shot glass and wine glass.

For each participant we collected 36 drinking episodes (3 fluid level x 6 containers x 2 positions). The idea of the different fluid level was to obtain drinking episodes with a short, medium and long duration. We also considered different body positions. The participants first performed the drinking gestures while being seated and afterwards they repeated the same gestures while standing.

5 RESULTS AND DISCUSSION

5.1 Intent Recognition and Local Implementation of Drinking Detection

A pilot phase will begin shortly, during which the intent recognition module will be evaluated.

Regarding the new model for drinking detection, a preliminary test of our new approach, ran on a subset of the Berkeley Multimodal Human Action Database (MHAD) dataset [5], reached an accuracy of over 90%, and we'll extend the analysis to our case once the dataset collection will be over.

5.2 Wearable Sensing Results

For evaluation, the leave-one-subject-out (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.

For the drinking detection model, we considered several classifiers including logistic regression (LR), linear discriminant analysis (LDA), k-nearest neighbors (KNN), naive Bayes (NB) and XGBoost.

The obtained results are shown in Table 1. It can be clearly seen that XGBoost outperforms all other classifiers. However, due to the technical limitations described in Section 3.1 the trained model is unable to fit below 100 KB. The size of the LR model is only 2 KB, which is optimal for our device. Furthermore, the results obtained with LR are only 0.03 lower compared to those from XGBoost. Therefore, we deployed the model trained with the LR classifier.

6 CONCLUSIONS

We presented our work on drinking detection using wearables and intent recognition/drinking detection using computer vision.

A pilot phase, beginning in October 2021, will provide thorough testing of the functionalities described in the paper. Nonetheless, the results obtained from the internal testing for each module of the system show promising results for both drinking (with both wearables and computer vision) and intent recognition.

[5] http://tele-immersion.citris-uc.org/berkeley_mhad

Table 1: Comparison of different classifiers for detection of drinking activity.

Method	Precision	Recall	F1 score
Logistic regression	0.87	0.77	0.81
Linear discriminant analysis	0.54	0.69	0.55
K-nearest neighbors	0.84	0.69	0.75
Naive Bayes	0.68	0.85	0.74
XGBoost	0.89	0.81	0.84

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Anomaly Detection in Magnetic Resonance-based Electrical Properties Tomography of in silico Brains

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ABSTRACT

Magnetic resonance-based electrical properties tomography (EPT) is one of the novel *quantitative* magnetic resonance imaging techniques being tested for use in clinical practice. This paper presents preliminary research and results of automated detection of anomalies from EPT images. We used in silico data based on anatomical human brains in this experiments and developed two algorithms for anomaly detection. The first algorithm employs a standard approach with edge detection and segmentation while the second algorithm exploits the quantitative nature of EPT and works directly with the measured electrical properties (electrical conductivity and permittivity). The two algorithms were compared on – as of yet – noiseless data. The algorithm using the standard approach was able to quite reliably detect anomalies roughly the size of a cube with a 14 mm edge while the EPT-based algorithm was able to detect anomalies roughly the size of a cube with a 12 mm long edge.

KEYWORDS

electrical properties tomography (EPT), magnetic resonance imaging (MRI), automatic anomaly detection, artificial intelligence

1 INTRODUCTION

The frequency-dependent electrical properties (EPs), including electrical conductivity and permittivity, of biological tissues provide important diagnostic information, e.g. for tumour characterisation [9]. EPs can potentially be used as biomarkers of the healthiness of various tissues. Previous studies, not based on magnetic resonance imaging (MRI), have shown that various diseases cause changes of EPs in the tissue [3].

Electrical properties tomography (EPT) is used for quantitative reconstruction of EPs distribution at radiofrequency (RF) with spatial resolution of a few millimetres. EPT requires no electrode mounting and, during MRI scanning, no external energy is introduced into the body other than the B_1 fields. Applied B_1 fields can easily penetrate into most biological tissues, making EPT suitable for imaging of the whole body. The MRI scans for EPT are performed using a standard MRI scanner, and its spacial resolution is determined by MRI images and quality of used B_1-mapping technique [9].

The objective of this research was to develop and evaluate algorithms to automatically detect anomalies of different sizes in the EPT images. The data consisted of in silico simulated brain scans of phantoms that either contained an anomaly or not. The evaluation was aimed towards answering whether an anomaly can be detected or not, and how large an anomaly can be (reasonably) reliably detected. This represents an initial step towards the potential clinical use of EPT.

2 METHODS

2.1 Data Acquisition

The MRI acquisition of the EPT inputs has been simulated in a noiseless case. Thus, the result of the electromagnetic simulation at RF has been directly converted in the acquired data, with no further post-processing. Precisely, the B_1 field generated by a current-driven 16-leg birdcage body-coil (radius 35, height 45) operated both in transmission and in reception with a polarisation switch has been computed in presence of anatomical human heads with a homemade FEM–BEM code [2]. The simulations have been conducted at 64 (i.e. the Larmor frequency of a 1.5 scanner).

The acquisitions of 19 human head models from the XCAT library [6] have been simulated. The considered population is statistically representative of different genders and ages. For each head model, 10 different variants are considered:

(1) Two physiological variants with the original distribution of the biological tissues. In one case, the nominal electrical conductivity provided by the IT'IS Foundation database [5] is assigned to each tissue. In the other case, the electrical conductivity of white and grey matter is sampled from a uniform distribution that admits a variation up to 10 with respect to the nominal value. This will be referred to as the *physiological variability* of the electrical conductivity.
(2) Eight pathological variants, in which a spherical pathological inclusion is inserted in the white matter tissue. The radius of the inclusion ranges from 5 to 45 and its electrical conductivity is set equal to that of the white

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matter increased by a factor uniformly sampled from 10 to 50 of the nominal value, because previous experimental results have shown that pathological tissues have higher EP values than healthy tissue [7, 8]. The location of the inclusion within the head is selected with a random procedure and only its intersection with the white matter tissue is kept in the final model (see Fig. 1 panels a and d). All the pathological variants take into account the physiological variability in the determination of the white and grey matter electrical conductivity.

2.2 Reconstruction Techniques

In order to retrieve the distribution of the electrical conductivity, the phase-based implementations of Helmholtz-EPT (H-EPT) and convection-reaction–EPT (CR-EPT) provided by the open-source library EPTlib [1] have been used. For each head model, the distribution of the *transceive* phase [3] (input of phase-based EPT) is obtained by linearly combining the phases of the rotating components of B_1 simulated both in transmission and in reception [1].

Since noiseless inputs are considered, the smallest filter has been used both in H-EPT and in CR-EPT. Moreover, CR-EPT has been applied for a volume tomography, with an electrical conductivity of 0.1 forced at the boundaries and an artificial diffusion coefficient equal to 10^{-4} .

Currently, the proposed anomaly detection algorithms have been tested only on the H-EPT results.

2.3 Anomaly Detection

We developed two anomaly detection algorithms: (i) a more classical approach for anomaly detection in MR images and (ii) an EPT-based approach working with direct quantitative properties estimated by the MRI-based EPT.

2.3.1 Classical Approach. The classical approach uses standard techniques used for anomaly detection in MR images. This approach could be applied (also) on standard MR images as it is independent of the MRI technique. The algorithm uses noiseless EPT images, produced with Helmholtz reconstruction technique, as input data.

The algorithm receives previously segmented (this segmentation was not of interest in this research) white matter from the EPT image and detects the edges in it. The edges are detected using a simple gradient edge detection technique. The gradient is calculated for each voxel based on the directional change of electrical conductivity of neighbouring voxels. The edges are represented as borders between white matter and other brain tissues as well as borders between white matter and anomalies. Edge voxels are ignored in order to avoid H-EPT reconstruction errors, which occur at borders between tissues [4].

The algorithm then calculates median electrical conductivity of all regions as separated by the detected edges. Figure 1 shows median electrical conductivity distribution by regions in a sample image.

The k-means algorithm is then employed for the classification of regions into healthy and anomaly-containing ones. The algorithm classifies an MR image based on median electrical conductivity of each region. The anomaly location is associated with the regions detected as containing the anomaly.

2.3.2 EPT Approach. EPT differs from standard MRI techniques by representing EPs as quantitative values. EPs are a reliable biomarker of healthy brain. Mandija et al. [4] presented mean electrical conductivity and standard deviation of white and grey matter as a reliable measure of whether the brain contains pathological tissue.

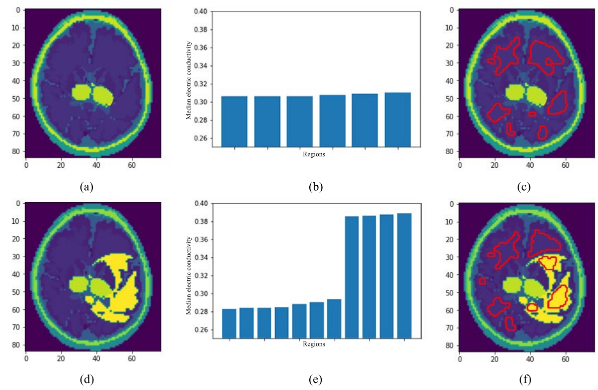

Figure 1: Median electrical conductivity distribution by regions. (a) Segmented healthy MRI image. (b) Median electrical conductivity distribution. (c) Detected regions (bordered red). (d) Segmented pathological MRI image (anomaly is yellow). (e) Median electrical conductivity distribution. (f) Detected regions (bordered red). Please note that not all of the regions are visible as only a 2D slice is shown while the data is 3D.

In input data for our experiments, electrical conductivity is distributed from 90% to 110% of nominal value for white matter, and from 110% to 150% for anomalies. However, it must be noted that these are the values used for setting up the phantoms, and that these values are then only approximated when EPT reconstruction is performed. These reconstructed properties have been used as input for anomaly detection. The algorithm detects anomalies based on the difference between white matter and anomalies. The algorithm uses noiseless EPT images, produced with H-EPT, as input data.

The algorithm, as the classical one, receives as input previously segmented white matter from the whole EPT image. It then detects all voxels that have electrical conductivity between 110% and 150% of median electrical conductivity of white matter and marks them as a potential anomaly. These voxels, marked as potentially being an anomaly, are then grouped into regions based by their location. The algorithm ignores all smaller regions (below a set size threshold) that likely represent noise and reconstruction errors. All the remaining regions are classified as the anomaly.

3 RESULTS

Figure 2 shows the predictions of whether an image contains an anomaly or not for both algorithms – classical on the left (a) and EPT approach on the right (b). Each EPT image corresponds to one bar on the chart and they are arranged with the increasing size of the anomaly; the size of the bar represents the size of the anomaly in voxels. The bars are cut off at 2,000 voxels for easier viewing. Only images actually containing the anomaly are shown; for the others the false positives (FP) rate describes the performance of the two algorithms. The green colour represents correct predictions and the red colour the incorrect ones. The yellow colour means that the algorithm correctly predicted the

Table 1: Classification evaluation of the classical approach.

Measure	Training data	Test data
Precision	0.975	1.000
Recall	0.750	0.708
F1 score	0.848	0.829
Accuracy	0.785	0.767

Table 2: Localisation evaluation of the classical approach.

Measure	Training data	Test data
IoU	0.197 ± 0.116	0.244 ± 0.110
Precision	0.932 ± 0.202	0.988 ± 0.050
Recall	0.204 ± 0.123	0.245 ± 0.110
F1 score	0.313 ± 0.163	0.379 ± 0.143

presence of the anomaly, but for the wrong reasons (hence Intersection over Union (IoU) is zero) – these cannot be counted as correct performance. Some misclassifications are labeled with the most likely cause: either that the anomaly is scattered in several smaller regions (each below the detection threshold size) or, in case of the EPT approach, that the anomaly is too close to the top border and is ”overshadowed” by the cranium. For the unlabelled misclassifications the most likely reason is the small size of the anomaly.

Figure 2 captures rather well the minimal anomaly size where each algorithm starts performing quite reliably. The classical approach detects anomalies larger than 350 voxels and the EPT approach detects anomalies larger than 170 voxels. Since each voxel represents a cube with a 2 mm edge, these volumes translate roughly to a cube with the edge of 14 mm for the classical approach and a cube with the edge of slightly less than 12 mm for the EPT approach.

Tables 1-4 further clarify the results. The images were split into a training set, used to optimise several internal parameters and a test set for independent evaluation. Internal parameters of the classical approach specify: (i) minimum gradient value for a voxel to be recognized as an edge; (ii) electrical conductivity difference between anomaly and healthy tissue; (iii) minimum region size. Internal parameters of the EPT approach specify: (i) how many initial slices of white matter are ignored (to avoid reconstruction errors); (ii) minimum region size. The split, while random in nature, was made based on individual phantom heads – the same head with different anomalies simulated could not be both in the test and training set. The training set consisted of 130 images (including 26 not containing an anomaly), and the test set consisted of 60 images (including 12 not containing an anomaly).

Table 1 shows the results of classification evaluation of the classical approach and Table 2 shows the results of localisation evaluation using the classical approach. The localisation results are reported as mean ± standard deviation of electrical conductivity. The values of IoU and F1 score for localisation are lower as a result of ignoring anomaly edge voxels. Anomaly edge voxels are ignored because of H-EPT reconstruction errors. This is not an issue for anomaly detection as values of precision are still high. Values of IoU and F1 score of localisation will be improved by acknowledging edges of anomaly after it is already detected.

Table 3: Classification evaluation of the EPT approach.

Measure	Training data	Test data
Precision	0.976	0.971
Recall	0.769	0.708
F1 score	0.860	0.819
Accuracy	0.800	0.750

Table 4: Localisation evaluation of the EPT approach.

Measure	Training data	Test data
IoU	0.381 ± 0.140	0.435 ± 0.125
Precision	0.874 ± 0.208	0.900 ± 0.177
Recall	0.396 ± 0.142	0.450 ± 0.126
F1 score	0.535 ± 0.166	0.594 ± 0.142

Analogously, Table 3 shows the results of classification evaluation of the EPT approach and Table 4 shows the results of localisation evaluation of the EPT approach. Again, IoU and F1 score values are reduced as the result of ignoring anomaly edge voxels.

An example of anomaly localisation is shown in Figure 3. As shown in the image, the EPT approach is generally better at anomaly localisation than the classical approach.

4 DISCUSSION AND CONCLUSIONS

The results indicate potential for future use of the EPT technique for the anomaly detection in clinical practice. The results in terms of the anomaly size are on par with what a trained radiologist is able to detect manually.

EPT, being a quantitative technique, offers the advantage of comparability of the images (e.g. in longitudinal monitoring of the patient) compared to the standard qualitative MRI. Furthermore, the direct EPT approach performed better than the classical one via edge detection. It is also less complex and this can often be a bonus in practical applications.

However, this is a pilot study and further research is required to put these approaches into actual practice. The biggest limitation of the presented study and results is that the images, while being an actual EPT reconstruction, were deliberately noiseless. With the introduction of noise the data would very much resemble the actual in vivo cases, however the obtained results will likely be worse. A lot of further work, mostly on noise reduction and detection in presence of noise is likely still required.

Moreover, currently only the data captured using H-EPT is used. This technique causes (large) reconstruction errors which occur at the borders between tissues. The results could potentially be improved by combining H-EPT and CR-EPT [1], as the latter technique does not cause reconstruction errors at borders between tissues.

The anomaly localisation could also be improved by not ignoring edges. The edges would still be removed when anomalies are detected, however, once an anomaly is detected, the edges around the anomaly could be classified as anomaly, thus improving the IoU and the F1 score.

In addition to the mean value of electrical conductivity, the standard deviation of the electrical conductivity could also be taken into account when detecting edges and anomalies.

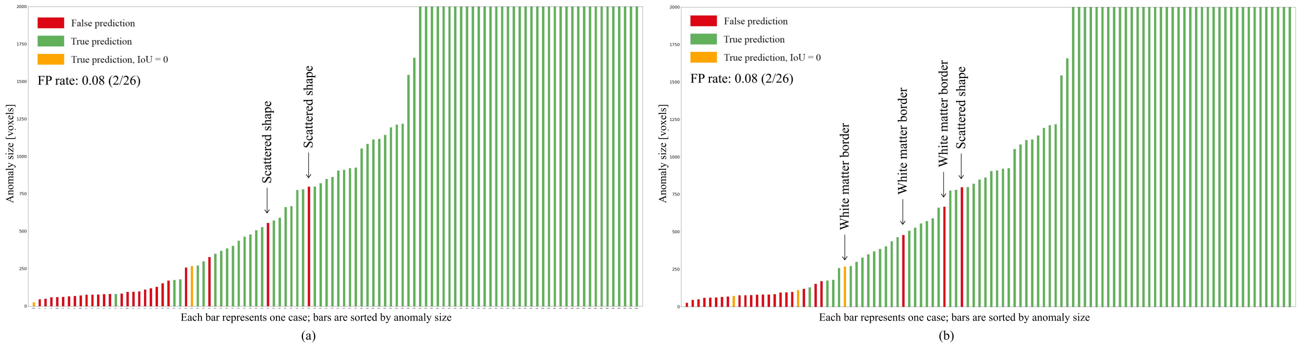

Figure 2: Predictions of anomaly detection algorithms. (a) Classical approach. (b) EPT approach.

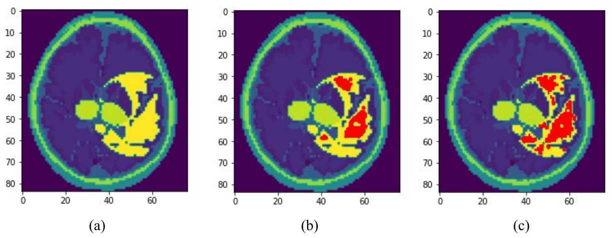

Figure 3: Anomaly localization. (a) Segmented pathological MRI image. (b) Localization of classical approach (detected anomaly is red). (c) Localization of EPT approach (detected anomaly is red).

Finally, once results achieved on EPT images of phantom brain are satisfactory, implemented approaches could be tested on in vivo data.

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Library for Feature Calculation in the Context-Recognition Domain

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ABSTRACT

Context recognition is a mature artificial intelligence domain with established methods for a variety of tasks. A typical machine learning pipeline in this domain includes data preprocessing, feature extraction and model training. The second of these steps is typically the most challenging, as sufficient expert knowledge is required to design good features for a particular problem. We present a Python library which offers a simple interface for feature calculation useful in a myriad of different tasks, from activity recognition to physiological signal analysis. It also offers additional useful tools for data preprocessing and machine learning, such as a custom wrapper feature selection method and prediction smoothing using Hidden Markov Models. The usefulness and usage is demonstrated on the 2018 SHL locomotion challenge where a few simple lines of code allow us to achieve solid predictive performance with F1 score of up to 93.1, notably surpassing the baseline performance and nearing the results of the winning submission.

KEYWORDS

feature calculation, python library, context recognition, machine learning

1 INTRODUCTION

Context recognition is a vague term encompassing a variety of tasks where sensors are put on (or around) a person and are then used to determine something about them. For example, sensors in a smartphone can determine if a user is standing, walking, running or even falling. A wristband sensor can read physiological signals like heart-rate or sweating to determine stress or blood pressure. These kinds of applications are usually used for self monitoring in sport activities or for helping the users manage various medical conditions.

The context-recognition field is quite mature and its applications often come pre-installed in many commercial devices like wristbands and smartphones. Nonetheless, the development of a new context recognition system can be tedious and time-consuming. It usually consists of collecting relevant sensor data, parsing it to a suitable format, calculating features based on this data and finally training the model.

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In this work we present a Python library focused on streamlining this process. Its main functionality is calculating the features from sensor data. It can generate over a hundred different features that have proven themselves in various context-recognition projects we tackled in the past [4, 3, 5]. Loosely, the features can be divided in two categories: those suitable for motion data (e.g. generated by accelerometer or gyroscope) and those specialized for physiological signals.

Furthermore, the library implements some other functionalities that are often used in context recognition pipelines: reshaping data into windows, re-sampling the data, selecting the best features after generating them and a method for smoothing the final predictions of the classifier using a Hidden Markov Model approach.

To demonstrate the usefulness of the library we used its functionalities exclusively (with the exception of a generic Random Forest classifier [11]) on the SHL Challenge dataset [16]. We demonstrate the whole pipeline, from reading in the raw data to the finished context-recognition system that is comparable to the best-performing submissions in the SHL Challenge.

2 LIBRARY FUNCTIONALITIES

The library is implemented in Python as this has been the most popular data science language in recent years [6]. It is available in a public repository with `pip install cr-features` command.

Its main and most valuable functionality lies in feature generation. The 'motion features' are listed in Section 2.1, while the 'physiological features' are described in Section 2.2. Remaining non-feature related functionalities are explained in Section 2.3.

2.1 Motion Sensors Features

Features listed in the first two subsections are general and can be applied on any sensor data time-series. The last subsection (2.1.3), on the other hand, lists features that have an additional semantic interpretation for acceleration and require data from three (x,y,z) axes. The library defines similar sensor subsets for some other sensors (e.g. gyroscope). Only a subset of features is listed for brevity, while the full list can be found in the documentation [1].

2.1.1 General Statistical Features.

- Basic statistical measures: maximum, minimum, standard deviation, median, mean difference between samples.
- Number of peaks – useful for detecting and counting steps, estimating the energy expenditure and determining the frequency of motion: peak count, number of times data crossed its mean value, longest time data was above or below its mean value.
- Different data aggregations that can indicate the intensity of the activity: (squared) sum of values, sum of absolute values.
- Autocorrelations (i.e. how similar the data is to a shifted version of itself) which indicate periodicity: autocorrelation for raw data, for peak positions, for mean crossings.
- Data shape: skewness (a measure of symmetry, or more precisely, the lack of symmetry), kurtosis (a measure of whether the data is heavy-tailed or light-tailed relative to a normal distribution), interquartile range.

2.1.2 Frequency Features. They are calculated by first computing an estimate of the power spectral density of the signal via a periodogram. We used the Welch's method which is an improvement over the traditional methods in that it reduces noise in the estimated power spectra.

Once the periodogram is obtained, the following features are computed: the magnitude value of the three highest peaks in periodogram, the three highest frequencies corresponding to the highest peaks, energy of the signal calculated as the sum of squared FFT component magnitudes, entropy of the signal computed as the information entropy of the normalized FFT component magnitudes, and the distribution of the FFT magnitudes into 10 equal sized bins ranging from 0 Hz to $F_s/2$, where F_s is the sampling frequency. Finally, we also computed the previously described skewness and kurtosis for the periodogram.

Most of the described features are useful for finding different periodic patterns, how often they occur and how intense they are.

2.1.3 Accelerometer Features.

- Phone rotation estimation. First, roll and pitch are calculated, then we calculate their characteristics: mean, standard deviation, peaks, autocorrelations.
- Physical interpretations: velocity, kinetic energy.
- Comparing data axis; useful for determining the sensor orientation relative to the direction of motion: correlation between axis data, comparing their means, mean direction of the vector they form.

2.2 Physiological Features

Physiological features are useful for obtaining information about a person's physiological state, typically reflected in their cardiovascular response. We computed several features from signals obtainable from many modern wristbands as described in the sections below.

2.2.1 Heart Rate and Heart Rate Variability. Cardiovascular measures are widely used to predict both medical problems as well as psychological processes [7]. They range from simple heart rate calculations to more complex heart rate variability indicators. Heart rate variability is a measure of how quickly heart rate itself changes and it is usually calculated on a beat-by-beat basis, considering the inter-beat interval (IBI). It reflects the interaction between sympathetic and parasympathetic regulation of heart beat [10] and is thus an especially useful physiological indicator.

Calculation of features related to cardiovascular activity follows recommendations by Malik, Bigger, Camm, Kleiger, Malliani, Moss and Schwartz [8]. To describe heart rate variability, the Fourier transform of inter-beat intervals is calculated and then several frequency features are derived from the spectrum [5].

2.2.2 Skin Conductivity. Electrical conductivity of the skin varies due to physiological changes in sweat glands, which are controlled by the autonomic nervous system. In a simple model of resistive properties of skin and sweat glands, whenever the level of sweat in the glands is increased, its conductivity also increases [2]. Sweat glands thus act as variable resistors and actual sweating, that is sweat secretion from the glands, is not needed for this change to be measurable.

Changes in skin conductivity are not only triggered by other physiological changes, such as the ones in (skin) temperature, but also reflect psychological processes. Skin conductivity can indicate cognitive activity or emotional responses and can do so with good sensitivity [see 7, for an exhaustive review].

Sweat glands continuously adapt to their environment and their reactions can be slow or fast. Two main modes of fluctuations are therefore distinguished: skin conductance level changes, which are slow variations of the general trend, also called tonic electrodermal measures, and skin conductance responses, quick reactions, also called phasic electrodermal measures [13].

To calculate skin conductivity features the two components are first separated. This is done using the EDA Explorer library [14] which enables searching for peaks (SCRs) in the signal by specifying their desired characteristics.

The signal is first filtered using a Butterworth low-pass filter from SciPy [15]. Next, the peaks are detected by considering their amplitude, onset, and offset time.

Once the SCRs are found, their characteristics are calculated which can be used as features. These include their number and rate (relative frequency in time) as well as the means and maxima of various characteristics, such as their maximum amplitude, their duration, increase time etc.

The tonic component is calculated using `peakutils` [9]. It is detected as the signal baseline, fitting a 10-th degree polynomial to the signal. Similarly to the phasic component, statistical features are calculated, such as the difference between this component and the raw signal, and the sum of its derivative.

2.2.3 Skin Temperature. Skin temperature is a fairly simple physiological parameter, both from the point of view of measurement as well as feature calculation. It can still serve as an indicator of affect [7]. Unlike the other physiological parameters which make use of expert features only some generic statistical features are calculated for this indicator.

2.3 Other Functionalities

The following functionalities are not directly related to the feature generation but are nonetheless often used in conjunction with it – and can thus make the workflow more straightforward.

2.3.1 Resize, Resample. The presented library works with raw data in matrix form: each row representing one window of data, i.e. one instance. If the original data is in the form of 1D time-series, the `convertInputInto2d` function can reformat it in the required format. It can work both with windows of fixed number of data samples as well as windows representing a fixed time interval. Another frequent pre-processing step is down-sampling the data and it can be done with the `resample` function.

2.3.2 Wrapper Feature Selection. While many feature selection libraries already exist (e.g. scikit-learn [11]), we implemented another one in this library as it was frequently used in our previous work [4, 3]. It combines the relatively common 'wrapper' approach with reducing the feature count using correlations. It works in three steps:

(1) Calculate the information gain for every feature and rank them based on it.
(2) Calculate the correlation between each feature pair. If the correlation exceeds the given threshold, discard the one with lower information gain.
(3) Create the classifier using only the highest ranking feature and measure the accuracy using a validation set. Then add the second feature and measure the accuracy again. If it was the same or higher, keep the feature, otherwise discard it. Repeat for all other remaining features.

2.3.3 Hidden Markov Model Smoothing. The final functionality is a tool to post-process the predictions of the context-recognition system – taking into account the temporal dependencies between the instances.

Take an example in which the classifier predicts the following minute-by-minute sequence: 'subway', 'subway', 'bus', 'subway', 'subway'. It is far more likely that the 'bus' prediction is a misclassification than switching vehicles for just a minute.

Such a sequence can be corrected using a Hidden Markov Model (HMM). This model assumes that there are hidden states corresponding to real activities which emit visible signals – classifications. The parameters of this models can be inferred from the matrix of transitions probabilities and confusion matrix of the predictor.

Once the parameters are estimated, the Viterbi algorithm is used in the background to determine the most likely sequence of hidden states (activities) given visible emissions (predictions). In many domains [4, 12] this method significantly improves the final prediction accuracy.

While this method is least connected to the feature generation, we have not seen it implemented in a different library and have found it greatly useful.

3 USAGE EXAMPLE

We illustrate the usage of our library with an example: The Sussex-Huawei Locomotion Challenge 2018 [16]. This was a worldwide open activity recognition challenge with monetary incentives, organized as part of the HASCA workshop within UbiComp conference. 17 teams participated with 19 submissions. The goal was to train a recognition pipeline on the provided training data and then use it to classify the withheld test data as well as possible in terms of the F_1 score metric.

3.1 SHL Dataset

The challenge used a subset of the full dataset which was recorded over a period of 7 months by 3 participants engaging in 8 different modes of transportation (still, walk, run, bike, car, bus, train and subway). The phones were worn on 4 body positions, namely the hand, torso, hip pocket and in a backpack and recorded 16 sensor modalities simultaneously. This totalled to 2812 hours of labelled data and this is considered one of the largest such datasets openly available [16].

In the actual challenge, the subset used was the data recorded by one of the three participants, which included 82 days of recording, split into the training set (271 hours) and testing set (95 hours). Raw data from 7 sensors was provided: accelerometer, gyroscope, magnetometer, linear acceleration, gravity, orientation and air pressure. All were sampled at 100 Hz [16].

Data was split into 1-minute segments using a sliding window without overlap and then randomly shuffled, providing consistent instances. Finally, the training data had 16 310 such instances and test data had 5698, where each instance contained 6000 samples. This highlights the sheer size of the data and the challenges in processing it in full.

3.2 Methods

We used a traditional ML pipeline for this task: first preprocessing the data, then computing informative features, selecting the best of them and finally using them to train and evaluate a classification model. We added another not so traditional step: smoothing the predictions using HMM.

All steps except training and evaluation were done in few lines using the presented library; the Python code (with some missing steps in comments) is given below. All classification was done using scikit-learn implementation of Random Forest with default parameters.

```
from CalculatingFeatures import resample,
     calculateFeatures, selectFeatures, hmm_smoothing

# Data was already windowed
# Data was resampled from 100 Hz to 20 Hz
acc_x = pd.read_csv(path, sep=" ")
acc_x = resample(acc_x, 6000, 1200)
# Repeat for all data types (and axes)
features_train = calculateFeatures(
    acc_x,
    acc_y,
    acc_z,
    featureNames=accelerationNames,
    prefix="acc",
)
# Repeat for all data types and train/test/valid sets
# Merge in one dataframe
selected = selectFeatures(
    features_train, features_validation
)
f1, cf, predictions = evaluate(
    features_train[selected],
    features_test[selected],
    labels_train,
    labels_test,
)
smoothed = hmm_smoothing(labels_train, cf, predictions)
# smoothed is an array representing final output
```

3.3 Results

We compared the results – in terms of F_1 score – of different stages in the machine learning pipeline against the top three submissions in the competition.

In the first stage we used just the mean and standard deviation as features (and calculated them for each data modality) to provide a baseline solution. Next, we calculated some features using the presented library. We then selected only a subset of them

Table 1: A comparison of different versions of the pipeline, against the best submissions in the SHL Challenge. The number of features used in our methods is also listed.

Experiment	# features	F_1 score
Baseline	38	80.3
All features	298	87.7
Feature selection	130	87.1
HMM	130	93.1
Third place	/	87.5
Second place	/	92.4
First place	/	93.9

and again measured the performance. Finally, we used the HMM smoothing; a post-processing step described in Section 2.3.3.

Results are shown in Table 1. It shows that the features generated by the library substantially improve the performance. The feature selection, on the other hand – while significantly reducing the number of features required – did not increase performance. Of note, the performance did increase in the internal validation set, but this gain did not translate to the test set. The final jump in performance was achieved using the HMM smoothing and we highly recommend this method in this and similar domains.

Using just the methods in the presented library and no parameter or method tuning we achieved the results comparable with the first placed submission to the challenge.

4 CONCLUSION

In this paper we demonstrated the base usage of a Python library capable of calculating features suitable for the context recognition domain. The most important features that can be calculated are listed in this paper with specialized ones thoroughly described.

We also showed on a topical example (SHL Challenge dataset) how only a few lines of code can generate a very capable context-recognition system that can compete with the best entries submitted to this challenge. Such system can be improved with extensive tuning but we provide a solid starting point.

It is our hope that by making this library publicly available we can help the workflow of many future context-recognition researchers.

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Določanje slikovnega prostora na umetniških slikah

Reconstruction of image space depicted on artistic paintings

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POVZETEK

V članku poročamo o analizi slikovnega prostora na umetniških slikah s pomočjo metod računalniškega vida. Naš cilj je bil, da ugotovimo, ali je možno zgolj na osnovi zaznave obrazov na slikah določiti prostorsko organizacijo slike. Analiza je potekala na izbranem vzorcu 3356 slik. Najprej smo določili tridimenzionalne koordinate zaznanih obrazov na posamezni sliki. Nato smo tem točkam priredili ravnino. Slikovni prostor smo tako določili z enačbo prirejene ravnine oziroma kotom med to ravnino in slikovno ravnino. Bolj kot je ravnina, ki jo določajo obrazi, nagnjena od navpične smeri, globlji je prikazani slikovni prostor.

KLJUČNE BESEDE

računalniški vid, slikovni prostor, zaznava obrazov, umetnostna zgodovina

ABSTRACT

In the article, we report on the analysis of the image space depicted on artistic paintings utilizing methods of computer vision. Our aim was to find out whether one can recover the spatial organization of a picture based on detection of faces. The analysis was conducted on the sample of 3356 paintings. First, 3D coordinates of faces were determined. Then, a plane was fitted to the faces on every painting. Images were therefore described in terms of the angle between the fitted plane and the picture plane. The bigger the angle between both planes, the deeper the picture space depicted.

KEYWORDS

computer vision, image space, face detection, art history

1 UVOD IN MOTIVACIJA

Odločili smo se povezati dve raziskovalni področji, ki sta si navidez zelo vsaksebi, to je umetnostna zgodovina in umetna inteligenca. Metode računalniškega vida se že redno uporabljajo tudi za analizo umetniških slik [12]. Večina teh raziskav je osredotočena na analizo posameznih ali manjšega števila umetniških slik. Po drugi strani smo danes v dobi velepodatkov (angl. *Big Data*), saj je vedno več informacij dostopnih v digitalni obliki. Tudi velike zbirke reprodukcij umetniških slik so danes prosto dostopne na medmrežju, na primer Google Arts and Culture, Wikimedia Commons, Getty Open Content Program, ADA (Archive of Digital Art) in druge [4]. Z analizo in vizualizacijo velikih umetniških zbirk se je prvi začel ukvarjati Lev Manovich [8]. Leta 2012 je preučeval vizualizacijske metode za družboslovne vede in medijske raziskave. Ukvarjal se je z informativno, uporabno in estetsko vrednostjo vizualizacij [9].

Analiza razlik med predstavitvijo prostora s fotografijo in umetniško sliko je bila narejena leta 2014 [11]. S statistično analizo slik tihožitij, ki so jih ustvarili udeleženci eksperimenta, so ugotovili, da so predmeti, na katere so udeleženci usmerjali pozornost, naslikani večji kot so na fotografijah. Zato je vprašanje, ali je dosledna uporaba linearne perspektive najbolj primerna metoda za posnemanje sveta [1]. Umetnostna zgodovina nam nazorno prikaže, da so umetniki za posnemanje sveta uporabljali zelo različne pristope.

Pri naši analizi slikovnega prostora smo izhajali iz dveh predpostavk:

(1) v raziskavi želimo analizirati veliko število umetniških slik v smislu današnjega trenda *Big Data*,
(2) uporabiti želimo take metode računalniškega vida, ki delujejo hitro in čimbolj zanesljivo.

Med hitre in zanesljive metode računalniškega vida zagotovo sodi zaznava in identifikacija oseb na osnovi njihovih obrazov. Zaradi varnostnih razlogov se je teh problemov na področju biometrije lotilo že zelo veliko znanstvenikov. Danes obstajajo hitre in zanesljive metode za zaznavo in analizo obrazov na slikah [10].

Za navdih nam je služil članek Irvinga Zupnicka iz leta 1959 [14], objavljen še veliko pred uporabo računalnikov v likovni umetnosti, ki opisuje kako je na slikah iz različnih umetnostnih obdobjih organiziran slikovni prostor. Zato smo si zastavili vprašanje, ali je mogoče s pomočjo metod računalniškega vida rekonstruirati slikovni prostor na umetniških slikah? Bolj konkretno, ali ga je mogoče rekonstruirati na osnovi zaznave obrazov na slikah? Določitve 3D razsežnosti prostora, upodobljenega na sliki, smo se lotili na osnovi pozicije obrazov na sliki (x in y koordinate) in njihove velikosti, kar nam daje grobo informacijo o tretji dimenziji z — to je oddaljenosti obraza od opazovalca. Ta pristop seveda temelji na predpostavki, da so na slikah ljudje oziroma da so upodobljeni njihovi dovolj veliki obrazi. Resda v zgodovini likovne umetnosti poznamo veliko tihožitij ali pokrajinskih slik, na katerih ni obrazov. Toda velika večina umetniških slik iz obdobja pred izumom fotografije dejansko upodablja ljudi oz. njihove obraze.

Iz javno dostopnih baz umetniških slik smo za našo študijo izbrali testno množico 3356 slik iz različnih umetnostnozgodovinskih obdobij in žanrov.

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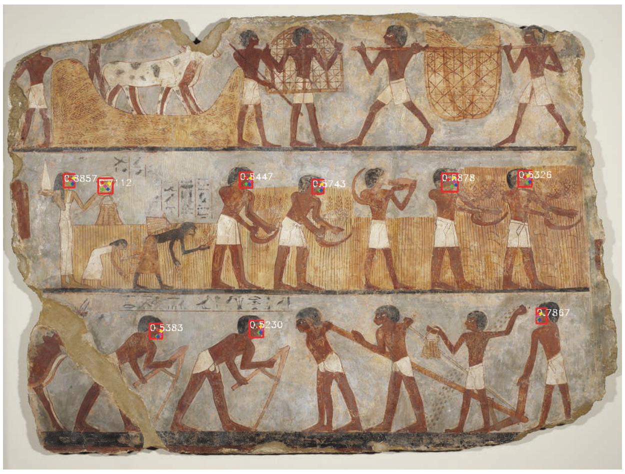
2 SLIKOVNI PROSTOR NA UMETNIŠKIH SLIKAH

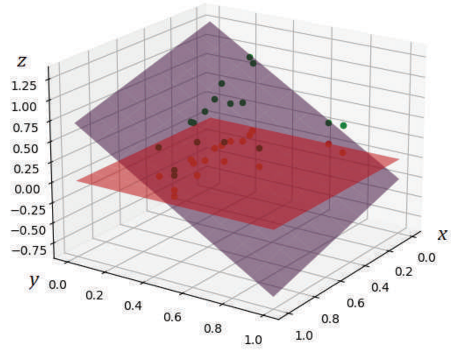
Slika 1: Auguste Renoir, *Ples v Le Moulin de la Galette*; vidijo se zaznani obrazi. Velikost obrazov jasno odraža globino slikarskega prostora.



Slika 2: Poslikava v grobnici *Unsu*. Vsi obrazi se enake velikosti, ves slikarski prostor je zgoščen kar v ravnini poslikave.

Vsakemu obrazu na slikah smo priredili tridimenzionalne koordinate, ki pa niso bile zanesljive v absolutnih vrednostih, temveč odražajo zgolj relativne razdalje. Nato smo tem obraznim točkam priredili ravnine s smislu vsote najmanjših kvadratov razdalj med točkami in iskano ravnino. Pri tistih slikah, ki prikazujejo obraze, ki so v spodnjem delu slike opazovalcu blizu, in se višje na sliki postopno oddaljujejo (Slika 1), so dobljene ravnine bolj nagnjene v globino kot pri tistih, kjer so vsi obrazi približno na enaki razdalji od opazovalca (Slika 2). V takih primerih je dobljena ravnina skorajda vzporedna s površino slike. Rafaelova *Atenska šola* in staroegipčanska poslikava v grobnici *Unsu* imata zelo različni prostorski ureditvi. Na prvi sliki se obrazi zmanjšujejo z oddaljevanjem ljudi. Ravnina, prirejena točkam na tej sliki, je zato nagnjena v globino (Slika 3).

Po drugi strani tudi poslikava na Sliki 2 prikazuje množico ljudi, vendar so vsi enake višine in njihovi obrazi so enako veliki. Ravnina, prirejena obrazom na egipčanski sliki, je zato vzporedna ravnini $z = 0$. Za egipčansko slikarstvo je značilno konceptualno



Slika 3: Vijoličasta ravnina, ki se prilega 3D pozicijam obrazov na Renoirjevem *Plesu v Le Moulin de la Galette* in in rdeča ravnina $z = 0$ – ploskev slikarskega platna, na kateri smo zaznali obraze.

upodabljanje prostora: velikosti oseb niso določene s prostorskim oddaljevanjem, temveč npr. z družbenim statusom.

3 ZAZNAVA OBRAZOV

Predpostavili smo, da so resnični obrazi pri vseh osebah približno enako veliki. Zato so bili večji obrazi obravnavani kot bližji površini slike in manjši kot bolj oddaljeni od površine slike oz. od opazovalca.

Zaznani so bili z orodjem *RetinaFace*, ki izvede dvodimenzionalno poravnavo in tridimenzionalno rekonstrukcijo obraza [2]. Zasnovan je na osnovi globoke nevronske mreže.

Detektor vrne podatke o obrazih v dvodimenzionalnem prostoru površine slike, torej imajo središča obraznih okvirjev in točke oči, nosu ter ust samo x in y koordinate. Toda za rekonstrukcijo tridimenzionalnega prostora slike potrebujemo tudi globine obrazov oz. koordinato z. Tridimenzionalni prostor, kot ga prikazuje umetniška slika, se razlikuje od fotografskega predvsem zato, ker slikarji redko dosledno upoštevajo linearno perspektivo. Na fotografijah je perspektiva po drugi strani bolj konsistentno določena. Zato je na njih mogoče z enačbo (1) [6] določiti oddaljenost predmeta od kamere:

$$d = \frac{f \cdot h_r \cdot h}{h_i \cdot h_s} \qquad (1)$$

Z enačbo (1) izračunamo oddaljenost d objekta v milimetrih, če je f goriščna razdalja fotoaparata, h_r resnična višina objekta v milimetrih, h višina slike v pikslih, h_i višina objekta na sliki v pikslih in h_s višina senzorja fotoaparata v milimetrih. Z njo so bile določene tudi oddaljenosti obrazov na slikah v vzorcu, pri čemer so bile uporabljene vrednosti goriščne razdalje in višine senzorja, kvocient katerih opiše, kako vidijo človeške oči. Četudi je bilo po tem postopku nemogoče določiti natančne tridimenzionalne koordinate obrazov na sliki, so bile določene relativne oddaljenosti med obrazi in površino slike. Za namen te raziskave tudi niti ni pomembno, če zaznamo vse obraze na sliki.

4 GEOMETRIJSKA INTERPRETACIJA PROSTORA

Parametre A, B in C enačbe ravnine $z = Ax + By + C$ smo določili z minimizacijo funkcije

$$E(A, B, C) = \sum_{i=1}^{m} (Ax_i + By_i + C - z_i)^2, \qquad (2)$$

kjer m pomeni število točk in x_i, y_i ter z_i koordinate točk. Funkcija (2) doseže minimum, ko je $\nabla E = (0, 0, 0)$ [3]. Za gradient te funkcije velja $\nabla E = (\frac{\partial E}{\partial A}, \frac{\partial E}{\partial B}, \frac{\partial E}{\partial C})$, kjer so $\frac{\partial E}{\partial A}$, $\frac{\partial E}{\partial B}$ in $\frac{\partial E}{\partial C}$ naslednji.

$$\frac{\partial E}{\partial A} = 2\sum_{i=1}^{m} x_i(Ax_i + By_i + C - z_i) \tag{3}$$

$$\frac{\partial E}{\partial B} = 2\sum_{i=1}^{m} y_i(Ax_i + By_i + C - z_i) \tag{4}$$

$$\frac{\partial E}{\partial C} = 2\sum_{i=1}^{m} (Ax_i + By_i + C - z_i) \tag{5}$$

Tako množici 3D točk priredimo ravnino z minimizacijo razdalj med temi točkami in njihovimi slikami na ploskvi v smeri z. Koeficienti A, B in C so zato rešitve sistema linearnih enačb (6), (7) in (8).

$$A\sum_{i=1}^{m} x_i^2 + B\sum_{i=1}^{m} x_i y_i + C\sum_{i=1}^{m} x_i = \sum_{i=1}^{m} x_i z_i \tag{6}$$

$$A\sum_{i=1}^{m} x_i y_i + B\sum_{i=1}^{m} y_i^2 + C\sum_{i=1}^{m} y_i = \sum_{i=1}^{m} y_i z_i \tag{7}$$

$$A\sum_{i=1}^{m} x_i + B\sum_{i=1}^{m} y_i + C = \sum_{i=1}^{m} z_i \tag{8}$$

5 REZULTATI

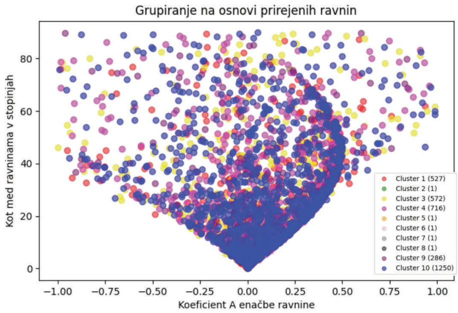
Slike smo izbrali iz prostodostopne zbirke WikiArt (https://www.wikiart.org), kjer so umetnine med drugim razdeljene po žanrih. Izbrana so bila slikarska dela (potrebno je bilo izločiti npr. kiparska), kjer je bilo upodobljenih več ljudi. Iz zbirke WikiArt so bila zato izbrana dela iz žanrov *pastorale* (77 slik), *allegorical painting* (1225 slik), *history painting* (1377 slik) in *literary painting* (667 slik), in sicer skupaj 3356 slik. Poleg žanra smo imeli tudi podatke o umetnostno zgodovinskem obdobju v katero sodi posamezna slika. Zanimalo nas je, kako lahko le na osnovi teh podatkov smiselno razdelimo testno množico slik z metodo gručenja in ali je ta delitev relevantna z vidika umetnostno zgodovine.

Kot kriterij pri gručenju so bile uporabljene enačbe ravnin ter kot med prirejeno ravnino in slikovno ravnino $z = 0$. Detektor *RetinaFace* opiše slednje s tremi parametri – rotacijami okoli osi x, y in z (v pozitivni in negativni smeri). Pri posamezni sliki so bile izbrane rotacije v vsaki smeri z največjimi absolutnimi vrednostmi.

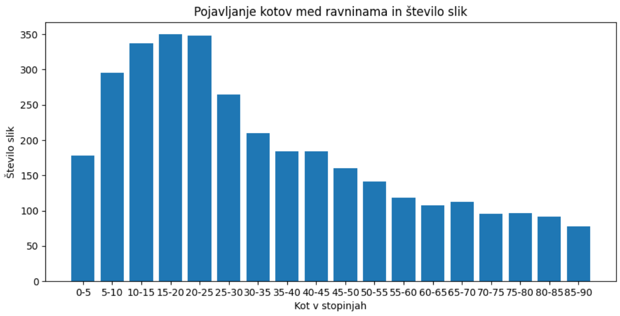
Gručenje je bilo opravljeno z algoritmom BIRCH, implementiranim s knjižnico *scikit-learn*. BIRCH (angl. *Balanced Iterative Reducing and Clustering using Hierarchies*) je algoritem gručenja, ki je posebej prilagojen delu z večjimi podatkovnimi vzorci [7].

Na Sliki 4 so ekstremne vrednosti izločene. Prikazana je razporeditev slik po gručenju na osnovi ravnin. Bila je izvedena primerjava tega, katerim umetnostnim slogom pripadajo slike v posameznih razredih. To je bilo mogoče, saj je bila vsaka slika v zbirki označena poleg žanra tudi z letom nastanka in umetnostnim slogom (barok, romantika ipd.). Število razredov smo omejili na deset. Zaradi izrazite drugačnosti prostorske razporeditve na nekaterih slikah so bile slednje izločene v posamezne razrede (2, 5, 6, 7 in 8). Ti razredi vsebujejo le po eno sliko in niso vidni na Sliki 4.

Histogram na Sliki 5 prikazuje zastopanost različnih intervalov kotov v proučevanem vzorcu. Vidi se, da je bil največji delež slik takih, kjer je bil kot med ravninama med 15 in 20 stopinj, kar se zdi relativno malo. Večji koti med ravninama večinoma



Slika 4: Razporeditev razredov pri gručenju na osnovi ravnin. Gruče so razpršene in izrazite razmejitve med njimi ni.



Slika 5: Zastopanost posameznih kotov za slike v testni množici.

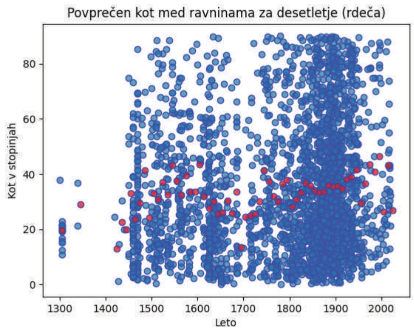
ustrezajo slikam, kjer se upodobljene osebe enotno oddaljujejo oz. približujejo. Če je bil kot med ravnino, ki je bila prirejena obrazom na sliki, in ravnino $z = 0$ izračunan kot natančno 0 stopinj, je to pomenilo, da na sliki ni bilo zaznanega nobenega obraza, samo en obraz ali pa so imeli vsi obrazi enake globine. Na intervalu od 0 do 5 stopinj (Slika 5) je bil najpogostejši barok, na preostalih intervalih po romantika. Ni pa na nobenem intervalu močno prevladoval le en slog, saj je odstotek slik, ki je pripadal najpogostejšemu slogu v posameznem intervalu med 20 in 30%.

Za določitev korelacije med časom nastanka posamezne slike in kotom med ravninama za to sliko je bil uporabljen Spearmanov koeficient korelacije. Ta predstavlja neparametersko stopnjo povezanosti med spremenljivkama oz. kako dobro je mogoče opisati njun odnos z monotono funkcijo [13]. Koeficient je bil 0.183, kar predstavlja šibko pozitivno korelacijo. p vrednost je bila v tem primeru blizu 0, kar pomeni, da korelacija med letom nastanka slike in kotom, ki odraža slikarsko globino ni linearna. Na prikazu na Sliki 6 je razvidno, da če opazujemo obdobje od približno leta 1700 in vse do danes, povprečen kot med ravninama za posamezna desetletja blago narašča.

6 RAZPRAVA

Glavna hipoteza naše raziskave je bila, ali lahko na nek enostaven način ugotovimo kakšen je slikarski prostor, to je, kako izrazita je globinska dimenzija na dani umetniški sliki. Slikarski prostor pa je povezan tako z umetnostno zgodovinskim obdobjem v katerega sodi slika, kot tudi z žanrom slike. Na ta način se nam odpira možnost avtomatske klasifikacije velikega števila slik, bodisi s statističnimi metodami, še bolj pa bi prišle v poštev metode strojnega učenja.

Odločili smo se, da bomo slikovni prostor določali posredno s pomočjo zaznave obrazov. Ko je bil posamezen obraz zaznan z orodjem *RetinaFace*, je bil s tem določen obrazni okvir na določeni



Slika 6: Koti med ravninama v odvisnosti od časa nastanka slike. Rdeče točke predstavljajo povprečen kot za posamezno desetletje.

koordinati x in y na ravnini slike. Velikost obraznega okvirja pa nam je dal še informacijo o relativni oddaljenosti obraza z od ravnine slike. Zanesljivost zaznave obrazov na umetniških slikah je bil verjetno nekoliko slabši, saj je bil *RetinaFace* naučen na fotografijah obrazov in ne na umetniških upodobitvah [2]. V kakšni prihodnji raziskavi bi lahko uporabili še dodatne informacije, ki jih daje orodje *RetinaFace* za zaznavo obrazov: orientacija obraza, lega oči, nosu in ust, spol ter starost osebe, določeno na osnovi obraza. Poleg tega bi lahko v prihodnjih raziskavah pri analizi slik upoštevali tudi barvno sestavo in druge slikovne značilke, ki jih lahko robustno določimo z metodami računalniškega vida [12]. Sami smo se ukvarjali npr. z detekcijo črt perspektivne projekcije na fotografijah [5, 1].

Četudi smo v našem preizkusu metode likovna dela združevali v razrede po podobnosti prostorske ureditve, se niso pokazale stroge meje med umetnostnimi slogi slik. Informativna pa je bila korelacija med časom nastanka dela in kotom med ravninama. V izbranem vzorcu slik različni umetnostnozgodovinski slogi niso bili povsem enakomerno zastopani in je bilo npr. veliko del iz romantike. Za vsako zgodovinsko obdobje so najverjetneje izrazite določene medsebojne povezanosti teh značilnosti. Ustaljen umetnostnozgodovinski pristop pri analizi slik je sočasno opazovanje dveh ali več del, pri katerih raziskovalec na osnovi svojega predhodnega znanja izloči značilne poteze, razlike ipd. [8]. Strojno učenje bi na tej točki postalo učinkovito, saj po eni strani nudi možnost analize velike količine podatkov, odkrivanje sočasnih povezav med različnimi značilkami, po drugi strani pa zagotavlja objektivnost matematičnih pristopov. Zato bi bilo v nadaljevanju koristno uporabiti poleg obrazov tudi druge informacije na slikah. Potrebno pa je upoštevati, da delitev umetniških del ne more biti absolutna, saj umetnostno zgodovino sestavljajo posamezni umetniki, vsak od njih ustvarja v svojem lastnem slogu, ki lahko do neke mere sledi splošnim trendom obdobja, vendar nikoli popolnoma. Tudi posamezni likovni umetniki v času svoje kariere lahko spremenijo svoj umetniški slog.

7 ZAKLJUČEK

V članku smo pokazali nov pristop k avtomatski analizi umetniških slik z uporabo metod računalniškega vida. Demonstrirali smo, da je z metodo zaznave obrazov na slikah možno nasloviti tudi bolj kompleksna vprašanja, kot v našem primeru organizacija prostora na slikah. Čeprav rezultati te raziskave morda niso tako jasno izraženi in niso reproducirali rezultatov umetnostnih zgodovinarjev, se uporaba računalnikov na področju umetnostne zgodovine kot na sploh v humanistiki šele zares začenja. Računalniško zasnovane analitične metode bodo omogočile odgovore na vprašanja, ki si jih umetnostni zgodovinarji do sedaj sploh še niso upali zastaviti.

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Automated Hate Speech Target Identification

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ABSTRACT

We present a new human-labelled Slovenian Twitter dataset annotated for hate speech targets and attempts to automated hate speech target classification via different machine learning approaches. This work represents, to our knowledge, one of the first attempts to solve a Slovene-based text classification task with an autoML approach. Our results show that the classification task is a difficult one, both in terms of annotator agreement and in terms of classifier performance. The best performing classifier is SloBERTa-based, followed by AutoBOT-neurosymbolic-full.

KEYWORDS

hate speech targets, autoML, text features spaces

1 INTRODUCTION

Hate speech and offensive content has become pervasive in social media and has become a serious concern for government organizations, online communities, and social media platforms [13]. Due to the amount of user-generated content steadily increasing, the research community has been focusing on developing computational methods to moderate hate speech on online platforms [6, 1, 8]. While several of the proposed methods achieve good performance on distinguishing hateful and respectful content, several important challenges remain, some of them related to the data itself. Several studies report both low amounts of hate speech instances in the labelled datasets, as well as relatively low agreement scores between annotators [9]. The low agreement score between annotators indicates that recognizing hate speech is a hard task even for humans suggesting that this task requires a more broad semantic interpretation of the text and its context beyond simple pattern matching of linguistic features.

To test this assumption, we have gathered a new Slovenian dataset containing tweets annotated for hate speech targets [1]. This dataset builds on the dataset used for detecting hate speech communities [3] and topics [2] on Slovenian Twitter. The dataset is available in the clarin.si dataset repository with the handle: https://www.clarin.si/repository/xmlui/handle/11356/1398.

Next, we addressed the hate speech target classification task by the autoML approach autoBOT [10]. The key idea of autoBOT is that, instead of evolving at the learner level, evolution is conducted at the representation level. The proposed approach consists of an evolutionary algorithm that jointly optimizes various sparse representations of a given text (including word, subword, POS tag, keyword-based, knowledge graph-based and relational features) and two types of document embeddings (non-sparse representations). To our knowledge, this is one of the first attempts to solve a Slovene-based text classification task with an autoML approach. Finally, we trained a model based on the SloBERTa pre-trained language model [11], a state-of-the-art transformer-based language model pre-trained on a Slovenian corpus and a set of baselines.

Our results show that the context-aware SloBERTa model significantly outperforms all the other models. This result, together with the lower inter-annotator scores, confirms our initial assumption that hate speech target identification is a complex semantic task that requires a complex understanding of the text that goes beyond simple pattern matching. The SloBERTa model reaches annotator agreement in terms of classification accuracy, indicating a fair performance of the model.

2 DATA

We collected almost three years worth of all Slovenian Twitter data in the period from December 1, 2017, to October 1, 2020, in total 11,135,654 tweets. The period includes several government changes, elections and the first Covid-19-related lockdown. We used the TweetCat tool [5], which is developed for harvesting Twitter data of less frequent languages.

2.1 Annotation Schema

Our annotation schema is adapted from OLID [13] and FRENK [4]. It is a two-step annotation procedure. After reading a tweet, without any context, the annotator first selects the type of speech. We differentiate between the following **speech types**:

- **0 acceptable** - non hate speech type: speech that does not contain uncivil language;
- **1 inappropriate** - hate speech type: contains terms that are obscene, vulgar but the text is not directed at any person specifically;
- **2 offensive** - hate speech type: including offensive generalization, contempt, dehumanization, indirect offensive remarks;
- **3 violent** - hate speech type: author threatens, indulges, desires or calls for physical violence against a target; it also includes calling for, denying or glorifying war crimes and crimes against humanity.

If the annotator chooses either the offensive or violent hate speech type, they also include one of the twelve possible targets of hate speech:

- Racism (intolerance based on nationality, ethnicity, language, towards foreigners; and based on race, skin color)
- Migrants (intolerance of refugees or migrants, offensive generalization, call for their exclusion, restriction of rights, non-acceptance, denial of assistance ...)
- Islamophobia (intolerance towards Muslims)

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*All authors contributed equally to this research.
[1]Slovenian Twitter dataset 2018-2020 1.0: http://hdl.handle.net/11356/1423

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- Antisemitism (intolerance of Jews; also includes conspiracy theories, Holocaust denial or glorification, offensive stereotypes ...)
- Religion (other than above)
- Homophobia (intolerance based on sexual orientation and/or identity, calls for restrictions on the rights of LGBTQ persons
- Sexism (offensive gender-based generalization, misogynistic insults, unjustified gender discrimination)
- Ideology (intolerance based on political affiliation, political belief, ideology... e.g. “communists”, “leftists”, “home defenders”, “socialists”, “activists for...”)
- Media (journalists and media, also includes allegations of unprofessional reporting, false news, bias)
- Politics (intolerance towards individual politicians, authorities, system, political parties)
- Individual (intolerance towards any other individual due to individual characteristics; like commentator, neighbor, acquaintance)
- Other (intolerance towards members of other groups due to belonging to this group; write in the blank column on the right which group it is)

2.2 Sampling for Training and Evaluation

The training set is sampled from data collected before February 2020. The sampling was intentionally biased to contain as much hate speech as possible in order to obtain enough organic examples to train the model successfully. A simple model was used to flag potential hate speech content, and additionally, filtering by users and by tweet length (number of characters) was applied. 50,000[2] tweets were selected for annotation.

The evaluation set is sampled from data collected between February 2020 and August 2020. Contrary to the training set, the evaluation set is an unbiased random sample. Since the evaluation set is from a later period compared to the training set, the possibility of data linkage is minimized. Furthermore, the estimates of model performance made on the evaluation set are realistic, or even pessimistic, since the model is tested on a real-world distribution of data where hate speech is less prevalent than in the biased training set. The evaluation set is also characterized by a new topic, COVID-19; this ensures that our model is robust to small contextual shifts that may be present in the test data. For the evaluation set, 10,000 tweets were selected to be annotated.

2.3 Annotation Procedure

Each tweet was annotated twice: In 90% of the cases by two different annotators (to estimate inter-annotator agreement) and in 10% of the cases by the same annotator (to assess the self-agreement). Special attention was devoted to an evening out the overlap between annotators to get agreement estimates on equally sized sets. Ten annotators were engaged for our annotation campaign. They were given annotation guidelines, a training session and a test on a small set to evaluate their understanding of the task and their commitment before starting the annotation procedure. The annotation process lasted four months, and it required about 1,200 person-hours for the ten annotators to complete the task.

In the training set, intentionally biased in favour of hate speech, about 1% of tweets were labelled as violent, 34% as offensive (to

Training set		Evaluation set	
Annotated for Vrsta:	99809	**Annotated for Vrsta:**	20000
0 ni sporni govor	60981	0 ni sporni govor	13273
1 nespodobni govor	3817	1 nespodobni govor	285
2 žalitev	34244	2 žalitev	6373
3 nasilje	767	3 nasilje	69
Annotated for Tarča:	34204	**Annotated for Tarča:**	6430
1 ksenofobija in rasizem	1103	1 ksenofobija in rasizem	125
2 begunci/migranti	1011	2 begunci/migranti	68
3 islamofobija	527	3 islamofobija	21
4 antisemitizem	55	4 antisemitizem	10
5 druge religije	172	5 druge religije	15
6 homofobija	304	6 homofobija	16
7 seksizem	773	7 seksizem	68
8 ideologija	6231	8 ideologija	839
9 novinarji in mediji	2517	9 novinarji in mediji	682
10 politika/-i	10924	10 politika/-i	2623
11 posameznik	7016	11 posameznik	1318
12 drugo	3571	12 drugo	645

Figure 1: Number of annotated examples for hate speech type and target. The class distribution is severely unbalanced.

either individuals or groups), 4% as inappropriate (mostly containing swear words), and the remaining 61% as acceptable. In the evaluation set, which is a random selection of 10.000 Slovenian tweets, only 69 tweets were labelled as violent by at least one annotator, which is about 0.3%.

The training dataset for hate speech type includes 34,204 examples and the evaluation dataset includes 6,430 examples. Many of the examples are repeated (by two annotations for the same tweet), yet conflicting (due to annotator disagreement). The training and evaluation sets for hate speech type and target are summarized in Table 1.

The overall annotator agreement for hate speech target on the training set is 63.1%, and Nominal Krippendorf Alpha is 0.537. The annotator agreement for hate speech target on the evaluation set is 62.8%, and Nominal Krippendorf Alpha is 0.503. These scores indicate that the dataset is of high quality compared to other datasets annotated for hate speech, yet the relatively low agreement indicates that the annotation task is difficult and ambiguous even for humans.

3 EXPERIMENTS

We compare different machine learning algorithms on the hate speech target identification task. They belong to one of the following three categories: classical, representation optimization and deep learning. The results are presented in Table 1.

3.1 autoBOT - an autoML for texts

With the increasing amounts of available computing power, *automation* of machine learning has become an active research endeavor. Commonly, this branch of research focuses on automatic model selection and configuration. However, it has recently also been focused on the task of obtaining a suitable representation when less-structured inputs are considered (e.g. texts). This work represents, to our knowledge, one of the first attempts to solve a Slovene-based text classification task with an existing autoML approach. The in-house developed method, called autoBOT [10], has already shown promising results on multiple shared tasks (and in extensive empirical evaluation). Albeit it commonly scores on average worse than large, multi million-parameter neural networks, it remains interpretable and does not need any specialized hardware. Thus, this system serves as an easy-to-obtain baseline which commonly performs better than *ad hoc* approaches such as, e.g. word-based features coupled

[2]Some annotators skipped some examples.

with, e.g. a Support Vector Machine (SVM). The tool has multiple configurations which determine the feature space that is being *evolved* during the search for an optimal configuration of both the representation of a given document, but also the most suitable learner. We left all settings to default, varying only the representation type, which was either symbolic, neuro-symbolic-lite, neuro-symbolic-full or neural. Detailed descriptions of these feature spaces are available online[3]. The main difference between these variants is that the neuro-symbolic ones simultaneously consider both symbolic and sub-symbolic feature spaces (e.g. tokens and embeddings of the documents), whilst symbolic or neural-only consider only one type. The neural variant is based on the two non-contextual doc2vec variants and commonly does not perform particularly well on its own.

3.2 Deep Learning

We trained a modelbased on the SloBERTa pre-trained language model [11]. SloBERTa is a transformer-based language model that shares the same architecture and training regime as the Camembert model [7] and is pre-trained on Slovenian corpora. For fine-tuning of the SloBERTa language model, we first split the original training set into training and validation folds in the 90%:10% ratio. We used the suggested hyperparameters for this model. We used the Adam optimizer with the learning rate of $2e-5$ and learning rate warmup over the first 10% of the training instances. We used a weight decay set to 0.01 for regularization. The model was trained for maximum 3 epochs with a batch size of 32. The best model was selected based on the validation set score. We performed the training of the models using the HuggingFace Transformers library [12].

We tokenized the textual input for the neural models with the language model's tokenizer. For performing matrix operations efficiently, all inputs were adjusted to the same length. After tokenizing all inputs, their maximum length was set to 256 tokens. Longer sequences were truncated, while shorter sequences were zero-padded. The fine-tuned model is available at the HuggingFace repository[4].

3.3 Other Baseline Approaches

The two mentioned approaches have demonstrated state-of-the-art performance; however, to establish their performance on this new task, we also implemented the following baselines. First, a simple majority classifier to establish the worst-case performance. Next, a doc2vec-based representation learner was coupled with a linear SVM (doc2vec). The *svm-word* is a sparse TF-IDF representation of the documents coupled with a linear SVM. Similarly, the *svm-char*, however, the representations are based on characters in this variant. The two alternatives use logistic regression (*lr-word*, *lr-char*). As another strong baseline, we used a multilingual language model called MPNet to obtain contextual representations, coupled with an SVM classifier. The baseline doc2vec model was trained for 32 epochs with eight threads. The min_count parameter was set to 2, window size to 5 and vector size to 512. For SVM and logistic regression (*LR*)-based learners, a grid search including the following regularization values was traversed: {0.1, 0.5, 1, 5, 10, 20, 50, 100, 500}.

4 RESULTS

The classification results for the discussed learning algorithms are given in Table 1. The results are sorted by learner complexity. The SloBERTa-based predictor performed the best, however, is also the one which includes the highest number of tunable parameters (more than 100m). The next series of learners are based on autoBOT's evolution and perform reasonably well. Interestingly, autoBOT variants which exploit only symbolic features perform better than the second neural network-based baseline which was not pre-trained specifically for Slovene – the *mpnet*. The remaining baselines perform worse, albeit having a similar number of final parameters to the final autoBOT-based models (tens of thousands at most). The autoBOT-neural, which implements the two main doc2vec variants, performs better than the naïve doc2vec implementation, however not notably better.

To better understand the key properties of the data set which carry information relevant for the addressed predictive task, we additionally explored *autoBOT-symbolic*'s 'report' functionality, which offers insight into the importance of individual feature subspaces. Each subspace and each feature in the subspace has a weight associated with it: the larger the weights, the more relevant a given feature type was for the learner. Visualization of these importances is shown in Table 2. It can be observed that character-based features were the most relevant for this task. This result is in alignment with many previous results on tweet classification, where e.g. punctuation-level features can be surprisingly effective. Furthermore, relational token features were also relevant. This feature type can be understood as skip-grams with dynamic distances between the two tokens. This feature type indicates that short phrases might have been of relevance. Interestingly, keyword-based features were not relevant for the learner. Further, autoBOT, being effectively a fine-tuned linear learner, also offers direct insight into fine-grained performances. Examples for the top five features per type are shown in Table 2.

5 CONCLUSION

In this work we present a new dataset of Slovenian tweets annotated for hate speech targets. To develop effective computational models to solve this task we use two approaches: the autoML approach combining symbolic and neural representations and a contextually-aware language model SloBERTa.

The results show that the context-aware SloBERTa model significantly outperforms all the other trained models. This result, together with the lower inter-annotator scores, confirm our initial assumption that hate speech target identification is a complex semantic task that requires a more complex understanding of the text that goes beyond simple pattern matching. However, the seemingly simpler models may still offer distinct advantages over the more complex neural models. First, the auto-ML models tested in this work are easily interpretable, offering insights into textual features which contribute to the classification. On the other hand, the neural language models generally work as black-boxes, and the extent of their interpretability is still an open research question. Second, the auto-ML models are significantly more straightforward to deploy as they tend to be much less computationally demanding both in terms of RAM and CPU usage. Neural language models are able to solve harder tasks but their increased number of parameters usually makes them a considerable challenge to deploy in a scalable fashion.

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[3] autoBOT feature spaces: https://skblaz.github.io/autobot/features.html
[4] Hate speech target classification model: https://huggingface.co/IMSyPP/hate_speech_targets_slo

Table 1: Overview of the classification results. The SloBERTa model significantly outperforms all the other models and reaches inter-annotator agreement.

Classification model	Accuracy	Macro Rec	Macro Prec	Macro F1
majority	40.79%	8.33%	3.40%	4.83%
doc2vec	43.25%	20.65%	20.67%	19.76%
AutoBOT-neural (9h)	45.79%	15.37%	20.00%	16.10%
svm-word	50.39%	21.40%	25.75%	22.02%
lr-word	50.39%	21.40%	25.75%	22.02%
lr-char	51.21%	25.14%	28.17%	26.10%
svm-char	51.90%	23.47%	27.59%	24.20%
AutoBOT-neurosymbolic-lite (4h)	54.26%	27.34%	35.06%	28.90%
Paraphrase-multilingual-mpnet-base-v2 + Linear SVM	55.40%	40.24%	44.29%	41.20%
AutoBOT-symbolic (9h)	55.99%	29.68%	37.86%	31.32%
AutoBOT-neurosymbolic-full (4h)	56.28%	32.29%	37.83%	33.07%
SloBERTa	63.81%	53.03%	45.63%	48.28%

Table 2: Most relevant features per feature subspace. Feature subspaces are ordered relative to their importance. Individual numeric values next to each feature represent that feature's importance for the final learner. The features are sorted per-type. Note the word_features and their alignment with what a human would associate with hate speech.

char_features	ta s : 3.56	ni d : 2.73	lič : 2.69	ola : 2.58	ne m : 2.5
relational_features_token	pa–3–je : 2.23	pa–2–se : 2.12	v–2–pa : 1.78	ne–1–pa : 1.75	v–2–se : 1.71
pos_features	nnp nn nnp : 1.77	nnp jj nn : 1.75	nnp jj : 1.57	cc : 1.46	nn nn rb : 1.45
word_features	idioti : 1.09	riti : 0.95	tole : 0.95	sem : 0.94	fdv : 0.93
relational_features_char	e–3–d : 1.74	i–3–s : 1.56	n–3–z : 1.48	h–5–v : 1.43	z–4–t : 1.4
topic_features	topic_12 : 0.14	topic_2 : 0.02	topic_0 : 0.0	topic_1 : 0.0	topic_3 : 0.0
keyword_features	007amnesia : 0.0	15sto : 0.0	24kitchen : 0.0	2pira : 0.0	2sto7 : 0.0

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SiDeGame: An Online Benchmark Environment for Multi-Agent Reinforcement Learning

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ABSTRACT

Modern video games present a challenging benchmark for artificial intelligence research. Various technical limitations can often lead to playing interfaces that are heavily biased in terms of ease of learning for either humans or computers, and it is difficult to strike the right balance. In this paper, a new benchmark environment is presented, which emphasises the role of strategic elements by enabling more equivalent interfaces, is suitable for reinforcement learning experiments on widely distributed systems, and supports imitation learning, as is demonstrated. The environment is realised as a team-based competitive game and its source code is openly available at a public repository.

KEYWORDS

simulation environment, multi-agent system, deep neural networks, imitation learning, reinforcement learning

1 INTRODUCTION

Reinforcement learning is a powerful concept that can be used to take on highly complex challenges. In its advancement, video games have emerged as suitable benchmarks: they define clear goals, allow agents to be compared between themselves and with humans, and, in comparison to preceding milestones [7], they begin to incorporate complexities of the real world.

Success has been achieved even in notably difficult tasks, such as the modern games of StarCraft II [8] and Dota 2 [1]. However, being modern games, the authors were forced to compromise: the intricate and graphically intensive input spaces had to be simplified and transformed, while combinatorically overwhelming action spaces were functionally changed until superhuman performances could, as well, be attributed to advantages of different playing conditions.

Search for examples that could compare in strategic depth and cultivate a competitive player base, while enabling consistent interfaces and being open to researchers leaves few options but to create one anew. This has led us to create *SiDeGame*, the "simplified defusal game" (abbrev. SDG), which incorporates key rules of an established video game title in a computationally and perceptively simpler simulation environment, accessible at: `https://github.com/JernejPuc/sidegame-py`

2 RELATED WORK

Importance of an even playing field has been emphasised by authors of the For The Win (FTW) agents [4], playing a form of "capture the flag" in first-person view, while using similar input and output schemes to those of human players. However, the project is based on an inaccessible implementation of a fundamentally shallow game mode, which makes it untenable as a benchmark for reinforcement learning. Nonetheless, it shows a type of game that can suit the given requirements.

The first-person shooter (FPS) genre has many interesting representatives, some of which have already been repurposed as reinforcement learning environments [4, 5]. Unsuitably, they tend to revolve around simpler content, such as single-player or deathmatch scenarios, and are not straight-forward for researchers to customise. Indeed, accessibility and modifications generally require developer support and cooperation [6].

Confronted with this barrier, recent work on Counter-Strike: Global Offensive (CSGO) [6] resigned itself to the limits of imitation learning, which could be facilitated by external recording of public matches. Although CSGO's standard competitive mode is fittingly strategic, it, instead, focused on the mentioned deathmatch, and withheld information from agents by ignoring sound and having them use cropped and downscaled image inputs with common information omitted or rendered unrecognisable.

This paper also considers imitation learning, in attempt of establishing a baseline and starting point for eventual reinforcement learning, akin to the approach of AlphaGo [7] and AlphaStar [8]. The deep neural network architecture that was used in these experiments accepts audio inputs similarly to instances from the literature [3], which convert sounds into their frequency domain representations using the discrete Fourier transform.

3 THE SDG ENVIRONMENT

SiDeGame relies on the game rules of CSGO to provide a foundation of notable depth. Crucially, the observation space is simplified by viewing the environment from a top-down perspective in low resolution to allow modern deep neural networks to process it directly. Consequently, not all aspects of the game could be reasonably adapted and the action space could not be fully preserved, yet the playing experience remains egocentric and is largely consistent with true first-person control schemes.

3.1 Description

By the rules carried over from CSGO, two teams of 5 players each asymmetrically compete in attack and defence: the goal of one team is to detonate a bomb at one of two preset locations, while the goal of the other is to prevent them from doing so. After a certain number of rounds, the teams switch sides, and the first to pass a threshold of rounds won is declared the winner.

In the course of a round, players must navigate a map, an artificial environment with carefully placed tactical elements of various degrees of passage and cover. Besides weaponry, a player can utilise auxiliary equipment, the availability of both of which depends on prior survival and economic rewards.

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Figure 1: Screenshots of various views encountered in SiDeGame.

Additionally interesting for AI research are aspects of the game that encourage or demand active coordination, such as shared economy, unassigned roles, and imperfect information on teammates' status and surroundings.

3.2 Observations

The majority of information is provided through the image display, several screenshots of which can be seen in Figure 1. Images are generated at a low base resolution of 256×144 pixels, constraining the visual elements to be small and carefully placed, while remaining easily distinguishable. The human interface simply upscales the display with nearest neighbour interpolation, ensuring equivalence of available information.

The main view is based on projection of the radar image of a classic CSGO map, *Cache*, which has only minor vertically overlapping components and thus proved easiest to adapt. Alternative views include the inventory wheel, map plan, and communication wheels. The latter are used to construct short messages of grounded signs that are appended to the chat log in the sidebar and allow explicit coordination within the team.

Since projection is egocentric, the prominent role of sound is retained: other agents out of line of sight may still give off some information regarding their relative position, equipment, and preparedness. To support the advantages of awareness of sound, spatial audio is implemented by convolving sound signals with HRIR filters [2], while amplitude and frequency attenuation characteristics were empirically formulated. SiDeGame supports conversion of sounds into spectral vectors, which were used in the experiments of this work directly, but can also be accumulated and later processed in the form of a spectrogram.

If there is a delay between action inference and its effect in the environment, an input analogous to proprioception can also be considered. It can be trivially simulated by tracking the effective mouse and keyboard states, i. e. which keys are pressed and how the cursor is moving at a given time.

3.3 Actions

The game expects 19 binary inputs, corresponding to distinct key presses, one ternary value for scrolling the chat log, and two real values for controlling cursor movement. In general, combinations of these can legitimately be executed simultaneously, providing no benefit to the use of compound actions.

It should be noted that some of the keys, pertaining to alternative views or otherwise functional when kept held down, expect unperturbed presses lasting several seconds. For stochastic policies, where actions during training are sampled, this duration could be long enough to cause even minute probabilities to be eventually expressed, causing unintended consequences and leading to practically unplayable conditions. Training regimes should, for example, reduce the regularity of sampling, bound sampling within acceptable thresholds, or use more sophisticated contextual rules to confirm the agent's intent.

3.4 Execution

Multi-agent interaction is built upon separate server and client processes regularly exchanging state and event information via packet communication using the UDP protocol. Simulations are intended to run in real-time, but can have their tick rate and time scale adjusted on both authoritative and local ends.

With the exception of pixel-wise iteration for tracing lines of sight and disregarding the dependencies of imported extensions, the environment is fully implemented in the Python programming language. Despite clear inefficiencies, this development choice streamlines integration with machine learning solutions, which predominantly relate to the Python ecosystem, and eases code readability and customisation. Server and client processes are spawned as single Python processes that are restricted to the CPU, enabling mass parallelisation and preserving GPU resources for learning processes.

For AI agents, development targeted 30 updates per second, which had been deemed acceptable to human opponents, although higher tick rates can be achieved at both the original (144p) and reasonably upscaled (e. g. 720p) resolutions. This could also be used to speed up the simulation, subject to the computational stability and potential overhead of a specific configuration.

3.5 Online Play

In the context of agent evaluation and comparison, capability of online play, where actors, both human and artificial, can compete remotely and without having to share their program, is an essential component, as outcomes of adversarial games cannot be compared in isolation.

Feasible physical distance between actors in a match is experientially limited by temporal delays that arise from communication steps in the client loop. Inclusion of select networking concepts, such as client-side state prediction and reconciliation, foreign entity interpolation, and server-side lag compensation, should maintain playable conditions to a large extent even among international participants.

In extrapolation, online play could also support widely distributed multi-agent reinforcement learning experiments in the form of large-scale population-based training [4, 8]. These are subject to training and inference data transfer constraints, which can be alleviated by slowing down the simulation and having the data pass fewer bottlenecks. In a general configuration, multiple process groups each reserve a subset of agents (unique model parameters) from the global pool and train them with locally distributed processes, while their instances participate in shared matches, as depicted in Figure 2.

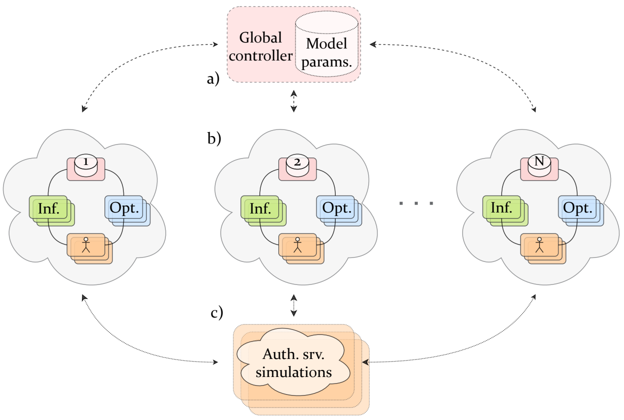

Figure 2: Online multiplayer reinforcement learning: a) The global controller process oversees all of the models in a population of agents, ensuring they are not simultaneously being updated by any two process groups. b) Process groups consist of a local controller and locally distributed inference, optimisation, and actor processes. c) All actor instances may interact through remote environments simulated by authoritative servers.

3.6 Replay System

The packets of information that a client exchanges with the server in the course of a session are made to be sufficient to faithfully reproduce the player's perspective. Byte strings can be gathered, annotated, and saved as binary files, which can then be replayed in real-time or manually stepped to inspect and extract the player's observations and actions, statistics, or other aspects of the underlying game state. Replays are an important resource for review and analysis of competitive games, but were primarily included in SiDeGame for the purposes of imitation learning.

4 SUPERVISED LEARNING BASELINE

Within the limits of available computational resources and in view of the scale of exemplary projects [1, 8], the estimated level of parallelisation, required for meaningful results of reinforcement learning experiments in an acceptable time frame, could not be reached. Instead, a baseline and a starting point for reinforcement learning was attempted to be achieved with imitation learning, a form of supervised learning from demonstrations.

4.1 Agent Model Architecture

The agent's policy was modelled as a parameterised deep neural network according to the architecture depicted in Figure 3.

The model is composed of common elements: residual convolutional blocks, recurrent cells, and fully-connected layers, forming recognisable sub-networks, such as the recurrent core, which provides the agent with memory and delay compensation, input encoding pathways, and distinct output heads.

The irregularity of visual encoding stems from the consideration that, while visual elements are simple, the display includes

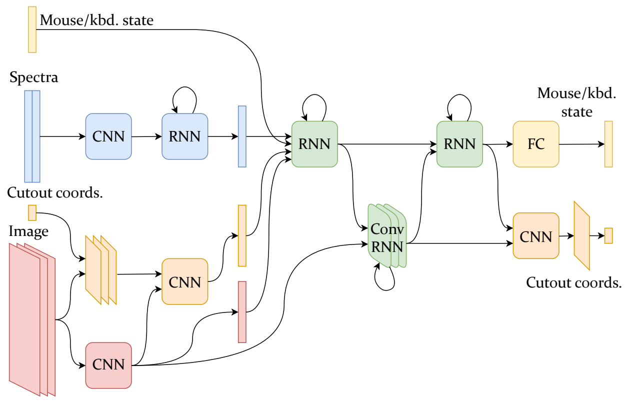

Figure 3: The deep neural network architecture used in our experiments: The visual (red), audio (blue), and mouse/keyboard state (yellow) encoding pathways converge in the recurrent core (green). Moreover, visual encoding splits off into focused encoding by cropping the input image as specified by the cutout coordinates (orange).

many of them and is relatively dense, hinting at the inevitability that not all bits of visual information can be equally accounted for at any given time. Generally, this could be addressed with sufficiently high model capacity and appropriate use of attention-based layers. In this work, however, the visual pathway was explicitly split into primary and focused visual encoding, based on the intuition of human visual perception, where only a small part of our field of view is perceived in sharp detail.

Instead of ingesting full-scale image data, focused visual encoding processes cutouts of much smaller size, so that singular entities can be unambiguously observed. The cutout coordinates are obtained from a spatial probability distribution along with future mouse and key states as outputs of the network. If they were, instead, determined internally, the cropping operation would need to be differentiable, which could prove hard to satisfy.

4.2 Imitation Learning

Imitation learning aims to align the agent's behaviour to that of a number of demonstrators, e. g. experienced humans. Among its basic methods is behavioural cloning, which relies on a dataset $D = \{\{o_1, a_1\}, \ldots, \{o_N, a_N\}\}$ of pairs of observations o and target actions a. The agent with parameterisation θ is tasked to predict for each observation o_i such an action $\hat{a}_i$ to satisfy the following optimisation problem:

$$\theta^* = \arg\min_{\theta} \frac{1}{N} \sum_{i=1}^{N} L(a_i, \hat{a}_i), \tag{1}$$

where the loss function L, evaluating similarity between predicted and imitated actions, is dependant on the form of the action space.

In this experiment, all outputs of the model were made discrete and the loss function formulated as an average of cross-entropy terms for T sub-actions of C categories:

$$L(a_i, \hat{a}_i) = -\sum_{t=1}^{T} \left(\sum_{c=1}^{C_t} a_i^{t,c} \log \hat{a}_i^{t,c} \right) \tag{2}$$

After the gradients are numerically computed with regards to the depth of truncated backpropagation through time, parameter updates are applied using one of the standard optimisation algorithms.

4.3 Demonstrations

A collection of replays was recorded from a short session between 10 demonstrators of negligible experience with SiDeGame, but with varying degrees of familiarity with related video games. Seven hours or 770,000 samples of total play were obtained at 30 frames per second, which is unideally low, especially since samples and episodes are highly correlated.

Main sub-actions were extracted from mouse and keyboard states, while focused cutout coordinates would require logistical and sensory measures that were infeasible to procure. Instead, the coordinates were manually labelled by viewing replays at 75% speed and tracing paths between estimated points of contextual interest. These labels, while not ideal, fared noticeably better than synthetically generated pseudo-labels.

Amid data extraction, observation-action pairs had actions shifted by 6 steps, conditioning the model to predict actions after a temporal delay close to the human response time.

4.4 Results

The neural network, consisting of approx. 2.9M parameters, and training procedure were implemented using the PyTorch package.

For training, a machine with 4 Nvidia 1080Ti GPUs was available. Each GPU corresponded to an optimisation process, which received an approximately equal share of training sequences and progressed them chronologically in batches of 12 sequences and epochs of 30 steps. After every epoch, the gradients with regard to the loss were computed with truncated backpropagation through time separately on each GPU, synchronously averaged between them, and used to separately update their copy of the model parameters using the AdamW optimisation algorithm with a cosine 1-cycle learning rate schedule.

The main training process ran for 300,000 steps over 6 days. The large variance in the loss in Figure 4 can be attributed to differences between game phases and subtler characteristics of demonstrators, which were found to be distinct from degrees of capability and activity.

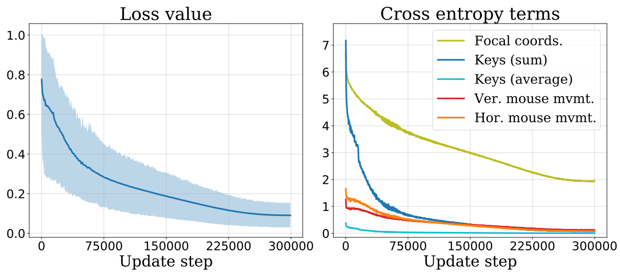

Figure 4: Loss progression over the course of training. Left: Average loss value enveloped by minimum and maximum evaluations. Right: Averages of constituent terms.

Figure 4 shows that, by the end of the training schedule, only imitation of focal coordinates leaves room for improvement, while other terms in the loss function have already overfitted. Due to the relatively small size of the network, overfitting had been underestimated, although the outcome could have been inevitable with the given amount of data.

In practice, the trained agent's behaviour was greatly sensitive to even imperceptibly slight changes in starting conditions. Its switching between alternative views was debilitatingly chaotic and had to be suppressed to allow expression of other behaviours. It seemed to respond to the presence and movement of other entities in its vicinity, was able to navigate across the map towards a tactical objective without hindering collisions and seemingly hide behind cover, but failed to demonstrate offensive behaviour.

5 CONCLUSIONS & FUTURE WORK

Attributing the shortcomings of recent works in deep reinforcement learning to inconsistencies between human and AI interfaces, a new benchmark environment has been created in the form of a lightweight multi-agent game with various tools for training and evaluation of agents. In addition to addressing these concerns, the simulation environment is based on a renowned tactical video game, providing interesting challenges for AI research, particularly in domains of sound and explicit communication.

In approaching the game with imitation learning, the trained agent failed to develop practically meaningful behaviours when trained on arguably few demonstrations and was found lacking as a starting point for reinforcement learning experiments. Nevertheless, the presented agent model architecture is general enough to be applicable to other common tasks with standard computer peripherals and lends itself to further experimentation.

Online characteristics of the created environment hint at its potential for large-scale reinforcement learning experiments, with its accessibility and adaptability allowing the AI community to explore this and other directions. At the same time, certain components of the environment that are not specific to AI research could also prove useful to a wider community, outside of the scope of its primary intent.

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Question Ranking for Food Frequency Questionnaires

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ABSTRACT

Food Frequency Questionnaires (FFQs) are probably the most commonly used dietary assessment tools. In the WellCo project, we developed the Extended Short Form Food Frequency Questionnaire (ESFFFQ), integrated into a mobile application, in order to monitor the quality of users' nutrition. The developed questionnaire returns diet quality scores for eight targets — *fruit intake*, *vegetable intake*, *fish intake*, *salt intake*, *sugar intake*, *fat intake*, *fibre intake* and *protein intake*. This paper explores the single-target problem of question ranking. We compared the question ranking of the machine learning algorithms on three different types of features for classification and regression problems. Our findings showed that the addressing problem as a regression problem performs better than treating it as a classification problem and the best performance was achieved by using a Linear Regression on features, where answers were transformed to frequencies of consumption of certain food groups.

KEYWORDS

nutrition monitoring, FFQs, question ranking

1 INTRODUCTION

Adopting and maintaining a healthy lifestyle has become extremely important and healthy nutrition habits represent a major part in achieving this goal. Self-assessment tools are playing a big role in nutrition monitoring and many applications are including Food Frequency Questionnaires (FFQs) as a monitoring tool, due to they in-expensiveness, simplicity and reasonably good assessment [8, 3]. An FFQ is a questionnaire that asks the respondents about the frequency of consumption of different food items (e.g., "How many times a week do you eat fish?"). In the EU-funded project WellCo we developed and validated an Extended Short Form Frequency questionnaire (ESFFFQ) [5] that was included in a health coaching application for seniors.

Cade et al. [2] suggest that for assessment of dietary data short FFQs could be sufficient and that marginal gain in information is decreasing with extensive FFQs. Block et al. [1] concluded that longer and reduced return comparable values of micronutrients intake. Taking this idea a step forward, we explored the possibilities to get the most information even if one does not answer the whole questionnaire. In our previous work we explored how to find the smallest set of questions that still provides enough information by applying different feature selection techniques [6, 7].

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This paper explores the ranking of questions and is the next step from our previous work. With ranking the questions by importance and asking them in the ranked order, it can be expected that quality of predictions will improve with each additional answer and we are not limited with the constraint that certain number of questions should be answered. We addressed the problem as a single-target problem for classification and regression. Additionally, we tested the algorithms on different representations of features for both type of problem. The findings of this paper could be used for setting the baseline for our future research.

2 METHODOLOGY

2.1 Problem outline

In our previous research [6, 7] we tried to find subsets of questions that would allow us to ask the users about their dietary habits with as few questions as possible and still get sufficient information to evaluate their nutrition. For this we used the Extended Short Form Food Frequency Questionnaire (ESFFFQ) [5]. The questionnaire returns diet quality scores scores for *fruit intake*, *vegetable intake*, *fish intake*, *salt intake*, *sugar intake*,*fat intake*, *fibre intake* and *protein intake*. We calculate the nutrient intake amounts and from there we further calculate the diet quality scores.

The questionnaire was included in a mobile application, where the system asked the users about their diet with one or two questions per day. The answers were saved into a database and every fortnight the quality scores were recalculated. As it could happen that the users did not answer all the questions by the time the recalculation was done, it was of great importance to ask the questions in the right order. In the terminology of machine learning this would be a feature ranking problem. We explored the problem as a set of single-target problems — separately for individual outcome scores. As three of the diet quality scores (*fruit*, *vegetable* and *fish intake*) are only dependent on one or two questions, the problem of feature ranking is trivial. Therefore we explored the problem for the remaining five targets — *fat intake*, *sugar intake*, *fibre intake*, *protein intake* and *salt intake*.

2.2 Dataset

We got the answers to ESFFFQ from 92 adults as a part of the WellCo project and additionally from 1039 adults included in SIMenu, the Slovenian EUMenu research project [4]. The questions included in the ESFFFQ were a subset of the questions in the FFQ in SIMenu. Furthermore, the answers (consumption frequencies) were equivalent in both questionnaires, and consequently extracting the answers from SIMenu and adding them to the answers from the ESFFFQ was a very straightforward task.

2.3 Feature ranking

To do the experiments, we first randomly split the data into validation and training sets in ratio 1:3. To train the models and rank the features we then used 4-fold cross-validation on the training set and used the average feature importance from all 4 folds as the final feature ranking.

The ranked features were used to predict quality scores (classification problem) and nutrient amount (regression problem), by adding the question as they were ranked. In this paper we present the results for two commonly used machine learning algorithms — Logistic/Linear Regression and Random Forest Classifier/Regressor. To rank the features we used the absolute value of the coefficients in the Linear/Logistic Regression and the `feature_importance` attribute as implemented in the Random Forest Classifier/Regressor in the `sklearn` library.

Additionally we compared different feature representations — features where answers are represented with nominal discrete equidistant values (once per week is represented as integer 2), features where answers were transformed into frequencies of consumption (once per week is represented as approx. 0.14 per day) and features where answers were transformed into amounts of nutrients (once per week is represented as grams/day). In the last represenation, the features differed between the targets *sugar*, *fat*, *salt*, *fibre* and *protein*. We ran the experiments for five diet categories (*fat intake*, *sugar intake*, *fibre intake*, *protein intake* and *salt intake*) for both classification and regression problem. In both cases we started with the best ranked question, trained the model and compared results on train and validation sets. Then we added the second best ranked question, trained the models and compared the results. We added the questions one by one until the last one.

3 RESULTS

3.1 Classification problem

For classification we tried to predict the quality scores for each of the five nutrition categories. There were three scores - 2 (good), 1 (medium) and 0 (bad). The distribution of the scores for all the categories is shown in Table 1.

Table 1: Distribution of target values for classification

Score	Fat	Sugar	Fibre	Protein	Salt
2	51%	74%	26%	79%	32%
1	31%	14%	22%	13%	47%
0	18%	12%	52%	8%	21%

We compared Random Forest Classifier and Logistic Regression for three different types of features - discrete equidistant answers, answers transformed to frequencies and answers transformed to amounts.

Fat. For Random Forest (RF) there was not a big difference between the three representations of the features. With all three, the highest accuracy on the validation set (79%) is achieved with 5 questions and afterwards the accuracy starts falling and stays on the interval between 75% and 79%. This clearly indicates overfitting, which is confirmed by the fact that the accuracy for RF on the training set was 100% from the fifth question. A similar situation happened for all the remaining targets and will not be repeated in the following subsections. On the training set Logistic Regression (LR) had worse results than the RF and it also performed the worst from all algorithms when run on the discrete features. However, when the features are transformed into frequencies or amounts, we get better results on the validations set than with RF.

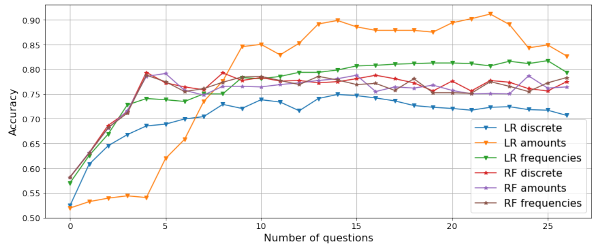

Figure 1: Results on validation set for *fat intake*

Sugar. For *sugar intake* the story is very similar. RF performed fairly well for the first few questions and then the accuracy began to fall. The best performing algorithm was the LR on the features (Figure 2, where the answers were transformed into frequencies.

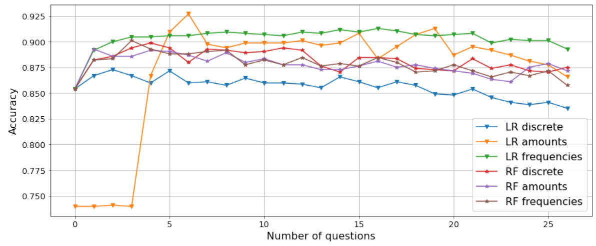

Figure 2: Results on validation set for *sugar intake*

Fibre. For *fibre intake* the RF algorithms performed better for a very long time (Figure 3) and it reached the best accuracy after 6 questions. The LR performed worse, and it did similarly badly on the training set as well.

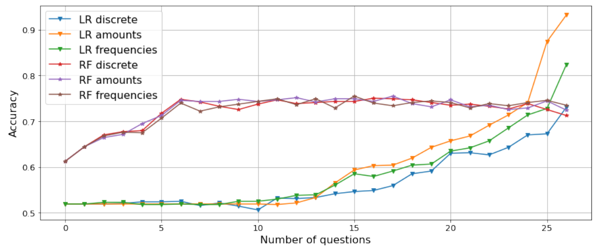

Figure 3: Results on validation set for *fibre intake*

Protein. For *protein intake* (Figure 4) the results are similar to those for *fibre intake*. However, in case of *protein intake* the majority class is 79% and most of the algorithms almost never exceeded this value.

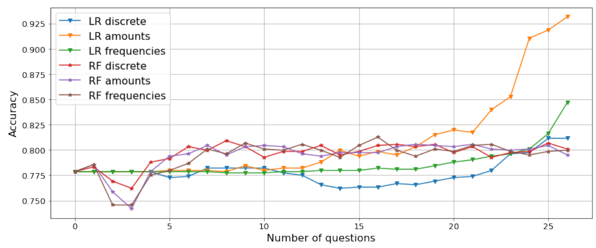

Figure 4: Results on validation set for *protein intake*

Salt. For *salt intake* the best model is the LR on the answers transformed to amounts. As seen in Figure 5, it exceeded the RF algorithms for almost 20% from eleventh added question on and predicted the quality scores with more than 90% accuracy with only 14 questions, which is half of the questionnaire.

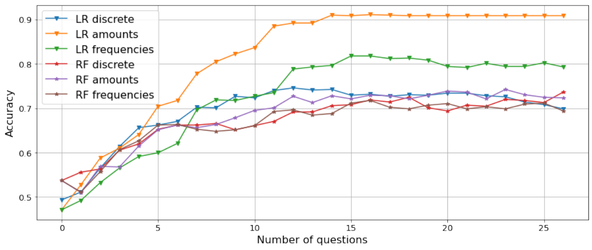

Figure 5: Results on validation set for *salt intake*

3.2 Regression problem

While knowing the quality score is a valid first information whether one's diet is good or not, generally more interesting information is how good (or how bad) it really is. Therefore it is reasonable to look at the same problem as a regression problem , where we try to predict the actual amount (in grams) of consumed nutrients. Again we explored the performance of Random Forest Regressor (RF) and Linear Regression (LR) on the three previously described feature sets.

Table 2: Nutrient intake in grams/day to quality scores

Score	Fat[g]	Sugar[g]	Fibre[g]	Protein[g]	Salt[g]
2	≤ 74	≤ 55	≥ 30	≥ 55	≤ 6
1	else	else	else	else	else
0	≥ 111	≥ 82	≤ 25	≤ 45	≥ 9

Fat. The best performing algorithm for *fat intake* was the LR on the answers transformed to frequencies. The overfitting of the RF is even more visible than with the classification problem as the errors for these models did not fall under 20 grams even if all the questions were used, while the error of the LR on the feature sets where the answers are transformed to frequencies or amounts was smaller than 5 grams from eleven included questions (Figure 6).

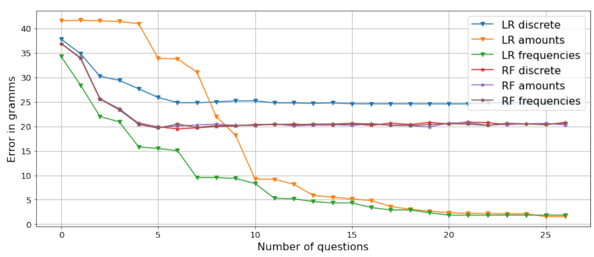

Figure 6: Results on validation set for *fat intake*

Sugar. Similarly to *fat intake*, LR with the 'frequency features' performed best (Figure 7). However the LR on the 'amounts features' performed well for more than 15 questions, but predicted the worst for the first eleven included questions.

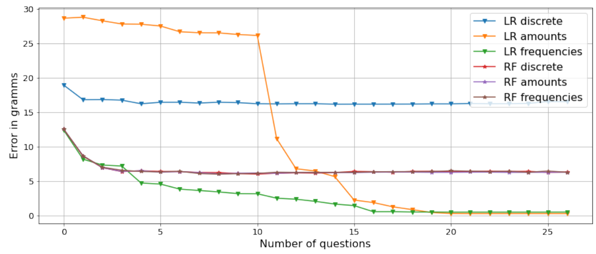

Figure 7: Results on validation set for *sugar intake*

Fibre. Classification for *fibre intake* was very bad, however, when considering it as a regression problem, the LR on 'frequency' features' predicted the amounts with error smaller than 2 grams when more than eleven questions were used 8. Considering Table 2 this means that predicting how bad/good the *fibre intake* was done better then predicting if it is bad or good.

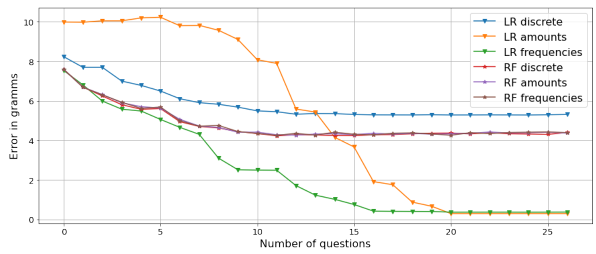

Figure 8: Results on validation set for *fibre intake*

Protein. For *protein intake* all algorithms had a similar performance up to ten included questions, however, the LR on the 'frequency features' started to perform better and better with each added questions and predicted the amount of protein consumption with error of 5 grams (Figure 9).

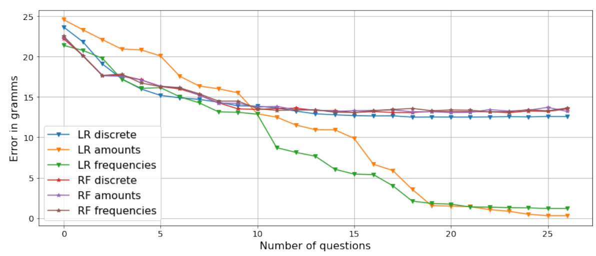

Figure 9: Results on validation set for *protein intake*

Salt. Similarly to the *protein intake* all algorithms performed with a comparable error up to nine included questions, and after that LR using the features transformed to frequencies started to perform way better and predicted *salt intake* with error smaller than 1 gram with eleven included questions (Figure 10).

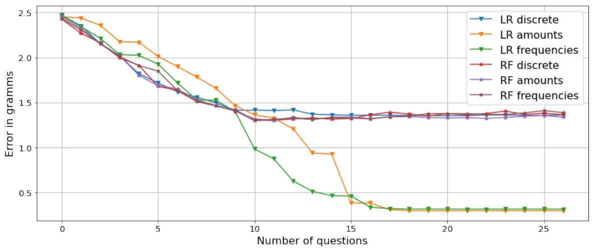

Figure 10: Results on validation set for *salt intake*

3.3 Discussion

We compared performance of feature ranking for two different machine learning algorithms on three different types of features for both classification and regression problems. While the classification problem might give the general idea about one's dietary habits, it is inclined towards overfitting even for very simple models, such as Logistic Regression, while more complex algorithms, Random Forest Classifier in our case, are even more subject to this deficiency. By predicting amounts instead of quality scores, one gets information about how good/bad the dietary habits are instead of just if they are good or bad.

Transforming features from discrete equidistant values to frequencies or amounts of nutrients proved to be a very good approach. The transformation gave better results for both classification and regression problem for both Random Forest Regressor/Classifier and Logistic/Linear Regression. While the performance of both algorithms on features transformed to frequencies and features transformed to amounts for the classification problem was comparable, and Linear Regression on features transformed to amounts gave markedly better results for *salt intake*, the Linear Regression on features transformed to frequencies outperformed all other combinations of features and algorithms for the regression problem for all of the targets. The reason for this is that linear regression on amounts is a very good match in the sense that the target variable (total amount) is the sum of all features (partial amounts).

Transforming the features to frequencies instead to amounts has another advantage — frequencies transformed to amounts are specific to each target, while features transformed to frequencies are equal for all targets. This is an important finding for possible future research where one would address ranking of questions as a multi-target problem. Additionally, regression problem using Linear Regression on features transformed to frequencies could solve as a baseline for future experiments.

4 CONCLUSION AND FUTURE WORK

Ranking the questions of FFQs when it could be expected that not all of the questions will be answered is an important step when building models for predicting quality of one's diet. In this paper we compared two feature ranking algorithms on three different types of features for classification and regression problem for five targets. The findings of this paper show that considering the problem as a regression problem on features transformed to frequencies and using a simple machine learning algorithms (Linear Regression) gives the best results for all five targets and provides baseline for future experiments.

There are several possibilities for future work. As hinted in the previous section, the question of multi-target question ranking is one of the first that appears — one might want to monitor several nutrition quality scores but still would want to avoid answering too many questions. Next, probably more important and interesting research problem, is how to use the answers already provided to our advantage — so instead of statically ranking the questions we would rather explore how we could improve the prediction performance by dynamically ranking and asking the questions.

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Daily Covid-19 Deaths Prediction For Slovenia

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ABSTRACT

In this paper, models for predicting daily Covid-19 deaths for Slovenia are analysed. Two different approaches are considered. In the first approach, the models were trained on the fist wave dataset of state intervention plans, cases and country-specific static data for 11 other European countries. The models with the best performance in this case were the k-Nearest Neighbors regressor and the Random Forest regressor. In the second approach, a time-series analysis was performed. The models used in this case were Seasonal Autoregressive Integrated Moving Average Exogenous and Feed forward Neural Network. For comparison, all 4 models were tested on the second wave for Slovenia and the model with the best performance was Feed forward Neural Network, with a mean absolute error of 1.34 deaths.

KEYWORDS

Covid-19, deaths, predictions, machine learning

1 INTRODUCTION

The aim of this analysis is to find out whether we can predict Covid-19 deaths for Slovenia based on the characteristics of the epidemic in other European countries, and whether we can predict deaths based on a time series analysis of historical data (e.g. predicting for the second wave based on the first wave information). The main advantage of the first approach is that we do not need historical case and death data for the country for which we are making a prediction (in this case Slovenia), while the second approach is generally more accurate but relies on historical death data. The aim is also to find out which of the two approaches provides more accurate predictions. It is important to note that although this is a study for Slovenia, the results can be interpreted as a general assessment of the effectiveness of the methods described for predicting Covid-19 deaths and can be applied to any country for which the data are available.

The data used in this analysis are described in Section 2. Section 3 provides a description of the approaches and the models. Section 4 contains a discussion of the determination of the optimal parameters of the selected models. The results are given in Section 5. The conclusion, along with ideas for possible improvements, is given in Section 6.

2 DATA DESCRIPTION AND PREPARATION

The data used in this paper consist of daily Covid-19 related features at the country level. It contains 12 different Covid-19 related government interventions (school closing, workplace closing, cancel public events, restrictions on gatherings, close public transport, stay at home requirements, restrictions on internal movement, international travel controls, public information campaigns, testing policy, contact tracing, and facial coverings), Covid-19 related cases and deaths, and some static data, in particular the country's population, population density, median age, percentage of people over 65, percentage of people over 70, gdp per capita, cardiovascular death rate, diabetes prevalence, percentage of female and male smokers, hospital beds per thousand people, and life expectancy. To suppress anomalies in registered cases on Sundays and holidays, a 7-day moving average was used for both cases and deaths. The dataset covers the European countries of Slovenia, Italy, Hungary, Austria, Croatia, France, Germany, Poland, Slovak Republic, Bosnia and Herzegovina, and the Netherlands from January 22, 2020 to December 11, 2020. All of the countries chosen for this study are geographically next to one another and are thus expected to have similar course of epidemic. The data on government interventions, cases and deaths are derived from the "COVID-19 Government response tracker" database, collected by Blavatnik School of Government at Oxford University [4]. The intervention values range between 0-4 and represent their strictness, for example, if only some or all schools are closed. The static data are collected from a variety of sources (United Nations, World Bank, Global Burden of Disease, Blavatnik School of Government, etc.) [3]. The original data are publicly available online. The processed data used for the purpose of this study can be found online at https://repo.ijs.si/davidsusic/covid-seminar-data.

3 METHODS AND MODELS

Two different approaches were considered for the analysis. For the first part of the analysis, referred to as the country-specific approach, the models were trained on the data of government intervention plans, cases, deaths and country-specific static data for the 10 other European countries, with the aim of predicting deaths for Slovenia. In this case, the predictions were made for each day, disregarding the time order. For the second part of the analysis, a time series prediction was performed, using only the daily deaths for Slovenia as data.

3.1 Country-Specific Approach

In the country-specific approach, the selection of the base model was very important, as models that perform worse than the base model are not worthy of interpretation. The baseline was defined as

$$N_{\text{deaths}}(t) = N_{\text{cases}}(t-14) \cdot M, \tag{1}$$

where $M = 0.023$ is the mortality rate factor of those infected, calculated as a weighted average of the mortality rates of the countries included in this study [2], and t denotes a specific day. This simple model implies, that the number of deaths on a given day t is equal to the number of new infections on the

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day $t - 14$, multiplied by the mortality rate factor. The regressor model that were tested are: Random Forest (RF), k-Nearest Neighbors (KNN), Stochastic Gradient Descent, Ridge, Lasso, and Epsilon-Support Vector. Description of all of the models can be found in the Python scikit-learn documentation [5]. The two that performed significantly better than the baseline were the KNN regressor and RF regressor. Other regression models performed the same or worse than the baseline model and were thus not used in the further analysis. All models were tested in the 10-fold cross-validation with the performance measures mean absolute error (MAE), mean squared error (MSE) and R^2 score on the data subset that does not include Slovenia. The measures are defined as:

$$\mathrm{MAE}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n-1} |y_i - \hat{y}_i|, \tag{2a}$$

$$\mathrm{MSE}(y, \hat{y}) = \frac{1}{n} \sum_{i=0}^{n-1} (y_i - \hat{y}_i)^2, \tag{2b}$$

$$R^2(y, \hat{y}) = 1 - \frac{\sum_{i=1}^{n} (y_i - \hat{y}_i)^2}{\sum_{i=1}^{n} (y_i - \bar{y}_i)^2}, \tag{2c}$$

where $\hat{y}$ is the predicted value of the i-th sample, y_i is the corresponding true value, n is the sample size and $\bar{y}$ is the average true value $\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_1$.

For each sample, additional features of the government interventions and cases were added for the previous days. The number of previous days was defined using the lookback parameter. Models were tested for lookback values between -28 and 0 days. The comparison is shown in Figure 1. It can be seen that the performance decreases in the range where the lookback is shorter than 14 days, but does not increase in the range where the lookback exceeds this value. The main reason for this is probably the fact that most deaths occur within the first 14 days of infection. A lookback of 14 days was used for further analysis as it was found to be the most appropriate.

3.2 Time-Series Approach

In the second approach, a time series analysis was performed. In this case, only daily deaths for Slovenia were used as data. The models used in this case were Seasonal Autoregressive Integrated Moving Average Exogenous (SARIMAX(p,d,q)(P,D,Q,m) [6] and Feed forward Neural Network (FFNN) [1].

The former is a combination of several different algorithms. The first is the autoregressive AR (p) model, which is a linear model that relies only on past p values to predict current values. The next is the moving average MA (q) model, which uses the residuals of the past q values to fit the model accordingly. The I(d) represents the order of integration. It represents the number of times we need to integrate the time series to ensure stationarity. The X stands for exogenous variable, i.e., it suggests adding a separate other external variable to measure the target variable. Finally, the S stands for seasonal, meaning that we expect our data to have a seasonal aspect. The parameters P, D, and Q are the seasonal versions of the parameters p, d, and q, and the parameter m represents the length of the cycle.

The FFNN structure included 10 input perceptrons - one for each death value in the last 10 days, a hidden layer of 64 perceptrons, and 1 output perceptron.

Since the future data of the time series contain the information about the past, a forward chaining approach was performed for

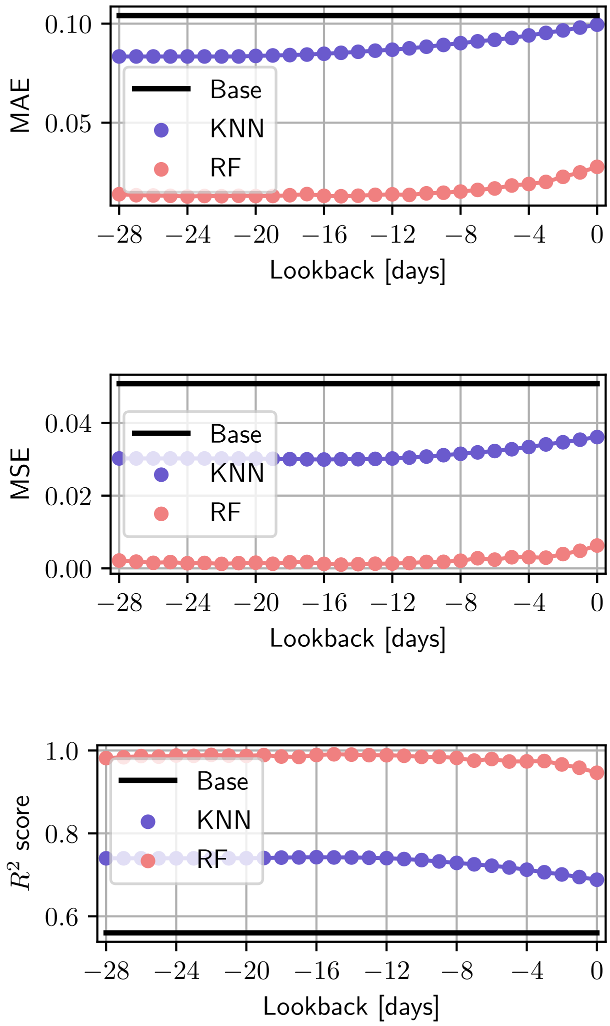

Figure 1: 10-fold cross validation performance measure of the models for different lookback parameter. The measures and its units are are: MAE [deaths/100k] (top), MSE [deaths^2/100k^2] (middle) and R^2 score (bottom)

Table 1: 10-fold cross-validation performance measures of the predictions for 21 days for SARIMAX and FFNN algorithms.

	MAE [deaths]	MSE [deaths^2]	R^2 score
SARIMAX	1.13	4.81	0.71s
FFNN	0.53	1.15	0.88

n-fold cross validation. This means, that there is no random shuffling of the data. The test set must always be the final portion of the data - the final part of the date range. The concept of forward chaining is shown in Figure 2. The results of the 10-fold cross-validation of the predictions for 21 days are shown in Table 1.

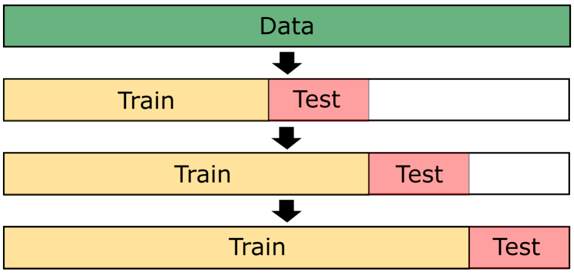

Figure 2: Forward chaining approach to time-series n-fold cross-validation.

4 MODELS' PARAMETERS SELECTION

The next step was to determine the optimal parameters of the selected models. For this purpose, the regressor models were trained on the same dataset used in the 10-fold cross-validation and tested on the data for Slovenia. For this particular case, different model parameters were tested to see which performed best. The MAE [deaths/100k] as a function of parameters K for the KNN and as a function of the number of trees for RF are shown in the Figures 3 and 4, respectively.

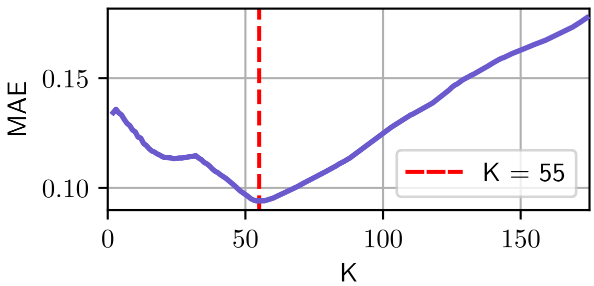

Figure 3: MAE of the KNN regressor as function of K.

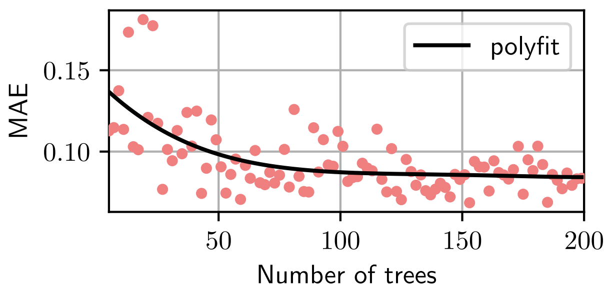

Figure 4: MAE of the RF regressor as a function of the number of trees.

For the KNN regressor, MAE has a minimum at $K = 55$, while for RF the fitting function shows that the appropriate number of trees is 100, since the model does not improve with additional trees at this point. It is important to note that since RF is random in the sense that it randomly selects a subset of features at each splitting decision, the results and hence the performance measures are also somewhat random. However, they do follow a certain trend that becomes apparent when a polyfit is applied. To reduce the randomness of the results, the average of 3 separate predictions was calculated for each number of trees.

To determine the best parameters of the SARIMAX model, the *auto_arima* algorithm from the Python *pmdarima* library was used [7]. The algorithm analyzes the given data and determines the best model and its parameters for that data. In this case, the selected model was SARIMAX(2, 1, 4)(4, 1, 1, 12).

In the case of FFNN, the parameter selection was omitted - the same model structure was always used.

5 RESULTS

With the optimal parameters selected, the graphs of the predictions can be plotted. The predictions of the country-specific approach are shown in Figure 5.

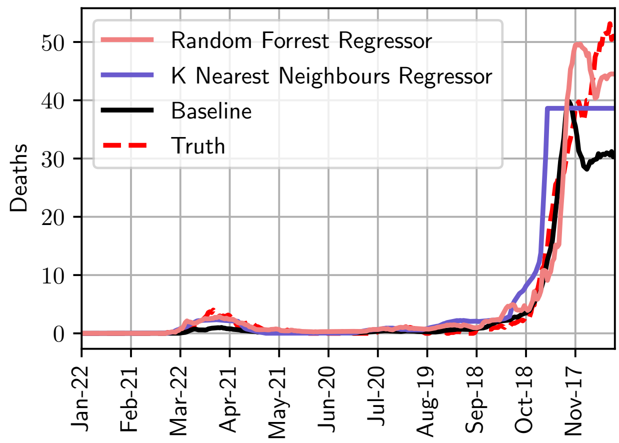

Figure 5: Deaths for Slovenia from 22.1.2020 to 11.12.2020. Models' predictions, compared to true values.

All models predicted the number of deaths for the first epidemic wave fairly accurately. As a result of the unrepresentative reporting of Covid-19 cases for the second wave, the base model predicts a much lower number of daily deaths. We can also see that the KNN regressor predicts the same value from a certain day forward. The reason for this is most probably that the algorithm always finds the same k=55 neighbors, thus always predicts the same value. To avoid this, a larger dataset would be required. MAE for RF, KNN and baseline are shown in Table 2.

Table 2: MAE comparison of the country-specific models for the interval from 22.1.2020 to 11.12.2020.

	RF	KNN	baseline
MAE [deaths]	5.41	5.39	5.48

The predictions for the time interval between 21.11.2020 and 11.12.2020 for the time-series approach are shown in Figure 6. MAE for FFNN and SARIMAX, shown in Table 3, are substantionally lower than MAE of the country-specific models. However, the accuracy decreases as the prediction time interval increases.

Table 3: MAE comparison of the time-series models for the interval from 21.11.2020 to 11.12.2020.

	FFNN	SARIMAX
MAE [deaths]	1.24	2.27

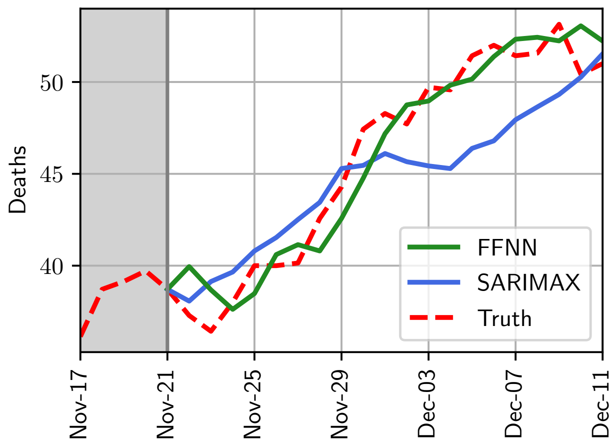

Figure 6: Slovenia deaths from 21.11.2020 to 11.12.2020. Time-series models' predictions, compared to true values.

To determine the overall best model for such predictions, all 4 models were tested on the second epidemic wave. The predictions are visualized in the Figure and the MAEs [deaths] are listed in the Table 4.

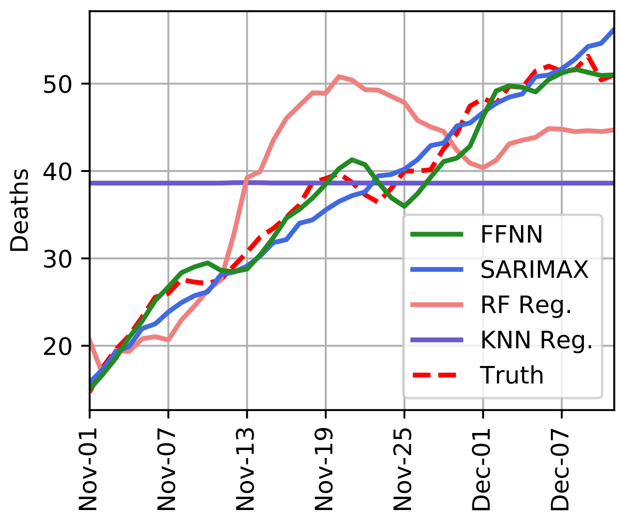

Figure 7: Slovenia deaths from 1.11.2020 to 11.12.2020. Models' predictions, compared to true values.

Table 4: MAE comparison of the models for the interval from 1.11.2020 to 11.12.2020.

	FFNN	SARIMAX	RF Reg.	KNN Reg.
MAE [deaths]	1.34	1.67	6.46	8.85

It can be seen that in this case the time-series approach is more accurate than the country-specific one. However, for longer time intervals, the country-specific approach is better because it does not rely on past data. It is important to note that the country-specific models' error are actually lower when making predictions from the start of the epidemic. The reason for this is that for the first 6 months, the numbers of deaths were very low as can be seen in the Figure 5.

The best performing model overall is the FFNN with the MAE of 1.34 deaths. The reason for the best performance of this model is probably that it had a relatively high number of input parameters. The input layer consisted of 10 perceptrons, i.e. each prediction was based on the values of the last 10 days.

6 CONCLUSION

In this paper, two different approaches to predicting Covid-19 deaths for Slovenia were tested. Both approaches turned out to be reliable. The main implications of the presented study are that for short time intervals the time series approach is much more accurate than the country-specific approach. The advantage of the country-specific approach is that it can predict the number of deaths for a given day, based on the number of cases, countermeasures and country-specific static data, without necessarily having information about the past. On the other hand, for the prediction of the second wave, where we already know the course of the epidemic in the first wave, the time series approach is better - at least for the prediction for Slovenia. In the future studies, predictions for the third and fourth waves will be analysed.

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Iris Recognition Based on SIFT and SURF Feature Detection

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ABSTRACT

Human iris recognition is generally considered to be one of the most effective approaches for biometric identification. Identification is required in numerous areas such as security (e.g., airports and other buildings, airports), identity verification (e.g., banking, electoral registration), criminal justice system. This paper presents an approach for iris image classification that is based on two popular algorithms for image feature construction Scale Invariant Feature Transform (SIFT) and Speed Up Robust Features (SURF). Both algorithms were used in combination with the bag of visual words approach to create descriptive image features that can be used by supervised machine learning methods and a set of standard machine learning methods (k-Nearest Neighbor, random forest, support vector machines and neural networks) were evaluated on publicly available iris data set.

KEYWORDS

Iris recognition, image classification, SIFT features, SURF features

1 INTRODUCTION

Biometrics is the science of determining a person's identity and is an important approach for forensic and security identity management. Face, fingerprints, voice and iris are the most commonly used biometrics identifiers for personal identification. They provide characteristics in terms of personal appearance. The biometric system first scans the biometric characteristic, and then, typically based on a library of scans or classification model identifies the person [5].

Typical iris recognition system consists of four key modules: (1) image pre-processing, where the system detects the boundary of the pupil and the outer iris, (2) normalization, where the inner and outer circle parameters obtained from iris localization are given as input. Then, a transformation from polar to Cartesian coordinates is applied which maps the circle (iris) into a rectangle. (3) Feature extraction, where a feature vector is generated using different filters, and (4) comparison, based on different distances (Hamming distance in specific cases) between pairs of transformed iris images and the corresponding masks [10]. The comparison step nowadays frequently implemented with a machine learned classification model.

This work firs uses Scale Invariant Feature Transform (SUFT) and Speed Up Robust Features (SURF) algorithms to extract image keypoints or descriptors and then the bag of visual words to generate image features that can be used by standard supervised machine learning methods. We evaluate our method on a publicly available iris image dataset.

2 RELATED WORK

Iris recognition is frequently used for gender recognition and personal biometric authentication [6, 8, 9]. Ali et. al. applied contrast-limited adaptive histogram equalization to the normalized image. They used SURF and investigated the necessity of iris image enhancement based on the CASIA-Iris-Interval dataset [1]. Păvăloi and Ignat present experiments carried out with a new approach for iris image classification based on matching SIFT on iris occlusion images. They used the UPOL iris dataset to test their methods [6]. Bansal and Sharma use a statistical feature extraction technique based on the correlation between adjacent pixels, which was combined with a 2-D Wavelet Tree feature extraction technique to extract significant features from iris images. support vector machines (SVM) were used to classify iris images into male or female classes [2]. Salve et. al. used an artificial neural network and SVM as a classifier for iris patterns. Before applying the classifier, the region of interest, i.e., the iris region, is segmented using a Canny edge detector and a Hough transform. The eyelid and eyelash effect are kept to a minimum. A Daugman rubber-plate model is used to normalise the iris to improve computational efficiency and appropriate dimensionality. Furthermore, the discriminative feature sequence is obtained by feature extraction from the segmented iris image using 1D Log Gabor wavelet [14]. Adamović et. al. applied an approach that classifies biometric templates as numerical features in the CASIA iris image collection. These templates are generated by converting a normalised iris image into a one-dimensional fixed-length code set, which is then subjected to stylometric feature extraction. The extracted features are further used in combination with SVM and random forest (RF) classifiers [15].

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3 METHODOLOGY

Our iris recognition approach combines image feature generation algorithms SIFT, SURF, bags of visual words model and standard supervised machine learning classification methods. In the following subsections we briefly describe each of these components, and then explain how these components are combined together.

3.1 SIFT

The SIFT algorithm detects a set of local features in an image. These features represent local areas of the image, and the algorithm also computes their description in a form of a vector. The algorithm proceeds in several stages. The first stage of computation is scale-space extrema detection which searches over all scales and image locations. It employs the so-called difference of Gaussian function to identify potential interest points that are invariant to scale and orientation. The second stage localizes each candidate at a location. Keypoints are extracted by detecting scale space extrema. The main idea behind the scale space extrema detection is to identify stable features which are invariant to changes in scale and viewpoint. At this point the keypoint descriptors are extracted [4, 6]. In essence, SIFT describes each image with a set of keypoints, and each keypoint is described with a vector of dimension 128. It is worth mentioning that SIFT can detect different numbers of keypoints in different images.

3.2 SURF

The SURF algorithm is based on similar ideas as SIFT, but their implementation is different. It can be used for similar tasks as SIFT, but it is faster, and produces highly accurate results when provided appropriate reference images. Instead of difference of Gaussian function, SURF uses approximate Laplacian of Gaussian images and a box filter. Determinants of the Hessian matrix are then used to detect the keypoints. A neighbourhood around the key point is selected and divided into sub-regions and then for each sub-region the wavelet responses are taken and represented to get SURF feature descriptor [1, 4]. In the end, each image is again represented with a set of keypoints, which are described with vectors.

3.3 Bag of Visual Words

The *bag of visual words* (BoVW) approach can be used for transforming or tokenizing keypoint-based image features, such as SIFT or SURF, into a fixed number of features, which is typically required by supervised machine learning methods. At first generates a visual word vocabulary from a (training) set of images, and then describes each image with these visual words. The visual word vector of an image contains the presence or absence information of each visual word in the image. In case of SIFT or SURF keypoints, for example, the visual word vector contains numbers of keypoints in an image that are similar to a given visual word. The process for extracting BoVW features from images involves the following steps: automatically detect regions or points of interest, compute local descriptors over those points (in our case, this means employing SIFT or SURF algorithm), quantize the descriptors into words to form the visual vocabulary, for example with a clustering algorithm, and find the occurrences in the image of each specific visual word in the vocabulary (generate a vector of visual word frequencies) [15]. It is worth mentioning that a specific BoVW model is based on a given training dataset and it only includes visual words that appear in the training images.

3.4 Classification Methods

The image classification phase of image analysis can be in principle performed with any machine learning method for classification. We have decided to evaluate a diverse set of standard methods, which we briefly describe in the following paragraphs.

The kNN is a supervised method that can be used for classification and regression. It is a simple algorithm where the classification of new instances is based on the majority class of the k closest training examples. The closeness is measured with a distance measure, which is usually Euclidean, Minkowski or Manhattan distance [9].

RF is a supervised learning algorithm based on the ensemble principle of using decision trees as the basic classifier and creating a learning model by combining multiple decision trees. The main idea of the RF classifier is to create multiple decision trees using a bootstrapped sampling method and introduce randomness in the individual tree building process. The class label of a new example is determined by majority voting of all trees in the ensemble [11].

The neural networks (NN) consist of several layers of simple units (neurons), which are simple functions with weight and bias parameters. Each neuron in one layer is connected to all neurons in the next layer by a process called back-propagation, and uses gradient descent to measure the rate of change of the loss function (e.g. Cross-Entropy loss). NN can have different structures, but typically have an input layer, one or more hidden layers and an output layer. Each of these layers contain one or more neurons [9, 12, 13]. In this work, we used the adam solver function because it is fast and gives good results. It is an optimisation algorithm that uses running averages of the two gradients and other moments of the gradients [13].

For the activation function, we use the logistic or sigmoid activation function. This determines how nodes in the network layer convert a weighted sum of input data into output data. The logistic or sigmoid activation function accepts any real value as input and the output values are from 0 to 1 [12].

Support vector machines (SVM) is a discriminant technique which means that the classification function takes a data point and assigns it to one of the different classes of the classification task. SVM transform the original data with a kernel function in a hyperspace, and then tries to find a hyperplane that distinguishes the two classes optimally. This hyperplane is defined with support vectors and distances between support vectors are maximised. SVM is very effective method for high dimensional problems [2, 14].

3.5 Our Method

Our approach for iris image classification is a based on the bag of visual words model, and we use either SIFT or SURF algorithm for image keypoint detection. In the training phase we perform the following steps.

1. For each image i, the SIFT or SURF algorithm is run, which detects K_i keypoints (each keypoint has $D = 128$ dimensions).
2. We collect keypoints from all training images, that is, $\sum_{i=1}^{n} K_i$ keypoints.
3. We cluster the above set of keypoints with the k-means clustering algorithm. Based on preliminary experimets we decided to use k = 500. The clusters, or their centroids, represent the visual words for our problem of iris recognition.
4. Now, we use the clustering model to assign each keypoint in an image to its nearest centroid (visual word) and sum up the occurrences of these visual words for each image. We end up with image descriptions, where each image is described with a vector of length k.
5. The dataset derived in the previous step can now be used to train a classification model with an arbitrary machine learning method. In our experiments, we have used four methods: k-Nearest Neighbor, Random Forest, Support Vector Machines and Neural Networks.

In the classification phase, when we need to classify a new image, we need to perform three steps.

1. Run the SIFT or SURF algorithm on the new image to detect keypoints (analogous to step 1 in training).
2. Use the clustering model to assign each keypoint to its nearest centroid and sum up their occurrences to derive visual words vector (analogous to step 4 in training).
3. Classify the image with the trained classification model.

We have performed experiments with two keypoint detection algorithms (SIFT and SURF) and four classification algorithms (kNN, RF, SVM and NN), and the results are presented in the next section.

4 RESULTS

For evaluating our approach, we have used the Ubiris.v1 dataset (http://iris.di.ubi.pt/ubiris1.html). It contains 1865 images of 200 x 150 resolution in 24-bit colours. They are grouped in two subsets: the first contains 1205 images in 241 classes and the second one contains 660 images in 132 classes. Images in the first subset have minimal noise factors, especially those related to reflections, luminosity, and contrast, because they were captured inside a dark room. The second subset of images was collected in a less controlled setting to introduce natural luminosity variation. This resulted in more heterogeneous images with included reflections, contrast, luminosity and focus problems. Images collected at this stage simulate the ones captured by a vision system without or with minimal active participation from the subjects [7].

These two subsets of images do not have the same classes. For our experiments we used the examples belonging to a subset of all classes: for the small subset we have selected 7 (the first seven classes) and for the big subset we have selected 127 classes (the first 127 classes). In the resulting datasets the examples were evenly distributed among the selected classes.

In our experiments we have used available Python implementations of included algorithms (scikit-learn for machine learning) with their default parameters, except the following:

- k-means: k=500,
- kNN: k=15, Euclidean metric,
- RF: number of estimators = 100,
- SVM: linear kernel function,
- NN: "adam" solver function, 8 hidden layers and 8 neurons, "logistic" activation function.

The classification accuracy was evaluated with 5-fold stratified cross validation. The results are presented separately for the small and big Ubiris.v1 datasets in Table 1 and 2, respectively.

Table 1: Classification accuracy on the small dataset with standard deviation

classifier/keypoint method	SIFT	SURF
kNN	0,37 ± 0,0	0,46 ± 0,0
RF	0,43 ± 0,06	0,63 ± 0,0
SVM	0,67 ± 0,0	0,86 ± 0,0
NN	0,63 ± 0,0	0,77 ± 0,0

The baseline accuracy for the small data set is 0.14 (i.e., 1/number of classes=1/7), and in Table 1 we can see that all instantiations of our method give better results than chance. The NN and SVM classifiers perform much better than RF and especially kNN. Comparing the keypoint detectors, we can see that SURF gives consistently better results than SIFT, although the difference is not very large. The results on the big dataset are, as expected, worse. The default accuracy in this case is 0.0079 (i.e., 1/127), and again all instantiations of our method give better results than chance. Again, SVM and NN perform best, but for some reason, NN performs very poorly in combination with SURF keypoints. RF in this case performs only slightly worse than SVM, while kNN is much worse. Also, on this data we can see that SURF keypoints give somewhat better results than SIFT, the only exception is NN, where SURF fails.

In summary we can conclude that for iris recognition the more complex learning algorithms (SVM, NN) outperform simpler ones (kNN and even RF), and that the SURF algorithm slightly outperforms SIFT. However, we can also conclude that iris recognition is a hard problem, which would probably benefit from application of state-of-the-art deep learning approaches.

Table 2: Classification accuracy on the big dataset with standard deviation

classifier/keypoint method	SIFT	SURF
kNN	0,02 ± 0,025	0,06 ± 0,039
RF	0,1 ± 0,018	0,11 ± 0,014
SVM	0,08 ± 0,039	0,13 ± 0,014
NN	0,17 ± 0,01	0,25 ± 0,005

To investigate whether any of the observed differences is statistically significant, we applied Friedman and Nemenyi tests as recommended in [8]. The results in the form of an average rank diagram with the estimated critical distance is presented in Figure 1 for big dataset and Figure 2 for small dataset.

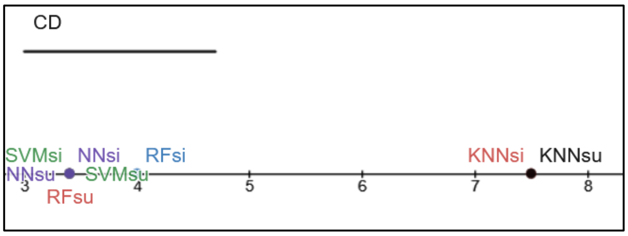

Figure 1: Average rank diagram with the estimated critical distance for the evaluated methods (small dataset)

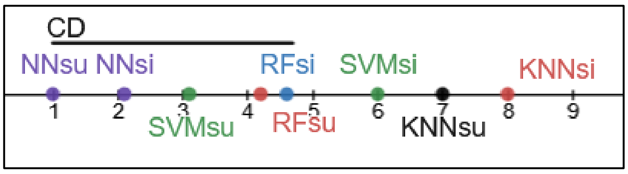

Figure 2: Average rank diagram with the estimated critical distance for the evaluated methods (big dataset)

The critical value for the eight classifiers and a confidence level of 0.05 is 3.031, the critical distance is CD = 4.695605.

Based on the size of CD we can only claim that the top of ranked methods and significantly better than the low ranked ones. For example, NN-SURF, NN-SIFT and SVM-SURF are better than KNN-SIFT. On the other hand, the differences among neighboring methods on the diagram are not significant.

5 CONCLUSION

The paper presents an evaluation of a typical bag of visual words approach on a specific dataset for human iris recognition. The results show that iris recognition is a relatively hard task and in order to improve the accuracy we would need a dataset with more examples of each class. In the future work we plan to evaluate additional feature extractors, like Oriented FAST and Rotated BRIEF (ORB) or Local Binary Pattern (LBP), and, given their success in image recognition in general, also convolutional neural networks approaches. With the latter, we will be especially interested in evaluating and comparing the performance vs. computational cost trade off.

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Analyzing the Diversity of Constrained Multiobjective Optimization Test Suites

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ABSTRACT

A well-designed test suite for benchmarking novel optimizers for constrained multiobjective optimization problems (CMOPs) should be diverse enough to detect both the optimizers' strengths and shortcomings. However, until recently there was a lack of methods for characterizing CMOPs, and measuring the diversity of a suite of problems was virtually impossible. This study utilizes the landscape features proposed in our previous work to characterize frequently used test suites for benchmarking optimizers in solving CMOPs. In addition, we apply the t-distributed Stochastic Neighbor Embedding (t-SNE) dimensionality reduction approach to reveal the diversity of these test suites. The experimental results indicate which ones express sufficient diversity.

KEYWORDS

constrained multiobjective optimization, benchmarking, landscape feature, t-SNE

1 INTRODUCTION

Real-world optimization problems frequently involve multiple objectives and constraints. These problems are called *constrained multiobjective optimization problems* (CMOPs) and have been gaining a lot of attention in the last years [13]. As with other theoretically-oriented optimization studies, a crucial step in testing novel algorithms in constrained multiobjective optimization is the preparation of a benchmark test.

One of the key elements of a benchmark test is the selection of suitable test CMOPs [1]. A well-designed benchmark suite should include "a wide variety of problems with different characteristics" [1]. This way the benchmark problems are *diverse* enough to "highlight the strengths as well as weaknesses of different algorithms" [1]. However, until recently there existed only few and limited techniques proposed to explore CMOPs [13]. For this reason, the test suites of CMOPs were insufficiently understood and measuring their diversity was virtually impossible.

To overcome this situation, in our previous work [13], we experimented with various exploratory landscape analysis (ELA) techniques and proposed 29 landscape features to characterize CMOPs, including their *violation landscapes*—a similar concept as the fitness landscape where fitness is replaced by the *overall constraint violation.*

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In this study, we employ the landscape features proposed in [13] to express and discuss the diversity of frequently used test suites of CMOPs. This is achieved by firstly computing the landscape features and then employing the t-distributed Stochastic Neighbor Embedding (t-SNE), a dimensionality reduction technique, to embed the 29-D CMOP feature space into the 2-D space. Note that due to space limitations, only selected results are shown in this paper. The complete results can be found online[1].

The rest of this paper is organized as follows. Section 2 provides the theoretical background. In Section 3, we present the landscape features and the t-SNE algorithm. Section 4 is dedicated to the experimental setup, while the results are discussed in Section 5. Finally, Section 6 summarizes the study and provides an idea for future work.

2 THEORETICAL BACKGROUND

A CMOP can be formulated as:

$$\begin{aligned} \text{minimize} \quad & f_m(x), \quad m = 1, \dots, M \\ \text{subject to} \quad & g_i(x) \le 0, \quad i = 1, \dots, I \end{aligned} \tag{1}$$

where $x = (x_1, \dots, x_D)$ is a *search vector*, $f_m : S \to \mathbb{R}$ are *objective functions*, $g_i : S \to \mathbb{R}$ *constraint functions*, $S \subseteq \mathbb{R}^D$ is a *search space* of dimension D, and M and I are the numbers of objectives and constraints, respectively.

If a solution x satisfies all the constraints, $g_i(x) \le 0$ for $i = 1, \dots, I$, then it is a *feasible* solution. For each of the constraints g_i we can define the *constraint violation* as $v_i(x) = \max(0, g_i(x))$. In addition, an *overall constraint violation* is defined as

$$v(x) = \sum_i^I v_i(x). \tag{2}$$

A solution x is feasible iff $v(x) = 0$.

A feasible solution $x \in S$ is said to *dominate* a solution $y \in S$ if $f_m(x) \le f_m(y)$ for all $1 \le m \le M$, and $f_m(x) < f_m(y)$ for at least one $1 \le m \le M$. In addition, $x^* \in S$ is a *Pareto-optimal solution* if there exists no $x \in S$ that dominates x^*. All feasible solutions represent a *feasible region*, $F = \{x \in S \mid v(x) = 0\}$. Besides, all nondominated feasible solutions form a *Pareto-optimal set*, S_o. The image of the Pareto-optimal set is the *Pareto front*, $P_o = \{f(x) \mid x \in S_o\}$. A connected component (a maximal connected subset with respect to the inclusion order) of the feasible region is called a *feasible component*, $\mathcal{F} \subseteq F$.

In [13], we introduced analogous terms from the perspective of the overall constraint violation. A *local minimum-violation solution* is thus a solution x^* for which exists a $\delta > 0$ such that $v(x^*) \le v(x)$ for all $x \in \{x \mid d(x^*, x) \le \delta\}$. If there is no other solution $x \in S$ for which $v(x^*) > v(x)$, then x^* is a

[1]https://vodopijaaljosa.github.io/cmop-web/

(global) minimum-violation solution. We denoted the set of all local minimum-violation solutions by F_l and called a connected component $\mathcal{M} \subseteq F_l$ a *local minimum-violation component*.

In order to express the modality of a violation landscape, we defined a local search procedure to be a mapping from the search space to the set of local minimum-violation solutions, $\mu : S \longrightarrow F_l$, such that $\mu(x) = x$ for all $x \in F_l$. A *basin of attraction* of a local minimum-violation component $\mathcal{M}$ and local search μ is then a subset of S in which μ converges towards a solution from $\mathcal{M}$, i.e., $\mathcal{B}(\mathcal{M}) = \{x \in S \mid \mu(x) \in \mathcal{M}\}$. The violation landscape is *unimodal* if there is only one basin in S and *multimodal* otherwise.

3 METHODOLOGY

3.1 ELA Features

The landscape features used in this study were introduced in our previous work [13] and can be categorized into four groups: space-filling design, information content, random walk and adaptive walk features. They are summarized in Table 1.

The space-filling design features are used to quantify the feasible components, the relationship between the objectives and constraints, and measure the feasibility ratio and proportion of boundary Pareto-optimal solutions. Next, the information content features are mainly used to express the smoothness and ruggedness of violation landscapes. They are derived by analyzing the entropy of sequences of overall violation values as obtained from a random sampling of the search space. Then, the random walk features considered in this study are used to quantify the number of boundary crossings from feasible to infeasible regions. They are used to categorize the degree of segmentation of the feasible region. Finally, features from the last group are derived from adaptive walks through the search space. They are used to describe various aspects of basins of attraction in the violation landscapes.

3.2 Dimensionality Reduction with t-SNE

The t-SNE algorithm is a popular nonlinear dimensionality reduction technique designed to represent high-dimensional data in a low-dimensional space, typically the 2-D plane [12]. First, it converts similarities between data points to distributions. Then, it tries to find a low-dimensional embedding of the points that minimizes the divergence between the two distributions that measure neighbor similarity—one in the original space and the other in the projected space. This means that t-SNE tries to preserve the local relationships between neighboring points, while the global structure is generally lost.

Finding the best embedding is an optimization problem with a non-convex fitness function. To solve it, t-SNE uses a gradient descent method with a random starting point, which means that different runs can yield different results. The output of t-SNE depends also on other parameters, such as the *perplexity* (similar to the number of nearest neighbors in other graph-based dimensionality reduction techniques), *early exaggeration* (separation of clusters in the embedded space) and *learning rate* (also called ε). The gradients can be computed exactly or estimated using the Barnes-Hut approximation, which substantially accelerates the method without degrading its performance [11].

4 EXPERIMENTAL SETUP

We studied eight suites of CMOPs which are most frequently used in the literature. These are CTP [2], CF [14], C-DTLZ [5], NCTP [7], DC-DTLZ [8], LIR-CMOP [3], DAS-CMOP [4], and MW [9]. In addition, we included also a novel suite named RCM [6]. In contrast to other suites which consist of artificial test problems, RCM contains 50 instances of real-world CMOPs based on physical models. Note that we actually used only 11 RCM problems, since only continuous and low-dimensional problems were suitable for our analysis. We considered three dimensions of the search space: 2, 3, 5. It is to be noted that large-scale CMOPs were not taken into account since the methodology described in Section 3 is not sufficiently scalable. This limits our results to low-dimensional CMOPs. Table 2 shows the basic characteristics of the studied test suites.

For dimensionality reduction, we used the t-SNE implementation from the *scikit-learn* Python package [10] with default parameter values. That is, we used the Euclidean distance metric, random initialization of the embedding, perplexity of 30, early exaggeration of 12, learning rate of 200, the maximum number of iterations of 1000, and the maximum number of iterations without progress before aborting of 300. The gradient was computed by the Barnes-Hut approximation with the angular size of 0.5.

Table 1: The ELA features used to characterize CMOPs categorized into four groups: space-filling design, information content, random walk, and adaptive walk [13].

Space-filling design features	
$N_{\mathcal{F}}$	Number of feasible components
$\mathcal{F}_{\min}$	Smallest feasible component
$\mathcal{F}_{\text{med}}$	Median feasible component
$\mathcal{F}_{\max}$	Largest feasible component
$O(\mathcal{F}_{\max})$	Proportion of Pareto-optimal solutions in $\mathcal{F}_{\max}$
$\mathcal{F}_{\text{opt}}$	Size of the "optimal" feasible component
ρ_{F}	Feasibility ratio
$\rho_{\min}$	Minimum correlation
$\rho_{\max}$	Maximum correlation
$\rho_{\partial S_o}$	Proportion of boundary Pareto-optimal solutions
Information content features	
$H_{\max}$	Maximum information content
ε_s	Settling sensitivity
M_0	Initial partial information
Random walk features	
$(\rho_{\partial F})_{\min}$	Minimal ratio of feasible boundary crossings
$(\rho_{\partial F})_{\text{med}}$	Median ratio of feasible boundary crossings
$(\rho_{\partial F})_{\max}$	Maximal ratio of feasible boundary crossings
Adaptive walk features	
$N_{\mathcal{B}}$	Number of basins
$\mathcal{B}_{\min}$	Smallest basin
$\mathcal{B}_{\text{med}}$	Median basin
$\mathcal{B}_{\max}$	Largest basin
$(\mathcal{B}_{\text{F}})_{\min}$	Smallest feasible basin
$(\mathcal{B}_{\text{F}})_{\text{med}}$	Median feasible basin
$(\mathcal{B}_{\text{F}})_{\max}$	Largest feasible basin
$\cup\mathcal{B}_{\text{F}}$	Proportion of feasible basins
$v(\mathcal{B})_{\text{med}}$	Median constraint violation over all basins
$v(\mathcal{B})_{\max}$	Maximum constraint violation of all basins
$v(\mathcal{B}_{\max})$	Constraint violation of $\mathcal{B}_{\max}$
$O(\mathcal{B}_{\max})$	Proportion of Pareto-optimal solutions in $\mathcal{B}_{\max}$
$\mathcal{B}_{\text{opt}}$	Size of the "optimal" basin

5 RESULTS AND DISCUSSION

The results obtained by t-SNE are shown in Figures 1 and 2. Specifically, the figures show the 2-D embedding of the 29-D

Table 2: Characteristics of test suites: number of problems, dimension of the search space D, number of objectives M, and number of constraints I. The characteristics of selected RCM problems are shown in parentheses.

Test suite	#problems	D	M	I
CTP [2]	8	*	2	2, 3
CF [14]	10	*	2, 3	1, 2
C-DTLZ [5]	6	*	*	1, *
NCTP [7]	18	*	2	1, 2
DC-DTLZ [8]	6	*	*	1, *
DAS-CMOP [4]	9	*	2, 3	7, 11
LIR-CMOP [3]	14	*	2, 3	2, 3
MW [9]	14	*	2, *	1–4
RCM [6]	50 (11)	2–34 (2–5)	2–5	1–29 (1–8)

*Scalable parameter.

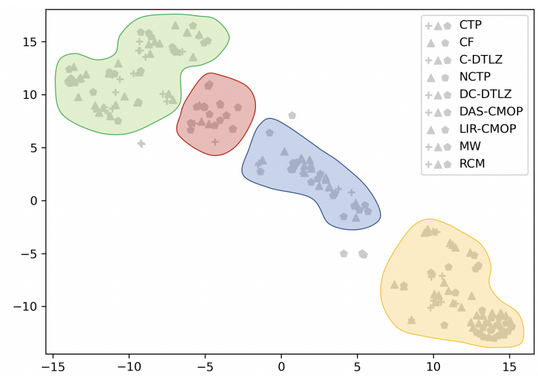

Figure 1: Embedding of the feature space as obtained by t-SNE. The four regions are depicted in green, red, blue, and orange. The points that are not contained in any region are considered to be outliers.

feature space consisting of the landscape features presented in Table 1. Each subfigure in Figure 2 corresponds to one of the test suites. For example, Figure 2a exposes the embedding of the CTP suite in blue, while the gray points correspond to the rest of the test suites. Points with a shape of a plus (+) correspond to CMOPs with two variables, points with a shape of a triangle (▲) to CMOPs with three variables, and points with a shape of a pentagon (⬟) to CMOPs with five variables.

An additional analysis shows that the embedding of the feature space can be, based on the corresponding characteristics, split into four regions: green, red, blue and yellow (Figure 1). The green region corresponds to CMOPs with severe violation multimodality, small basins of attraction, and rugged violation landscapes. The red region corresponds to CMOPs with moderate violation multimodality, rugged violation landscapes, and small feasibility ratios. The blue region corresponds to relatively low violation multimodality, rugged violation landscapes, small feasibility ratios, and positive correlations between objectives and constraints. Finally, the yellow region corresponds to unimodal CMOPs with large feasible components, smooth violation landscapes, and large feasible regions.

As we can see from Figure 2a, almost all CTP problems are located in the orange region. Therefore, many relevant characteristics are poorly represented by CTP, e.g., violation multimodality, small feasibility ratios, etc. Similarly, NCTP fails to sufficiently represent severe multimodality since it contains no problems from the green region (Figure 2d). On the other hand, DC-DTLZ, LIR-CMOP, and MW are biased towards highly multimodal violation landscapes or those with small basins of attraction (Figure 2e, Figure 2g, and Figure 2h). Nevertheless, MW is one of the most diverse suites considering other characteristics (Figure 2h).

The C-DTLZ and DAS-CMOP suites are mainly located in the green and orange regions and fail to sufficiently represent the characteristics of the red and blue regions.

Finally, the results show that CF and RCM are well spread through the whole embedded feature space (Figure 2b and Figure 2i). As we can see, they have at least one representative CMOP instance in each region. Therefore, CF and RCM are the most diverse test suites according to the employed landscape features.

6 CONCLUSIONS

In this paper, we analyzed the diversity of the frequently used test suites for benchmarking optimizers in solving CMOPs. For this purpose, we considered 29 landscape features for CMOPs that were proposed in our previous work. In addition, the t-SNE algorithm was used to reduce the dimensionality of the feature space and reveal the diversity of the considered test suites.

The experimental results show that the most diverse test suites of CMOPs according to the applied landscape features are CF and RCM. Indeed, they include the widest variety of CMOPs with different characteristics. In addition, MW also proved to be a diverse suite except for unimodal CMOPs. Nevertheless, we suggest to consider CMOPs from various test suites for benchmarking optimizers in constrained multiobjective optimization.

One of the main limitations of our study is that only low-dimensional CMOPs were used in the analysis. Therefore, we were unable to adequately address the issue of scalability. For this reason, a crucial task that needs to be addressed in the feature is the extension of this work to large-scale CMOPs.

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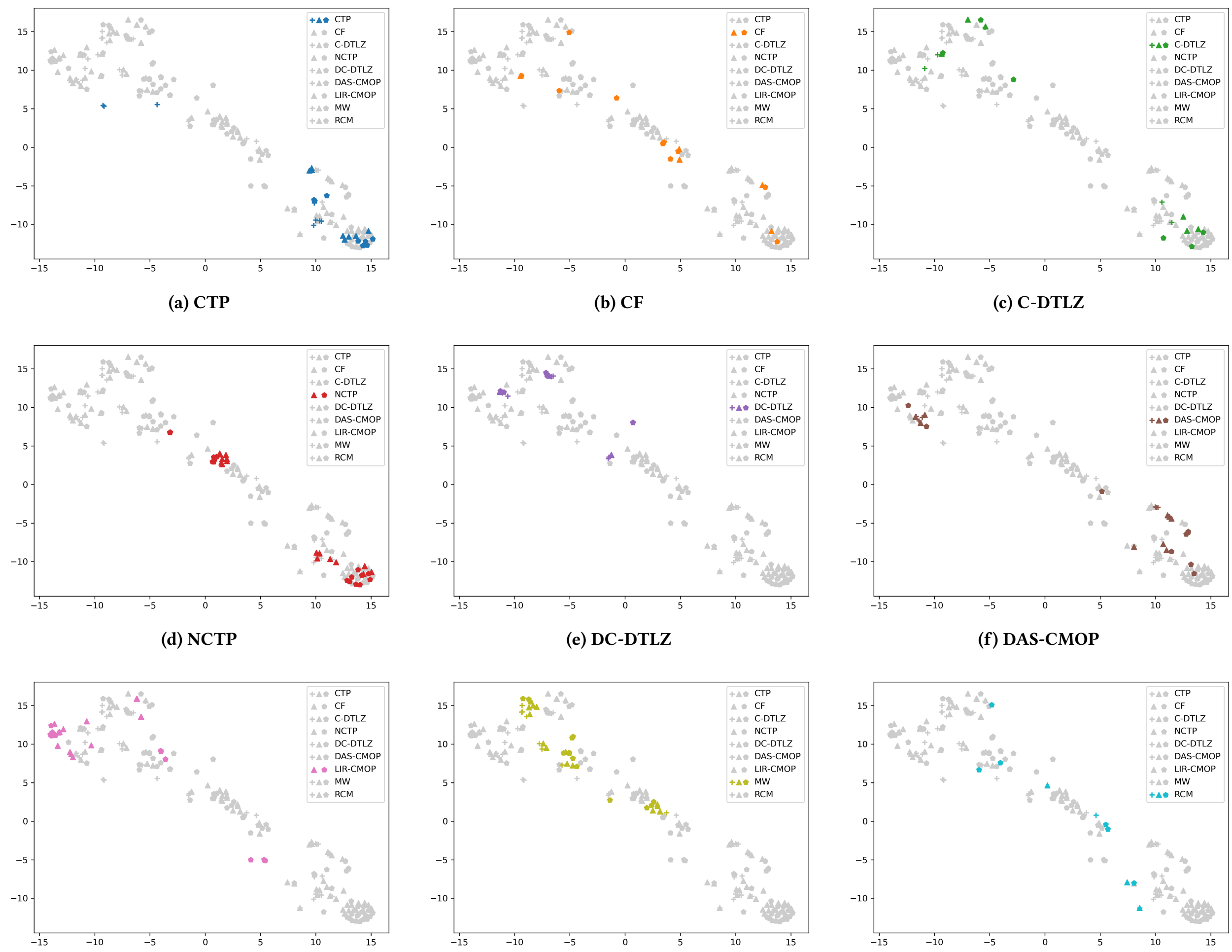

(a) CTP (b) CF (c) C-DTLZ

(d) NCTP (e) DC-DTLZ (f) DAS-CMOP

(g) LIR-CMOP (h) MW (i) RCM

Figure 2: Embedding of the feature space as obtained by t-SNE. Each subfigure exposes the embedding of a selected suite.

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Corpus KAS 2.0: Cleaner and with New Datasets

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ABSTRACT

Corpus of Academic Slovene (KAS) contains Slovene BSc/BA, MSc/MA, and PhD theses from 2000 - 2018. We present a cleaner version of the corpus with added text segmentation and updated POS-tagging. The updated corpus of abstracts contains fewer artefacts. Using machine learning classifiers, we filled in missing research field information in the metadata. We used the full texts and corresponding abstracts to create several new datasets: monolingual and cross-lingual datasets for long text summarization of academic texts and a dataset of aligned sentences from abstracts in English and Slovene, suitable for machine translation. We release the corpora, datasets, and developed source code under a permissible licence.

KEYWORDS

KAS corpus, academic writing, machine translation, text summarization, CERIF classification

1 INTRODUCTION

The Corpus of Academic Slovene (KAS 1.0)[1] is a corpus of Slovenian academic writing gathered from the digital libraries of Slovenian higher education institutions via the Slovenian Open Science portal[2] [3]. It consists of diploma, master, and doctoral theses from Slovenian institutions of higher learning (mostly from the University of Ljubljana and the University of Maribor). It contains 82,308 texts with almost 1.7 billion tokens.

The KAS texts were extracted from the PDF formatted files, which are not well-suited for the acquisition of high-quality raw texts. For that reason, the KAS corpus is noisy. Our analysis showed that most original texts contain tables, images, and other kinds of figures which are transformed into gibberish when converted from the PDF format. The extracted figure captions also do not give any helpful information. Some texts contain front or back matter (for example, a table of contents at the beginning or references at the end), which shall not be present in the main text body.

The Corpus of KAS abstracts (KAS-Abs 1.0)[3] contains 47,273 only Slovene, 49,261 only English, and 11,720 abstracts in both languages. We observed several shortcomings of this corpus. A vast majority of abstracts contain keywords or the word "Abstract" somewhere in the abstract text. Many texts contain other kinds of meta-information, e.g., the name of the author or supervisor and the title of the thesis. Several corpus entries contain English and Slovene abstracts in the same unit, only one of them wrongly marked to contain both abstracts or switched Slovene and English abstracts. Several entries did not contain the abstract; instead, there was front or back matter like copyright statement, table of contents, list of abbreviations etc.

Our analysis has shown that the corpora can be improved in many aspects. Besides addressing the above-mentioned weaknesses, the main improvements in the updated KAS 2.0 and KAS-Abs 2.0 corpora are chapter segmentation and improved metadata with machine learning methods (described in Sections 2 and 3). A further motivation for our work is the opportunity to extract valuable new datasets for text summarization (monolingual and cross-lingual) and a sentence-aligned machine translation dataset created from matching Slovene and English abstracts (see Section 4). We present conclusions and ideas for further improvements in Section 5.

2 UPDATES: KAS 2.0 AND KAS-ABS 2.0

We first describe methods for extracting text and abstracts from PDF, followed by the differences between the versions 1.0 and 2.0 of corpora.

2.1 Extraction of Text Body

As many texts in corpora version 1.0 contained several hard to fix faults (like gibberish due to extracted tables and figures), we decided to extract texts once again from the PDFs. We used the pdftotext tool, which is a part of the poppler-utils. The software proved to be accurate and reliable. Its important feature is keeping the original text layout and excluding the areas where we detected figures, tables, and other graphical elements.

In the first step, we converted PDF files to images, one page at a time and used the OpenCV computer vision library to detect text and non-text areas. We marked the text areas on each page. For each document, we also calibrated the size of the header and footer areas and removed them from the text areas together with the page numbers. In this process, we removed 2,467 out of the original 91,019 documents due to the documents containing less than 15 pages or some unchecked exceptions in the code.

Next, we searched for the beginning and the end of the main text body. We observed that practically all bodies start with some variation of the Slovene word "Uvod" (i.e. introduction). If we found the beginning, we searched for the ending in the same way but with different keywords (viri, literatura, povzetek, etc). For texts with found beginning and end, the areas were clipped and the extracted texts were normalized. The normalization included handling Slovene characters with the caret (č, š, ž), ligattures (tt, ff, etc.), removal of remaining figure and table captions, and empty lines. The obtained text was segmented into the structure extracted from the table of contents. We matched headings in the text with the entries in the table of contents and used page numbers as guidelines. We ended with 83,884 successfully extracted documents.

[1] https://www.clarin.si/repository/xmlui/handle/11356/1244
[2] https://www.openscience.si/
[3] https://www.clarin.si/repository/xmlui/handle/11356/1420

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2.2 Extraction of Abstracts

We tried to improve the KAS-abstracts corpus by cleaning the existing documents and extracting the abstracts directly from the PDFs. An initial analysis of existing texts showed different formattings (71 different organizations publish the works in the KAS corpus). We identified five major patterns of problems and created scripts for resolving them. This produced approximately 40,000 cleaned texts while 20,000 were still problematic. The direct extraction from the PDFs followed the same procedure as for the main text body (described above). We considered figures, headers, footers, page numbers, keywords, meta-information, abstract placement at the beginning and end of the documents, multiple abstracts of different lengths, etc. This resulted in 71,567 collected Slovene abstracts. A similar procedure was applied to English abstracts and yielded 53,635 abstracts.

2.3 Differences from Version 1.0 to 2.0

Besides cleaner texts, excluded gibberish from figures and tables, and excluded front- and back-matter, the most important difference between KAS versions 1.0 and 2.0 is that the texts are segmented by structure, i.e. by headings. Unfortunately, some documents present in the original KAS were lost due to the different extraction, and for some documents appearing only in version 2.0, there is no metadata.

KAS-abstracts is greatly improved and no longer contains large quantities of unusable text and different artefacts (e.g., metadata, keywords, or front- and back-matter). Again, for some abstracts present only in version 2.0, there is no metadata. Still, they are usable for several tasks, including machine translation studies. Table 1 gives the quantitative overview of the obtained body texts and abstracts.

Table 1: Statistics of the obtained body texts and abstracts in version 2.0 of the KAS corpora.

	Sum	Same as in 1.0	Missing from 1.0	With metadata
Slo abstracts	71,567	56,610	2,383	67,533
Eng abstract	53,635	44,685	16,296	50,674
Body text	83,884	79,320	2,988	79,320

3 SUB-CERIF CLASSIFICATION

CERIF (Common European Research Information Format) is the standard that the EU recommends to member states for recording information about the research activity[4]. The top level has only five categories (humanities, social sciences, physical sciences, biomedical sciences, and technological sciences). In comparison, the lower level distinguishes 363 categories. As Slovene libraries use the UDC classification, in the KAS corpus 1.0, only 17% of the documents also contain the CERIF and sub-CERIF codes in their metadata. These are mapped from UDC codes by the heuristics produced by the Slovene Open Science Portal. Below, we describe how we automatically annotated documents with missing sub-CERIF codes using a machine learning approach.

We build a dataset for automatic annotation of sub-CERIF codes from the body texts of the documents. A document may have more than one sub-CERIF code, which means that classes are not mutually exclusive. Thus, we tackle a multi-label classification problem. In the corpus, there are 13,738 documents with high confidence levels of CERIF codes which we use in machine learning. Our dataset contains 64 labels out of 363 possible. We used 10% or 1374 samples as the test set and the remaining 90% as the training set.

As several studies have shown that recent neural embedding approaches are not yet competitive with standard text representations in document level tasks, we decided to use standard Bag-of-Words representation with TF-IDF weighting. In the preprocessing step, we lemmatized texts using CLASSLA lemmatizer[5] and removed stop-words[6] and punctuation.

We compared four classifiers. For logistic regression (LR), k-nearest neighbours (KNN), and support vector machines (SVM), we used Scikit-learn [6], and for the multi-layer perceptron (MLP), we tried Keras implementation. For the first three, we preliminary tried several different parameter values but found that they perform the best with the default ones. The MLP neural network consists of one hidden layer with 256 units, sigmoid activation function on hidden and output layers, Adam optimizer [5] with an initial learning rate of 0.01, and binary cross-entropy as a loss function. We used the early stopping (5 consecutive epochs with no improvement) and reduced the learning rate on the plateau (halving learning rate for every 2 epochs with no improvement) as callbacks during the learning process.

In Table 2, we report pattern accuracy and binary accuracy of the trained classifiers. A model predicts a correct pattern if it assigned all true sub-CERIF codes to a document. For binary accuracy, a model predicts a sub-CERIF code correctly if it assigns a true single sub-CERIF code to the document. For example, let us assume that we have four sub-CERIF codes and an example with a label sequence '1010'. If a model predicts '1010', it receives 100% for both pattern and binary accuracy. If a model predicts '0010', it gets 0% pattern accuracy and 75% binary accuracy since it misclassified only the first label.

Table 2: Results on the sub-CERIF multi-label classification task. The best result for each metric is in bold.

Algorithm	Binary accuracy	Pattern accuracy
LR	98.48	38.36
KNN	98.52	43.75
SVM	**98.68**	**47.82**
MLP	98.66	46.58

Using the pattern accuracy metric, SVM and MLP are significantly better than KNN and LR. LR is the worst performing model, and KNN is in the middle. SVM is the best, and MLP is behind for 1.24 points. We assume that we do not have enough data for MLP to beat SVM. It is difficult to assess the models regarding binary accuracy. In the test set, we have 761 examples with 1 label, 466 with 2 labels, 107 with 3 labels, 26 with 4 labels, 10 with 5, and 4 with 6. A dummy model that predicts all zeros achieves binary accuracy of 97.51. All our models are better than this baseline, and their ranks correspond with the pattern accuracy.

We conclude that given 64 labels and 10k training instances, our best model (SVM) correctly predicts almost half of them, which is a useful result.

[4]https://www.dcc.ac.uk/resources/metadata-standards/cerif-common-european-research-information-format

[5]https://github.com/clarinsi/classla

[6]We used the list from https://github.com/stopwords-iso/stopwords-sl

4 NEW DATASETS

We created two types of new datasets, described below: summarization datasets and machine translation datasets.

4.1 Summarization Datasets

We created two new datasets appropriate for *long-text summarization* in the monolingual and cross-lingual settings. The monolingual slo2slo dataset contains 69,730 Slovene abstracts and Slovene body texts and is suitable for training Slovene summarization models for long texts. The cross-lingual slo2eng dataset contains 52,351 Slovene body texts and English abstracts. It is suitable for the cross-lingual summarization task.

4.2 Machine Translation Datasets

For the creation of a sentence-aligned *machine translation dataset*, we used the neural approach proposed by Artetxe & Schwenk [1]. The main difference to other text alignment approaches is in using margin-based scoring of candidates in contrast to a hard threshold with cosine similarity. We improved the approach by replacing the underlying neural model. Instead of BiLSTM-based LASER [2] representation, we used the transformer-based LaBSE [4] sentence representation, which has significantly improved average bitext retrieval accuracy. We used the implementation from UKPLab[7]. This approach requires a threshold that omits candidate pairs below a certain value. This value represents a trade-off between the quantity and quality of aligned pairs. The higher the threshold, the better the quality of alignments, but more samples are discarded.

In text alignment, sentences do not always exhibit one-to-one mapping: a source sentence can be split into two or more target sentences and vice versa. To address the problem, we iteratively ran the alignment process until all sentences above the chosen threshold were assigned to each other. In cases of more than one sentence assigned to a single sentence, we merged them and thus created a translation pair.

We manually inspected the alignments consisting of more than one sentence in either source or target text on a small subset of abstracts. We observed that a merging process produces better results than imposing a restriction allowing only the one-to-one mapping. In Table 4, we present an example of the alignment. The first column represents a margin-based score. If an aligned pair contains more than one sentence in the source or target, the score consists of the average margin-based score between a single sentence and multiple sentences. The last column is an indicator of whether merging was applied.

We used the ratio variant of margin-based scoring and set the default threshold to 1.1. We manually tested the alignment on our internal dataset. From 2015 examples, we successfully aligned 2002 of them (99.3%), misaligned 1 (0.1%), and omitted 12 of them (0.6%). The analysis of 12 omitted cases showed that some pairs do not match each other or are not accurate translations of each other, e.g., a large part of the original sentence is omitted, phrases are only distantly related, etc. However, approximately half of the 12 cases shall be aligned, which means that our model works very well, but conservatively and may fail for free translation pairs.

With the default value of the threshold (1.1), we produced 496.102 sentence pairs. We believe the threshold is strict enough to produce good-quality dataset (especially if compared to many other sentence alignments in existing translation datatsets). However, if one would prefer even more certain alignment, the value of the threshold can be further increased at the expense of less sentences in the datatset. We released three such datasets that reflect a trade-off between quality and quantity of the data. The sizes of the obtained datasets are available in Table 3.

[7] https://github.com/UKPLab/sentence-transformers/blob/master/examples/applications/parallel-sentence-mining/bitext_mining.py

Table 3: Size of the machine translation datasets based on the margin-based quality threshold.

Dataset	Threshold	Size
Normal alignment	1.1	496,102
Strict alignment	1.2	474,852
Very strict alignment	1.3	425,534

5 CONCLUSIONS

In this work, we created version 2.0 of Corpus KAS and Corpus KAS-Abstracts. We cleaned the texts and abstracts, introduced the text segmentation based on its structure, and improved the metadata. We created two new long text summarization datasets and a dataset of aligned sentences for machine translations. The latest versions of corpora and datasets are available on the CLARIN.SI. The corpora are annotated with the CLASSLA tool and released in txt, JSON and TEI formats. The source code for producing the new versions of the corpora[8] and the created datasets are publicly available[9] .

In future work, the extraction of metadata for entries where they are missing would be beneficial. There could be further improvements in cleaning the texts, and this would increase the number of available documents. When the corpora are extended with data post-2018, the software might need further modifications due to new formats and templates used in the academic works. Further experiments on the created MT datasets would clarify the setting of parameters and show if current MT systems benefit more from better quality or larger quantity of data.

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[8] https://github.com/korpus-kas
[9] KAS 2.0: https://www.clarin.si/repository/xmlui/handle/11356/1448
KAS-Abs 2.0: https://www.clarin.si/repository/xmlui/handle/11356/1449
Summarization datasets: https://www.clarin.si/repository/xmlui/handle/11356/1446
MT datasets: https://www.clarin.si/repository/xmlui/handle/11356/1447

Table 4: Examples from sentence-aligned Slovene-English abstracts.

Score	Slovene source sentence	English target sentence	Mrg
1.670	Moški pa pogosteje opravljajo opravila, ki se tičejo mehanizacije na kmetiji.	Men, however, often perform tasks related to machinery on the farm.	No
1.612	Zanimala nas je tudi prisotnost tradicionalnih vzorcev pri delu.	Additionally, I have also focused on the presence of traditional work patterns.	No
1.520	Želeli smo izvedeti, ali se kmečke ženske počutijo preobremenjene, cenjene in kako preživljajo prosti čas (če ga imajo).	I wanted to know whether rural women feel overwhelmed or valued, and how they spend their free time (if they have it).	No
1.441	Dotaknili smo se tudi problemov, s katerimi se srečujejo kmečke ženske med javnim in zasebnim življenjem.	Moreover, I have tackled the problems that rural women face when it comes to their public and private life.	No
1.437	Na koncu teoretičnega dela smo opisali še predloge za izboljšanje položaja kmečkih žensk v družbi.	At the end of the theoretical part, I have denoted further proposals for improving the situation of rural women in today's society.	No
1.388	V diplomskem delu obravnavamo položaj žensk v kmečkih gospodinjstvih v Sloveniji.	The thesis deals with the situation of women in rural households of Slovenia.	No
1.354	V empiričnem delu pa smo s pomočjo anketnega vprašalnika, na katerega so kot respondentke odgovarjale kmečke ženske, ugotavljali, kako je delo na kmetiji porazdeljeno med spoloma.	In the empirical part, I have conducted a survey on peasant women to determine the gender division of farm labour.	No
1.271	V teoretičnem delu predstavljamo pojme, kot so gospodinja, kmečko gospodinjstvo ter kmečka družina, kjer smo opisali tudi tipologijo kmečkih družin.	In the theoretical part, I have presented the following concepts: ″housewife″, ″rural household″ and ″rural family″. In addition, I have described the typology of rural families.	Yes
1.249	V nadaljevanju smo predstavili tradicionalno dojemanje kmečkih žensk, njihovo obravnavo skozi čas v slovenski literaturi, pojasnili smo procese, ki so vplivali na spremembo položaja kmečkih žensk skozi zgodovino ter se osredotočili na delo kmečkih žensk (delovni dan, delitev dela, vrednotenje dela).	I have explained the processes that have influenced the change in the situation of rural women through history and focused on their work (working day, divison of labour, work evaluation). Furthermore, I have shed light on the traditional perception of peasant women and their treatment over time in Slovene literature.	Yes
1.217	Ugotovili smo, da so tradicionalni vzorci delitve dela na kmetiji še vedno prisotni, saj smo iz analize anket in literature ugotovili, da ženske opravljajo večino del vezanih na dom in družino, to pa so gospodinjska dela in vzgoja otrok.	Hence, the majority of work related to home and family (housework and child-rearing) is performed by women. By analyzing the conducted survey and examining the literature, I have come to the conclusion that the division of farm labour more or less still follows traditional patterns.	Yes

[2] Mikel Artetxe and Holger Schwenk. 2019. Massively multilingual sentence embeddings for zero-shot cross-lingual transfer and beyond. *Transactions of the Association for Computational Linguistics*, 7, 597–610.

[3] Tomaž Erjavec, Darja Fišer, and Nikola Ljubešić. 2021. The KAS corpus of Slovenian academic writing. *Language Resources and Evaluation*, 55, 2, 551–583.

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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 področij – od psihologije in jezikoslovja do nevrofenomenologije, 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
Borut Trpin
Maša Rebernik
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 psychology and linguistics to neurophenomenology, philosophy, 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
Borut Trpin
Maša Rebernik
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Nevrofenomenološka študija skupinskih dinamik v spletnem učnem okolju: Preliminarni rezultati

Neurophenomenological Study of Group Dynamics in the Online Learning Environment: Preliminary results

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POVZETEK

Učno okolje je prostor, v katerem se med udeleženimi v učnem procesu ustvarjajo kompleksne skupinske dinamike. V prispevku predstavimo preliminarne rezultate eksploratorne nevrofenomenološke študije, v kateri smo preučevali takšne dinamike v spletnem učnem okolju. Udeleženci so na štirih srečanjih merili elektrodermalno aktivnost in ob naključnih trenutkih vzorčili doživljanje. Po vsakem srečanju so izvajali fenomenološke intervjuje in se spoznavali s podatki. Rezultati so pokazali obstoj različnih skupinskih dinamik na ravni doživljanja in psihofiziologije, kar predstavlja osnovo za nadaljnjo nevrofenomenološko analizo. Nadejamo se, da bodo ugotovitve ponudile svež uvid v vedno pogostejše spletno poučevanje in pomagale oblikovati boljše učne pristope.

KLJUČNE BESEDE

Skupinska dinamika, nevrofenomenologija, vzorčenje doživljanja, elektrodermalna aktivnost, fiziološka sinhronizacija, spletno učno okolje

ABSTRACT

A learning environment is a space wherein complex group dynamics form between those who participate in the learning process. In this paper, we present the preliminary results of an exploratory neurophenomenological study in which we examined such dynamics in an online learning environment. Throughout four sessions, participants measured electrodermal activity and sampled their experience at random moments. After each session, they conducted phenomenological interviews and familiarized themselves with the data. The results showed the existence of various group dynamics at the level of experience and psychophysiology, which represents the basis for further neurophenomenological analysis. We hope that the findings will offer fresh insight into the increasingly common online teaching and help shape better learning approaches.

KEYWORDS

Group dynamics, neurophenomenology, experience sampling, electrodermal activity, physiological synchrony, online learning environment

1 UVOD

Učno okolje sestavljajo učitelji in učenci, ki sodelujejo v izmenjavi znanja. Čeprav gre v osnovi za delovanje avtonomnih posameznikov, postane to delovanje včasih zelo usklajeno, tj. tvorijo se skupinske dinamike [1]. V zadnjem času se je zvrstilo več študij, ki skušajo raziskati naravo tovrstnih dinamik z družnim raziskovanjem doživljanja (prvoosebni vidik) in nevrološke aktivnosti (tretjeosebni vidik) [2, 3, 4, 5, 6]. Pokazale so, da obstaja korelacija med kolektivnim doživljajskim stanjem učencev v razredu (npr. čustveno atmosfero) in pripadajočo nevrološko oziroma psihofiziološko sinhronizacijo [2, 3, 4]. Kljub temu, da se poučevanje vztrajno širi na splet [7], kar lahko predrugači običajne skupinske dinamike [8], se nobena takšna študija še ni ukvarjala s spletnim učnim okoljem. Z raziskavo, ki jo opišemo v tem prispevku, smo želeli zapolniti to vrzel.

Sodobni kognitivni znanosti povezovanje doživljajskega in nevrološkega nivoja ni tuje [9, 10]. Tretjeosebne opise, ki jih podaja npr. nevroznanost, je potrebno osmisliti skozi prizmo pripadajočih prvoosebnih opisov [11]. Toda slednji so pogosto pridobljeni s tehnikami, ki dajejo prednost posploševanju in formalizaciji, zapostavljajo pa veljavnost in ločljivost [11, 12]. Zaradi tega lahko ostane ogromno nevroloških variabilnosti, kot tudi morebitnih korelacij med prvoosebnim in tretjeosebnim nivojem, spregledanih [13, 14]. Potencialno rešitev je v svojem nevrofenomenološkem programu predlagal Francisco Varela

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[11]. Poudaril je pomembnost poglobljenega, a sistematičnega pridobivanja prvoosebnih podatkov in združevanja prvoosebnega in tretjeosebnega nivoja po principu vzajemnega omejevanja. Več študij je pokazalo, da takšno nevrofenomenološko raziskovanje ni samo izvedljivo, pač pa lahko ponudi svež uvid v pereče probleme kognitivnih znanosti (za nedavni pregled glej [12]). Tehnika za pridobivanje prvoosebnih podatkov, ki je bila že večkrat uspešno uporabljena v nevrofenomenološkem kontekstu [15, 17], je opisno vzorčenje izkustva (OVI) [18, 19]. Sestavni del tehnike OVI sta naključno vzorčenje doživljanja in kasnejši fenomenološki intervjuji, pri čemer sta tako spraševanje kot tudi poročanje o doživljanju smatrana za spretnosti, v katerih se je potrebno uriti [19].

Za razumevanje nevrološke podstati doživljajskih stanj se pogosto uporabljajo mere delovanja avtonomnega živčnega sistema (AŽS), kot je npr. elektrodermalna aktivnost (EDA) [20], [21, 22]. EDA je produkt interakcije lokalnih procesov v koži in delovanja simpatičnega dela AŽS ter se navadno uporablja kot indikator vzburjenosti, čustev in stresa [24, 25]. Različne mere sinhronizacije EDA med več udeleženci so se nedavno uveljavile kot učinkovit pokazatelj skupinskih dinamik, povezanih npr. z empatijo [26], s povezanostjo med govorniki in občinstvom [27] ter s povečano slušno osredotočenostjo [28]; pa tudi skupinskih dinamik, ki se oblikujejo v učnem okolju, npr. nižja vključenost v učni proces [29], mentalni napori skupine [30] in čustvena atmosfera [27]. Kljub obetavnim rezultatom pa doslej še ni bilo opravljene študije, ki bi mero EDA na nevrofenomenološki način združila s sodobno metodo za pridobivanje prvoosebnih podatkov, kot je npr. tehnika OVI.

V nadaljevanju predstavimo preliminarne rezultate eksploratorne nevrofenomenološke raziskave, v kateri smo na ekološko veljaven način preučevali doživljanje in EDA udeležencev v spletnem učnem okolju. Odgovoriti smo želeli na štiri raziskovalna vprašanja: (RV1) Kaj doživljajo študenti in izvajalci tekom spletnih predavanj? (RV2) Ali lahko ob istih časovnih trenutkih prepoznamo skupinske dinamike na doživljajskem nivoju? (RV3) Ali se med udeleženimi v učnem procesu tekom spletnih predavanj pojavljajo skupinske dinamike oziroma sinhronizacije na nivoju EDA? (RV4) Ali obstajajo povezave med doživljanjem in EDA udeleženih v učnem procesu?

2 METODA

2.1 Oris raziskave

Raziskava je vključevala štiri spletna srečanja (pilotno in tri raziskovalna) v okviru predavanj na skupnem Interdisciplinarnem srednjeevropskem magistrskem študijskem programu Kognitivna znanost (MEi:CogSci). Sodelovanje v raziskavi je bilo izrazito aktivno oziroma participatorno. Med srečanjem so udeleženci vzorčili doživljanje in merili EDA, po srečanju pa so opravili fenomenološke intervjuje o izbranih vzorcih in krajšo sprotno analizo. Fazi zbiranja podatkov je sledila obširnejša analiza, v načrtu pa imamo opraviti še nevrofenomenološko analizo, v kateri bo izveden poskus integracije prvoosebnih in tretjeosebnih podatkov. Splošno shemo poteka raziskave prikazuje Slika 1.

Slika 1: Shema poteka raziskave

2.2 Udeleženci

V raziskavi je sodelovalo petnajst udeležencev (enajst žensk; povprečna starost = 27,0 let; *SD* = 7,4) od tega štirinajst študentov in en izvajalec. Izvajalec je imel večletne izkušnje z raziskovanjem doživljanja, študenti pa so pred raziskavo opravili trening vzorčenja doživljanja in izvajanja fenomenoloških intervjujev. Po vzoru tehnike OVI [19] je vsak študent vzorčil doživljanje vsaj 9 dni, pridobil vsaj 39 vzorcev, bil intervjuvan o vsaj 15 svojih vzorcih in opravil intervju o vsaj 15 vzorcih nekoga drugega. Pred prvim srečanjem so bili udeleženci seznanjeni z raziskavo, pridobljeno pa je bilo tudi njihovo soglasje za sodelovanje. Udeleženci so lahko s sodelovanjem v raziskavi opravili del obveznosti pri študiju.

2.3 Pripomočki in tehnike

Za merjenje EDA je bil uporabljen brezžični nadlahtni merilnik BodyMedia SenseWear. Merilnik je beležil EDA štirikrat na minuto in shranjeval podatke v interni spomin.

Prvoosebni podatki so bili pridobljeni s tehniko vzorčenja doživljanja, osnovano na tehniki OVI [19]. Signal za vzorčenje je sprožila aplikacija, naključno v intervalu od 5 do 15 minut. Za vzorčenje je bil uporabljen vprašalnik, ki se je delno razlikoval med pilotnim in ostalimi srečanji. Na pilotnem so udeleženci poročali o kontekstu in doživljanju v zadnjem trenutku pred signalom za vzorčenje, podali pa so lahko tudi komentar in opazke o doživljanju pred tem. Na vseh ostalih srečanjih so udeleženci poročali o istih postavkah kot na pilotnem srečanju in dodatno o doživljanju, ki je bilo v zadnjem trenutku pred signalom za vzorčenje v ospredju, podali pa so tudi odgovor na dve vprašanji z vnaprej predvidenimi odgovori. Pri prvem so označili stopnjo, do katere so bili v trenutku vzorčenja vpeti v vsebino predavanja (označili so lahko: *aktivna vpetost*, *vpetost*, *delna vpetost*, *delna odsotnost*, *odsotnost* ali *drugo*), pri drugem pa vrsto socialnega doživljanja, ki je bila takrat prisotna (označili so lahko: *brez socialnega doživljanja*, *preverjanje doživljanja drugih*, *občutek kolektivnega doživljanja*, *socialno uravnavanje* ali *drugo*).

Doživljajski vzorci so bili razširjeni in preverjeni s tehniko fenomenološkega intervjuja, osnovano delno na ekspozicijskem [26] in delno na mikrofenomenološkem [31] intervjuju.

2.4 Postopek

Vsa srečanja so potekala na spletni platformi Zoom. Pilotno srečanje je bilo namenjeno spoznavanju protokola raziskave in raziskovanega pojava, testiranju uporabljene tehnologije ter natančni specifikaciji raziskovalnih vprašanj. Na podlagi podatkov, pridobljenih na pilotnem srečanju, je bil oblikovan vprašalnik za vzorčenje doživljanja.

Na začetku vsakega srečanja so si udeleženci namestili merilnik za merjenje EDA, sledili sta dve minuti mirovanja, nato se je začelo predavanje. Tekom predavanja se je od pet do šestkrat predvajal zvočni signal, po katerem so imeli udeleženci na voljo eno do dve minuti za vzorčenje doživljanja. Po srečanju so udeleženci zbrane podatke naložili na spletni repozitorij.

Študenti so v času do tri dni po vsakem srečanju izvedli sprotno analizo prvoosebnih in tretjeosebnih podatkov, med tremi do šestimi dnevi po srečanju pa še fenomenološke intervjuje o izbranih doživljajskih vzorcih. O vsakem intervjuju so zapisali kratko poročilo.

2.5 Analiza

Analizo podatkov smo izvajali med in po koncu zbiranja podatkov. Glavni cilj analize je bil prepoznavanje vzorcev, ki namigujejo na obstoj skupinskih dinamik.

Sprotna analiza. Sprotna analiza podatkov EDA je vključevala vizualno identifikacijo sinhronizacij v signalih, sprotna analiza doživljajskih podatkov pa primerjavo vzorcev in preliminarno kategorizacijo. Izsledki sprotnih analiz so informirali nadaljnje faze raziskovanja in analize.

Doživljajska analiza. Primarne podatke za doživljajsko analizo so predstavljali odgovori na odprto vprašanje o doživljanju v zadnjem trenutku pred signalom za vzorčenje, odgovori na ostale postavke vprašalnika in poročila o intervjujih pa so služili dodatnemu preverjanju. Analiza je potekala po vzoru smernic za doživljajsko [32] in kvalitativno analizo [33, 34]. Najprej smo označili »satelitske« [31] dimenzije doživljanja, nato pa z induktivnim pristopom odprtega kodiranja [33] vsakemu vzorcu pripisali kategorije prvega reda. S primerjalno analizo smo prvotne kategorije po potrebi prilagodili, oblikovali višjenivojske kategorije in dobljene kategorije definirali. Na koncu smo izbrali tiste kategorije, ki so bile najpogostejše in/ali najbolj relevantne z vidika zastavljenih raziskovalnih vprašanj.

Analiza EDA. Analiza EDA je vključevala izračun sinhronizacij med pari udeležencev (od tu naprej parnih sinhronizacij) in izračun povprečnih parnih sinhronizacij (PPS) različnih skupin: (1) skupin vsaj treh med seboj sinhroniziranih udeležencev ($r \geq 0{,}40$)[1]; (2) vnaprej definiranih skupin (vsi udeleženci; samo študenti; izvajalec z vsakim študentom).

Petminutne odseke signalov EDA[2], ki so bili posneti v času pred vzorčenjem doživljanja, smo ročno pregledali in odstranili takšne, ki so vsebovali artefakte [24]. Pred nadaljnjo analizo smo dobljene signale standardizirali. Za izračun parnih sinhronizacij smo uporabili prilagojen algoritem Marci in Orra [26]. Sinhronizacijo EDA enega para pri enem vzorčenju smo izračunali kot povprečje dvanajstih Pearsonovih korelacij, pridobljenih s pomikanjem tekočega okna dolžine osmih meritev (dvominutni odsek) po eno meritev naprej, dokler nismo obdelali vseh dvajsetih meritev (petminutni odsek).

[1] Kriterij $r \geq 0{,}40$ razumemo kot spodnjo mejo srednje močne korelacije [23].

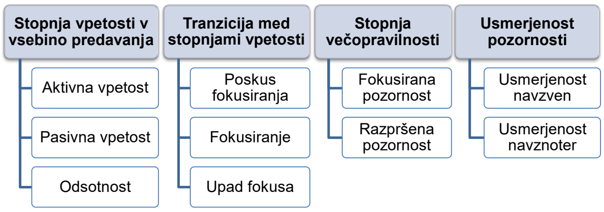
[2] Doživljajski podatki so bili omejeni izključno na zadnji trenutek pred signalom za vzorčenje, zato v analizi EDA nismo upoštevali celih signalov, ampak zgolj petminutne odseke, ki so bili posneti pred vzorčenjem doživljanja.

3 REZULTATI

Cilj raziskave je bil opisati doživljajsko pokrajino udeležencev med spletnimi predavanji (RV1) in preveriti, ali se na doživljajskem (RV2) in psihofiziološkem (RV3) nivoju, ter na obeh nivojih skupaj (RV4), porajajo skupinske dinamike. V nadaljevanju predstavimo preliminarne rezultate, ki se navezujejo na RV1, RV2 in RV3.

3.1 Doživljanje udeležencev (RV1)

Kot je razvidno iz Slike 2, je doživljajska analiza pokazala, da lahko doživljanje udeležencev (izvajalca in študentov) tekom spletnih predavanj opišemo s štirimi krovnimi kategorijami, vezanimi na osredotočenost in socialno doživljanje.



Slika 2: Hierarhija izbranih doživljajskih kategorij

Stopnja vpetosti v vsebino predavanja. Nekateri študenti so se v trenutku vzorčenja aktivno ukvarjali z relevantno vsebino ali pa so kako drugače izkazovali zanimanje zanjo; poročali so npr. o vizualizaciji in interpretaciji relevantnih konceptov, povezovanju z obstoječim znanjem, pa tudi o pričakovanju sledeče vsebine. Tako je zapisala Mara[3]: “Slušno zaznavam besede [izvajalca], subtilno si predstavljam nadaljnji potek predavanja, kot ga opisuje, na način, da interpretiram pomen besed v nesimbolnih mislih.” Izvajalec je sicer zmeraj aktivno posredoval vsebino, a je včasih vseeno poročal o večjem zanimanju. Takšne primere smo imenovali *aktivna vpetost* (n = 88). Včasih so študenti vsebino predavanja sicer zaznavali, a ne tako pozorno in z njo niso ničesar aktivno počeli. Tudi izvajalec je včasih poročal o manjši zbranosti ali naveličanosti. Takšne primere smo uvrstili v podkategorijo *pasivna vpetost* (n = 50). Nazadnje smo prepoznali tudi več primerov *odsotnosti* (n = 30), ko v doživljajskih pokrajinah študentov ni bilo mogoče zaznati vsebine predavanja, izvajalec pa je poročal npr. o zmedenosti.

Tranzicija med stopnjami vpetosti. Doživljanje udeležencev se je včasih nanašalo na prehodne faze med *stopnjami vpetosti v vsebino predavanja*. Nekateri udeleženci so v trenutku vzorčenja poročali o *poskusu fokusiranja* (n = 19) oziroma prizadevanju za aktivnejšo vpetost v vsebino predavanja. Mara je na primer zapisala: “Doživljam težnjo po poglobitvi pozornosti na predavanje.” Drugi so težnjo po fokusiranju že začeli udejanjati – signal za vzorčenje jih je ujel v procesu *fokusiranja* (n = 15), ko so pozornost že preusmerjali na vsebino predavanja. Spet drugi so poročali o pravkaršnjemu *upadu fokusa* (n =19), bodisi zaradi utrujenosti, zaspanosti, lakote ali naveličanosti.

[3] Izseki, ki jih podajamo ob opisih kategorij, so urejeni tako, da ne razkrivajo identitet udeležencev in so po potrebi osnovno lektorirani.

Stopnja večopravilnosti. Doživljanje udeležencev je bilo mogoče razdeliti tudi glede na številčnost aktivnosti, na katere so bili pozorni. Včasih so bili osredotočeni le na vsebino predavanja – takšne primere smo imenovali *fokusirana pozornost* (n = 15). Med njimi najdemo zapis Mare: "Sem v stanju pričakovanja, občutim radovednost kot željo po razjasnitvi pojma izomorfizem." Občasno so bili udeleženci, npr. Zoja, poleg predavanja osredotočeni še na kaj drugega: "Poslušam in zdi se mi (čutim), da vem, o čem predavatelj govori [...]. Moja pozornost je sicer rahlo razpršena – misli mi tavajo na več koncev, predvsem preverjam, kaj vse moram še danes narediti." Takšne primere smo označili z *razpršeno pozornostjo* (n = 16).

Usmerjenost pozornosti. Doživljanja udeležencev so včasih zaznamovali občutki, vezani na druge (virtualno) prisotne na srečanju; udeleženci so se zavedali drugih, skušali so ugotoviti, kaj drugi doživljajo, ali pa so jih opazovali na Zoomu. Te primere smo združili v podkategorijo *usmerjenost navzven* (n = 44). Toda socialnega doživljanja ni bilo zmeraj zaznati; včasih so udeleženci opazovali svoje doživljanje, izvajali samorefleksijo, ali pa se samoopazovali na Zoomu. Takšne zapise smo označili z *usmerjenostjo navznoter* (n = 27).

3.2 Doživljajske skupinske dinamike (RV2)

Skupinsko dinamiko na doživljajskem nivoju smo definirali kot skupino treh ali več udeležencev, katerih istočasno podane vzorce doživljanja smo uvrstili v isto podkategorijo (glej Sliko 2). Skupno smo prepoznali 56 primerov skupinskih dinamik, od tega 19 za prvo, 19 za drugo in 18 za tretje srečanje. 40-krat so skupinske dinamike tvorili študenti, 16-krat pa študenti in izvajalec. Najpogosteje so bile skupinske dinamike vezane na podkategorijo *aktivna vpetost* (n = 18). Najbolj opazno usklajenost smo prepoznali pri petem vzorčenju tretjega srečanja, ko so tako izvajalec kot sedem študentov sočasno poročali o *aktivni vpetosti*. Izvajalec je takrat zapisal: "Stanje zaganjanja v predavateljski tok – ne še čisto tam. Tokrat je nemir v ozadju močnejši, je pa tudi višja energija – bolj aktivno 'sodelujem' pri oblikovanju predavanja." Ena izmed študentk, Ajša, pa je poročala: "Zanimanje za to, kar [izvajalec] govori, kar sem čutila kot željo, da si o tem kaj napišem ter da slišim vse, kar izreče, da ne izgubim toka govora."

Skupinske dinamike so se tekom vzorčenj posameznega srečanja sistematično spreminjale. Denimo na prvem srečanju smo pri četrtem vzorčenju zaznali splošen upad osredotočenosti tako pri izvajalcu kot pri študentih. Do tretjega vzorčenja so izvajalec in večina študentov (M = 9,3; SD = 2,3) poročali o *aktivni vpetosti*, manj študentov pa je poročalo o *pasivni vpetosti* (M = 2,7; SD = 2,4) in *odsotnosti* (n = 1). Zatem izvajalec ni več poročal o *aktivni vpetosti*, prav tako je o njej poročalo bistveno manj študentov (M = 5,0; SD = 0,0), število tistih, ki so bili *pasivno vpeti* (M = 5,0; SD = 2,0) v vsebino predavanja, ali so bili *odsotni* (M = 3,0; SD = 0,0), pa se je dvignila. Izvajalec je takrat zapisal: "Čutim se odsotnega, avtomatično govorjenje – tema mi je dolgočasna, rad bi, da jo čim prej zrecitiram, da grem naprej na bolj zanimivo vsebino."

3.3 Psihofiziološke skupinske dinamike (RV3)

Analiza podatkov EDA je pokazala skupno 25 skupin s tremi ali več medsebojno parno sinhroniziranimi člani. Na prvem srečanju (pet vzorčenj) smo prepoznali šest sinhroniziranih skupin, na drugem (šest vzorčenj) deset in na tretjem (pet vzorčenj) devet. Sinhronizirane skupine se niso ohranjale prek več vzorčenj enega srečanja. Najvišja PPS je znašala 0,78 (tretje vzorčenje tretjega srečanja), povprečje PPS vseh skupin pa je bilo 0,62 (SD = 0,08).

Pri vnaprej definiranih skupinah smo največjo skupinsko dinamiko opazili na prvem srečanju, kjer je bila PPS vseh udeležencev 0,20 (SD = 0,54), vseh študentov 0,14 (SD = 0,53), izvajalca s študenti pa 0,40 (SD = 0,58). Pri drugem vzorčenju je bila PPS vseh udeležencev 0,19 (SD = 0,29), vseh študentov 0,17 (SD = 0,30), izvajalca s študenti pa 0,29 (SD = 0,22). Pri zadnjih treh vzorčenjih se je PPS gibala okrog 0. Na drugem srečanju smo prepoznali manj očitne skupinske dinamike. Pri prvem vzorčenju je PPS izvajalca s študenti znašala 0,17 (SD = 0,55), pri drugem 0,15 (SD = 0,38) in pri šestem prav tako 0,15 (SD = 0,29). Pri četrtem vzorčenju je znašala PPS vseh udeležencev 0,12 (SD = 0,37), vseh študentov pa 0,16 (SD = 0, 38). Sicer se je PPS gibala okrog 0. Na tretjem srečanju nismo prepoznali PPS večjih od 0. Za vsa tri srečanja je povprečje PPS vseh udeležencev znašalo 0,04 (SD = 0,07), vseh študentov 0,03 (SD = 0,10) in izvajalca s študenti 0,05 (SD = 0,15).

4 DISKUSIJA

V prispevku smo pokazali, da se tudi v spletnem učnem okolju, kjer udeleženci niso fizično prisotni, tvorijo doživljajski in psihofiziološki vzorci koordiniranega delovanja tako med študenti kot med študenti in izvajalcem. Da bi videli, ali se prepoznane skupinske dinamike porajajo na obeh nivojih hkrati, bomo v naslednjem koraku izvedli nevrofenomenološko analizo, v kateri bomo izsledke neodvisne doživljajske analize preverili z dodatno analizo EDA in izsledke neodvisne analize EDA z dodatno doživljajsko analizo. Upamo, da bodo končni rezultati poglobili razumevanje skupinskih dinamik, ki se tvorijo v spletnem učnem okolju. Ker so določene skupinske dinamike povezane z akademsko uspešnostjo [1, 35, 36], upamo, da bodo naši rezultati pripomogli tudi k izboljšanju učnih pristopov.

Določene pomanjkljivosti raziskave najdemo v načinu izvedbe, uporabljeni tehnologiji in izbrani metodi. Prvič, dejstvo, da je bila raziskava izvedena v naravnem okolju je po eni strani povečalo njeno ekološko veljavnost, po drugi strani pa otežilo posploševanje zaradi nezmožnosti zagotavljanja univerzalnosti eksperimentalnega okolja. Drugič, merilnik, s katerim smo pridobivali podatke EDA, je namenjen za uporabo na nadlahti, ki je optimalna lokacija z vidika nizke invazivnosti, ne pa tudi z vidika pridobivanja podrobnih podatkov o psihofiziološkem stanju uporabnika [24, 37]. Tretjič, podatke o psihofiziologiji smo pridobivali zgolj s pomočjo mere EDA, medtem ko bi lahko kombinirana uporaba več senzorjev psihofiziologije omogočila podrobnejši uvid v delovanje AŽS [38]. Četrtič, doživljajski vzorci so bili mestoma premalo natančni, fenomenološki intervjuji, s katerimi smo reševali ta problem, pa so bili opravljeni le o izbranih vzorcih in včasih šele tretji dan po srečanju, kar je otežilo priklic informacij iz spomina. Izvajanje intervjujev o vseh vzorcih v krajšem času od vzorčenja bi po drugi strani bistveno povečalo že tako visoke zahteve, ki jih je raziskava polagala na pleča udeležencev.

Metodološki izziv za prihodnje raziskave je torej najti način, kako sočasno zagotoviti visoko ekološko veljavnost in univerzalnost okoljskih dejavnikov, kako sočasno zadovoljiti potrebo po nizki invazivnosti in visoki odzivnosti merilnikov psihofiziologije, ter kako uskladiti potrebe po pridobivanju podrobnih in veljavnih prvoosebnih podatkov na način, ki ne bo pretirano zahteven za udeležence.

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The ONE-ness of change: An exploratory neurophenomenological single case study on change in mood

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ABSTRACT

The process of change is universally referred to when explaining the human psyche in the domain of attitude and behavior change. However, change is either presumed to simply exist without further elaboration, or it is reduced to neurobiological processes. While there is a substantial effort to detect, forecast and induce change, especially in the mental health-related fields, the results have been mixed so far. Understanding what change is is therefore crucial. Data on first-person experience has been thus far absent from studying change, which may turn out to be a deciding oversight. This exploratory study employs the framework of neurophenomenology to explore the process of change from multiple perspectives. In this circularly informing research process, we used ecological momentary assessment to gather daily questionnaire and diary data on mood. Afterward, we selected a single case, and determined the moment of change in mood through an inter-methodological agreement using qualitative and computational methods. Lastly, we conducted phenomenological interviews to study change on the experiential level. We found that while there may be inter-methodological agreement on the moment of change, different levels of analysis (operational, narrative, experiential - ONE) establish different definitional aspects, whereas the existence of change on the experiential level is unclear. It was ambiguous whether the same phenomenon was studied even after inter-methodological agreement. Further intersubjective research is needed to explore the phenomenon further.

KEYWORDS

ecological momentary assessment, empirical phenomenology, human change processes, idiographic computational dynamics, mental health, natural language processing, neurophenomenology

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[1] Please note that throughout the text we use "state A" and "state B" to delineate, respectively, the state before change and the state after change. However, the different instances of "state A" and "state B" do not necessarily correspond.

1 INTRODUCTION

Established research on the mind related to human change processes, also referred to as attitude and behavior change, presumes change simply exists, without any further elaboration. Implicitly, researchers treat change as dark matter: there is *state of interest* S_A at *a time t*, *state of interest* S_B at *time t+1*, and what happens in between is magic [1-4].[1] When change is defined, albeit rarely, it falls into reductionist pits, being reduced to neurobiological processes [5], or it is defined functionally, where change equals S_B less S_A, especially in quantitative research.

Thus, research is mostly concerned with how to drive S_A to S_B, tackling questions such as "What motivates change?", "How is change implemented?", "How is change sustained?", "When to induce change?", and similar [1-4]. What surprisingly lacks from this list is a bit more intimate and primary: **What is change?**

The question is neither trivial nor unimportant. Various domains interested in change - from mental health [4] to green behavior [6] - are facing a considerable obstacle when trying to detect, forecast and induce (desired) change [7]. Physiological (e.g., sensors) and psychological (e.g., questionnaires) tools have been used to this end, but have produced mixed results, especially on longer scales [8]. What is more, it seems that cognitive science is still in its infancy when studying change. Analogies can be found in both extreme levels of analysis. In physics, classical thermodynamics ignored the process of change, and it was only non-equilibrium thermodynamics that started to consider change as a fundamental process as opposed to only studying substances [9]. In philosophy, process philosophy faced Plato's claim on change as illusionary, and stood against the classical philosophical view of ontology [10]. Post-cognitivist paradigms in cognitive science provided a similar opposure, especially dynamical systems theory (e.g., psychotherapy [7]). In behavioral sciences, the study of persuasion is starting to brush against the notion of what change might be [11].

Another consequence of the prolificacy of post-cognitivist paradigms was the introduction of first-person experience [12] as an essential aspect of studying the mind. Expectedly, empirical phenomenology [13, 14] has so far eluded inclusion into the science of change, an oversight which might have hurt its efforts.

First-person experience reports might uncover experiential patterns that may thus prove to be an invaluable tool for answering the questions on change. Phenomenological interviews in particular are often focused on the “transitions between different phases [in time of an experience]” [15, p. 6], and could therefore elucidate the nature of the *magic* happening between two states. However, to our knowledge, no empirical phenomenological study investigated the experience of change, that is, no empirical phenomenological study aimed at an accurate phenomenological description of how it is to experience change per se (for a study on the experiential nature of the transition between two sequential moments, see [16]).

This exploratory study therefore aimed to spur non-reductionist research on the fundamental nature of what change is (see section Outline of the research framework for details). The general domain of mental health offers an appropriate context to study change, because it makes it salient. We focus on change in mood, which is not only ubiquitous, but also one of the primary concerns in mental health. We followed neurophenomenology [17] on combining first-person and third-person methodologies with mutual constraints, and used ecological momentary assessment (EMA) to collect daily quantitative and qualitative data on mood as well as conducted phenomenological interviews on selected data.

2 OUTLINE OF THE RESEARCH FRAMEWORK

The highly exploratory nature of this research is two-fold: 1) its object of inquiry is on the one hand ubiquitous and on the other hand definitionally very vacuous; and 2) the mutual-informing of the methods used has been untested so far. Since our presupposition is that change is fundamentally a dynamical process, we rely on collecting time series and diachronic data. Due to the human idiography [18], this touches the framework of small or personalized data [19], where inter-human variance and noise are reinterpreted and feature as important data. Following this, our framework investigates a moment in time with dynamics-sensitive methods on various levels of analysis. What is sought is inter-methodological agreement, and descriptions of the phenomenon on various levels of analysis. Once the latter are gathered, the unified definitional outlines can occur.

For this study, we are focusing on a single case, and within this single case, on a single identified unity of data. We believe methodological pluralism is necessary to explore this phenomenon. Note that this research is not executed sequentially, as various types of data inform one another and the direction of the research [17]. The decision on the context of mood was made due to the ubiquity of it, and the importance of change processes in mental health. We note that change may not be invariant in every context.

2.1 Research Questions

This work pursues the following research questions:

RQ1: What is the inter-level agreement between various methods with which change can be detected?

RQ2: What are the properties of change that are discerned (or constructed) by various methods and where do they diverge? Are they addressing and describing the same phenomenon?

RQ1 is concerned with the level of methodological agreement that change occurred in a selected moment in time. RQ2 is concerned with how change can be described when using specific methods, how the latter influence the definition, and whether the phenomenon they ultimately research is the same.

The research questions specific to the phenomenological investigation were informed by time series data.

pRQ1: Was change experienced at any point of the investigated episode?

pRQ2: What is the experiential difference between the state before and the state after the change?

These RQs cannot be addressed through the results only due to the exploratory nature of the work. We thus partially address them in the Discussion section as well.

3 METHODOLOGY

To pursue the research questions, we employed a mixed-methods methodology, using quantitative data collected from daily questionnaires, text data collected from daily diary entries, and first-person experiential data collected with phenomenological interviews. Due to the circular informing that occurred between these data that guided the research, we have adopted the framework of neurophenomenology, where “‘neuro’ refers [...] to the entire array of scientific correlates which are relevant to cognitive science” [17, p. 330].

To be able to study change ecologically, occurring in the wild as much as possible, we followed the EMA framework, which involves "repeated sampling of subjects’ current behaviors and experiences in real time, in subjects’ natural environments", which aims to "minimize recall bias, maximize ecological validity, and allow study of microprocesses that influence behavior in real-world contexts" [20, p. 1].

3.1 Materials

We used the 10-item international Positive and Negative Affect Schedule Short Form (I-PANAS-SF) in English [21] to collect daily mood data. I-PANAS-SF evaluates the following moods in a desired time span (in our case, daily) on a 5-point Likert scale: Afraid (AF), Alert (AL), Determined (DE), Distressed (DI), Enthusiastic (EN), Excited (EX), Inspired (IN), Nervous (NE), Scared (SC), Upset (UP).

To collect the diary entry data, guidelines suggested to the co-researchers (see [22] for the use of the term co-researcher) to focus on the descriptions of mood, the effects of mood on the experiences of themselves and the world, the change of the latter from the previous day to the present day, and on any salient factual information about the day (for more, see Supplementary materials, section Diary entry guidelines).

3.2 Sample and Case

The sample included seven people, largely acquaintances of the authors, from which a single person was arbitrarily selected, codenamed as Quentin. Our co-researcher was 30 years old at the end of the data collection phase, biologically assigned at birth as male and identifying as a man and as non-binary, with a master's degree. He was of somewhat good mental health, had never been diagnosed with a mental disorder, did not have mental health-related therapy in the recent past, and was not taking any mental health-related medications. He slept seven hours on average per night and had bad sleep quality. He was generally a positive person who felt neutral about his emotional arousal or did not identify with having positive or negative emotional arousal. His experience with phenomenological reporting amounted to around 70 hours.

3.3 Data Collection

We used the Synergetic Navigation System (SNS), a web- and mobile-based technology for EMA [23], to collect questionnaire and diary data, and conducted in-depth phenomenological interviews based on micro-phenomenology [24] to collect experiential data. The data was collected from June 24th to July 14th 2021. The SNS data on a given day was collected from 18:00 onwards on the same day or in the morning of the following day. Quentin was notified at the starting hour of data collection through email and mobile push notifications. The interviews were recorded with a Samsung Galaxy A41.

3.4 Computational Definition of Change

To detect change in quantitative data, change had to first be defined methodologically. Since quantitative data are generally analyzed computationally, we present a computational definition of change which was applied to the data. We computationally defined (inspired from sudden gains literature [11] and anomaly detection [25]) that change C between data point or state A (S_A) at time t and data point or state B (S_B) at time $t+1$ occurs if

$$(((SB > (M + SD/MAD)) \| (SB < (M - SD/MAD))) \& ((M - SD/MAD) < SA < (M + SD/MAD))) \quad (1)$$

$$\|$$

$$(((SA > (M + SD/MAD)) \| (SA < (M - SD/MAD))) \& ((M - SD/MAD) < SB < (M + SD/MAD))) \quad (2)$$

$$\|$$

$$(\Delta C > SD/MAD) \quad (3)$$

where M equals the mean value of the entire time series and standard deviation (SD) is used if the data is normally distributed, and median and mean average deviation (MAD) is used if the data is not normally distributed. It denotes that change occurs:

a) if S_B falls outside of bounds of SD/MAD while S_A falls inside (Equation (1)); or

b) if S_A falls outside of bounds of SD/MAD while S_B falls inside (Equation (2)); or

c) if both are inside the SD/MAD bounds, S_B is more than one SD/MAD away from S_A (Equation (3)).

SD/MAD bounds represent the baseline, which means that between a data point falling outside of these bounds while the preceding data point was inside the bounds change occurred, and vice versa. If inside the baseline, change can still occur, but it has to be bigger than one SD/MAD.

To apply this calculation to the data, it has to be preprocessed, extracting the described values.

This computational definition of change is independent of the context (in our case, mood).

3.5 Empirical Phenomenology

We included empirical phenomenology as a method to obtain data on experience. Empirical phenomenology, based on the concept of *epoché* [26], allows to get descriptions of how the investigated episodes and phenomena are actually lived. It excludes the possible narratives, conceptualizations, and judgements that might be constructed after the experience per se. In particular, we opted for an interviewing approach based on the micro-phenomenological interview method [24]. The interviewer non-suggestively accompanies the interviewee in providing accurate phenomenological descriptions of the diachronic (temporal unfolding) and synchronic (non-temporal dimension, associated with a specific moment or phase) structure of the experience. For these reasons, empirical phenomenology allowed us to investigate how it is to experience change. The interviewing was informed by our research questions, and the interviews were conducted after change had already been partially identified (see Results, Subsection Identifying the moment of change).

3.6 Collected Data

Quentin completed 16 questionnaires and provided 16 diary entries between June 24th and July 14th 2021. The mean of Quentin's diary entries was 195 words. Furthermore, three in-depth phenomenological interviews were conducted on the selected moment within the time series data (see Results, subsection Identifying the moment of change), clocking 00:43:33, 01:00:51, 1:09:41 in length, respectively. The interviews are being transcribed verbatim.

4 RESULTS

This section presents the analysis of the collected data. For computational analysis of the time series data, features were extracted in order to calculate whether and when change had occurred. Change was already defined computationally for the time series in the previous section. Phenomenological results present the effort to identify change experientially, without a definition pre-given by the authors.

4.1 Feature Extraction

Features extracted from the quantitative questionnaire scores included: the mean and SD of a given mood category if the distribution was normal; and the median and MAD if the distribution was non-normal. We performed a normalcy test to discern that. Instances with missing questionnaire data were filled with last collected data scores.

Features extracted from the diaries included sentiment analysis features and statistical features of sentiment features. We used VADER, “a lexicon and rule-based sentiment analysis tool,” [27, para. 1] to get negative and positive sentiment scores for each daily diary entry. Afterward, we extracted statistical features following the same process as for the quantitative questionnaire scores. Instances with missing diary data and therefore missing sentiment scores were linearly interpolated.

4.2 Identifying the Moment of Change

To identify the moment of change and address RQ1, several steps were taken. Authors studied the data, particularly reading the diary entries, and asked Quentin to propose a data instance where he felt an instance of change had occurred. Quentin suggested the data instance from July 1st, 2021. This is the selected data instance:

Table 1: Quentin’s mood scores on July 1st 2021 (see full names in this subsection, para. 5).

DI	AF	UP	NE	SC	IN	AL	EX	EN	DE
1	1	1	1	1	5	5	5	5	5

For the selected diary entry (DiaryE0) and the data from the previous day, see Supplementary material, section Diary entries and quantitative questionnaire mood scores. The text part (pDiaryE0) containing the description of change can be read below:

> *I saw myself as important, I was very self-confident. This brought about a certain feeling, a certain change in the air around me. [...] people listening to me [...] had this directionality towards me which gave me some sort of power. Compared to yesterday, when I also felt inspired and enthusiastic, today I had this huge undertone of confidence, and this caused a difference especially in how I perceived others.*

Quentin confirmed this is a good example of change occurring during the data collection. The authors had beforehand identified the same data instance as a potentially good candidate. The change specifically referred to the particular confidence (“*Compared to yesterday, […] today I had this huge undertone of confidence*”*).* The state of the mood before the change (or State A) was therefore either no confidence or a different kind of confidence, coupled with inspiration and enthusiasm, and the state of the mood after the change was the newly found confidence (or State B).

For inter-methodological agreement on the moment of change, the computational method for detecting change (see Methodology, subsection Computational definition of change) was applied to two data streams, the quantitative questionnaire scores (all the 10 mood categories) and the diary entries.

For the quantitative questionnaire scores, change was detected in 7 out of 10 mood categories (AL, DE, DI, EN, EX, IN, UP). The three categories where change was not detected (AF, NE, SC) were stationary, which means that there were no changing curves. See Supplementary material, section Mood graphs for mood graphs with detected change. Figure 1 presents one such graph, signifying the change in EN.

Figure 1: Detected change in the Enthusiastic mood category from 30. 06. 2021 to 01. 07. 2021.

Furthermore, change was detected in both the positive and negative sentiment scores from the diary entries. See Supplementary material, section Sentiment graphs for sentiment graphs.

The results show maximum inter-methodological agreement. Every part of the two data streams that could have possibly validated the initial identification of change had validated it. The next step was to see whether change occurred in the selected moment on the experiential level.

4.3 Phenomenological Results

To identify the moment of change to be investigated in the interviews, we analyzed the fragment of the co-researcher’s diary entry in which the selected episode is described (pDiaryE0 below Table 1). We identified two possible instances of change: one in the third sentence, and the other in the last sentence. We decided to focus on the first one, as it seemed to have had occurred at a specific point in time, and it was therefore possible to investigate it with phenomenological interviews.

We present the provisional results of the phenomenological investigation. On the 1st July 2021, our co-researcher, Quentin, was giving a lecture at a seminar. He was sitting at a desk in a lecture hall, and he was talking to the people in front of him. He initially felt a self-confined confidence that later changed into a new confidence. We summarize the experiential categories that were different from before (state A) to after the change (state B) in Figure 2 (pRQ2).

In between state A and state B, Quentin noticed a ray of sunshine filtering through the air. He felt like his arms had the potentiality to move more freely in that direction, experienced as a sense of brightness on their upper left part. This aspect was part of the new confidence, which was not fully present yet. Quentin realized that this brightness was something new ((1) in Figure 2). Quentin felt a ball-like entity in his chest, which expanded until it reached the audience. It is at this point that the experience reached state B, where Quentin felt the full new confidence. Quentin had the knowledge that the way he was perceiving and could interact with people had changed ((2) in Figure 2).

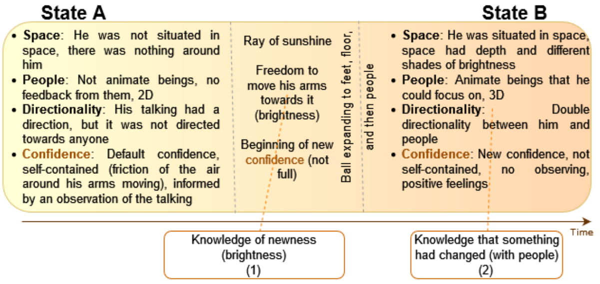


Figure 2: Experiential structure (diachronic and synchronic) of the target episode.

5 DISCUSSION

5.1 The ONE-ness of Change

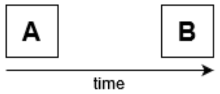
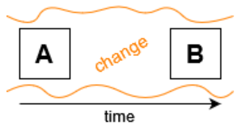
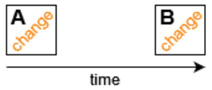
While discussing the data from the different methods, we specified incongruencies between the data and how it characterizes change (addressing RQ2). In quantitative analysis, change was necessarily defined by the authors - the computationally defined bounds were arbitrary wrt the phenomenon itself. We labeled this kind of (definition of) change OPERATIONAL (definition of) change (oC). In diary data, change was defined by the co-researcher in two instances, one of which includes the exact word "change" (see pDiaryE0). It is argued that we "organize [our] experiences and actions according to narrative structures thereby situating them in the context of a unifying story," [28, p. 179] which we attest also happens while writing a diary entry. Change was therefore narratively constructed. Arguably, this construction occurred in the moment of the writing of the diary, at a point in time successive to the original experience that the narrative was about. We labeled this kind of change NARRATIVE change (nC). In the phenomenological data, change was looked for in a collaboration between the co-researcher and the researcher conducting the interviews. Differently from the other levels of analysis, the understanding of something as change was here not already given, but to be explored and discussed. In fact, our phenomenological inquiry was aimed precisely at investigating how change might present itself in experience, if it does at all. We labeled this kind of change EXPERIENTIAL change (eC).

There are two big problems that arise from this: a) the granularity problem, and b) the level problem. It is not clear how the various time spans correspond to each other (a)), and whether the various levels of change (oC, nC, eC) refer to and describe the same phenomenon, using different levels of analysis. It might in fact be that oC, nC and eC refer to multiple phenomena. We do sense there is a certain correspondence between the three levels (and there was an agreement on the moment between the co-researcher's suggestion and the authors' suggestion), but unraveling the complexity of that is out of scope of this paper.

5.2 Models of Experiential Change

We hypothesize different models of how change might be experienced in a simplified "state A to state B transition".

Table 2: Models of experiential change.

1) Change is not present at all at the level of experience.	
2) Change is the experiential nature of the experiential flow in which state A and state B succeed each other.	
3) Between state A and state B there is a state C where change is experienced.	
4) a) Change is an experiential element present in both state A and state B. b) Change is an experiential element present either in state A or c) in state B.	

Some representational aspects of the models above are due to functional reasons. We envisioned further models but for the sake of brevity we only included some.

Following, we discuss how we tried to address pRQ1. During the first interview, Quentin said: "*Not that I felt the change, the change happened and I felt the consequences of the change*". This seems to suggest either model 1) or 4c). Later, we found two different instances of experience that could represent experiential change. The first refers to (1) in Figure 2. Quentin made it clear that the knowledge was about the brightness being something new, not something different from before, since "*There was no trace of what was before or how this came to be*". This does not mean that this experience does not entail experiential change: as far as we know, experiential change might be precisely experienced as the knowledge, or perception, of the newness of something. This would correspond to model 3). The other instance that might delineate experiential change refers to (2) in Figure 2. This change would correspond to model 4c). However, we were specifically interested in the experience of change in mood, and we cannot claim that the change referred to in (2) in Figure 2 complies with this. When asked towards the end of the third interview whether at any point of the investigated episode he realized that his confidence had changed, Quentin answered no (which hints at model 1)).

6 CONCLUSIONS AND FUTURE WORK

This work represents an exploratory neurophenomenological inquiry into the nature of change in the context of mood. We used ecological momentary assessment to collect daily questionnaire and diary data, and after selecting a proper data instance, we conducted phenomenological interviews on it. We discerned that there was an inter-methodological agreement on the moment of change; however, it is not clear how it manifested, if at all, on the experiential level. We observed various definitional aspects of change, culminating in *ONE-ness of change*, describing operational, narrative, and experiential change. Finally, we presented some possible models of experiential change and analyzed how our phenomenological data fit into them. We found two major problems to address in the future: the granularity and the levels problem.

The study had many limitations, mostly due to its exploratory nature. It was ultimately single case, where it analyzed only one episode. It had a limited number of interviews, which may have not gone in depth enough to really identify and specify the phenomenon of interest. Furthermore, interviews on the moment of writing might be necessary as well. When collecting quantitative data, not every day was sampled, and the amount of data may have produced biased baseline calculations, resulting in faulty change detections. Using a single method to detect change may also not be enough, and a discussion is needed on how to proceed when two methods from the same or different levels of analysis disagree on the change moment. We will not delve into the potential problems of ecological momentary assessment and quantitative and qualitative self-reports.

In future work, apart from addressing the limitations, we plan to continue with the general effort of this study. Future possibilities include: applying the same methodology transdiagnostically and for induced, volitional and spontaneous change; conducting interviews on episodes reported as including experiential change, and with expert meditators observing change; analyzing the inter-methodological and experiential structure of change, where it seems to follow some aspects of the matryoshka principle [29]; applying post-cognitivist frameworks, e.g., the dynamical systems theory framework; addressing the granularity problem by expanding the methodology by changing the EMA contingency (e.g., when experiential change occurs, when a physiological signal occurs) and including descriptive experience sampling [30]; seeing whether change can be forecasted with machine learning and what implications it brings; exploring what the possibilities in how oC, nC and eC relate to one another are; testing models of experiential change with computational simulations; making the dataset and codebook publicly available; interpreting our findings in the contexts of different theories of change and time.

ACKNOWLEDGMENTS

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Supplementary material

1 Diary entry guidelines

Please, answer the following questions in the form of a diary entry. Be mindful that your entry is approximately 150 words at minimum. There is no upper word limit. Questions:

1) Describe your mood.
2) Describe how your mood affected your experience:
   a) of yourself;
   b) towards the world and its elements.
3) Describe how these experiences have changed from yesterday to today.
   a) Change of experience towards yourself from yesterday to today.
   b) Change of experience towards the world and its elements from yesterday to today.
4) Factual information from the last day that you would like to highlight.

2 Diary entries and quantitative questionnaire mood scores

a) July 1st 2021

DiaryE0:

Today I mostly felt quite inspired, determined and enthusiastic. I saw myself as important, I was very self-confident. This brought about a certain feeling, a certain change in the air around me. The air was pointing up, and I could move throughout differently. Also, for example, people listening to me at a seminar about using a tool for daily assessment had this directionality towards me which gave me some sort of power. Compared to yesterday, when I also felt inspired and enthusiastic, today I had this huge undertone of confidence, and this caused a difference especially in how I perceived others. Otherwise it was a full day, I had a meeting about the future of my software, I worked on my study, I sorted out the details of my stay in another country which I was invited to visit, to see the psychiatric processes and to share knowledge at their clinic, I had the before mentioned seminar, my girlfriend Jaya and I went together to a wonderful classical concert with my parents, and finally, we ate homemade apple pie and drank champagne that was a gift from my mom's best friend. It was a great day.

Mood scores:

DI	AF	UP	NE	SC	IN	AL	EX	EN	DE
1	1	1	1	1	5	5	5	5	5

b) June 30th 2021:

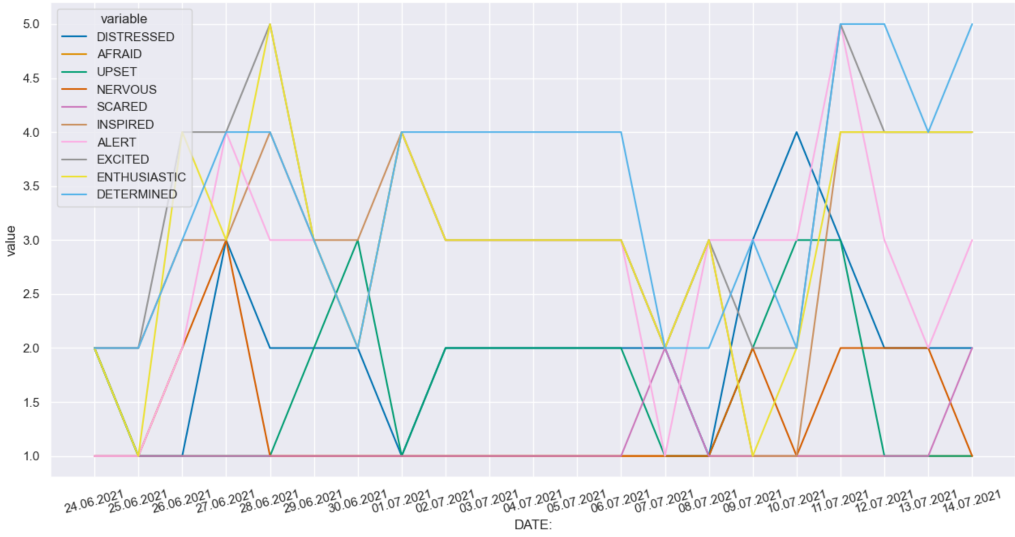
DiaryE1:

The day was signified by three moods - uninterested, determined, and inspired. I saw myself too scattered, without a center to hold me or to hold onto, and this made me uninterested in the world around me and it was hard to do anything I wanted to, which I disliked. The narrative of where I am was quite dispersed, and it was hard to look at the things that hold me together. At first I was frustrated, so I spend some time just embracing that feeling, with knowledge that afterwards I will pull myself together. When this phase came, I became determined to set myself straight, and I made a sort of a plan or a diagram of what I want to do and is important to me, what makes me happy. This was quite successful and afterwards I was inspired to do the tasks I wanted to do. The world was consequently also different, it is like after being inspired I am seeing it, it has this brighter quality, but not visually, but the feeling of its atmosphere. Otherwise I was quite happy to have my weekly meet with two of my friends online.

Mood scores:

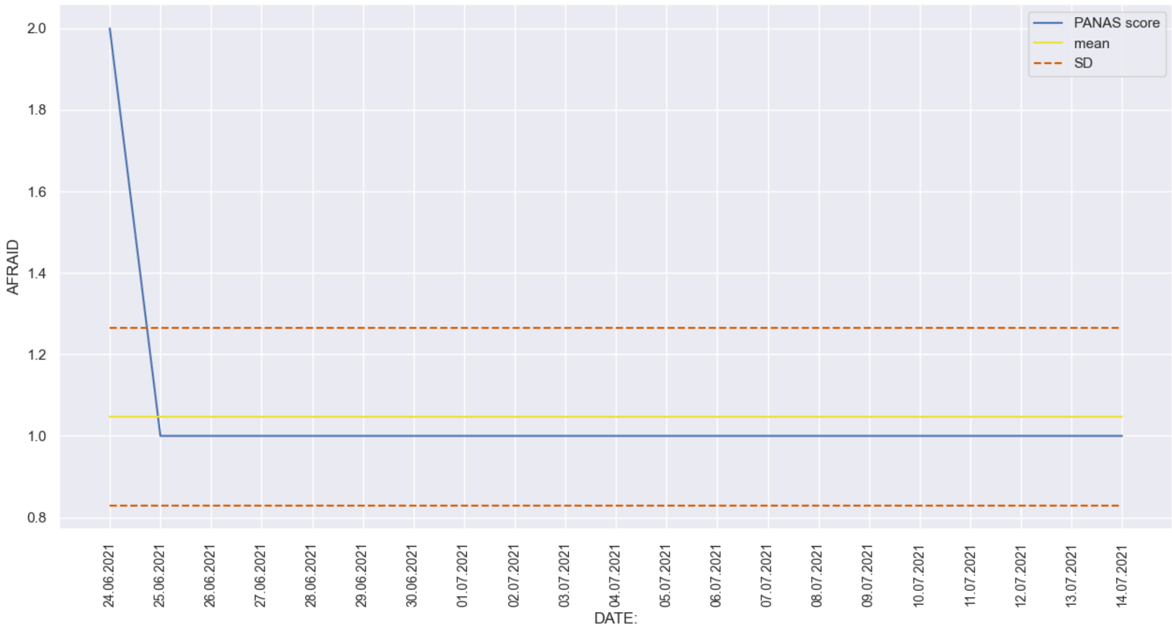
DI	AF	UP	NE	SC	IN	AL	EX	EN	DE
2	1	3	1	1	3	2	2	2	2

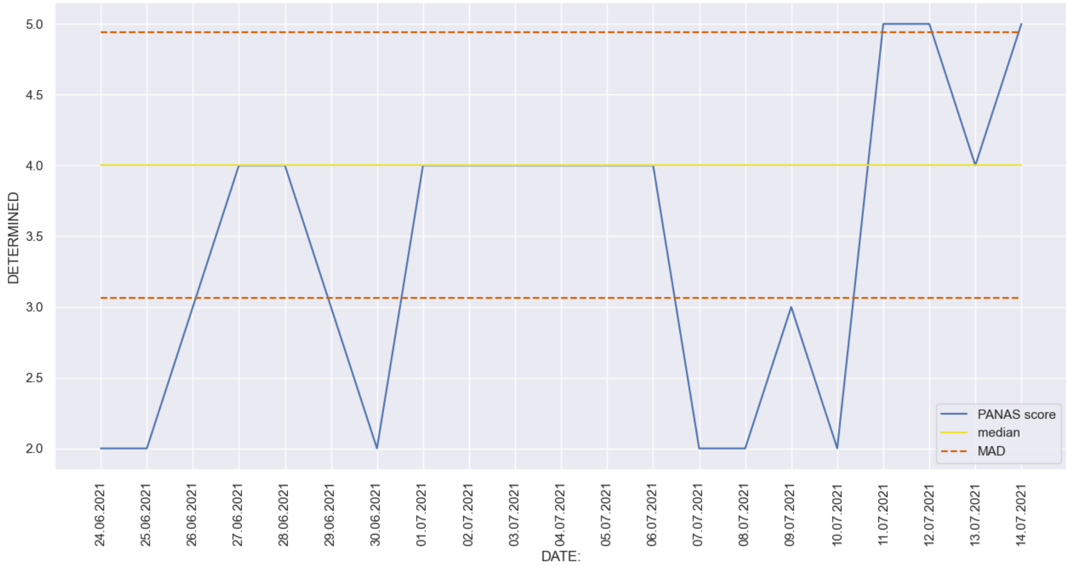
3 Graph of the mood over the entire time series



4

4 Mood graphs

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PANAS score
median
MAD
5.0
4.5
4.0
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24.06.2021
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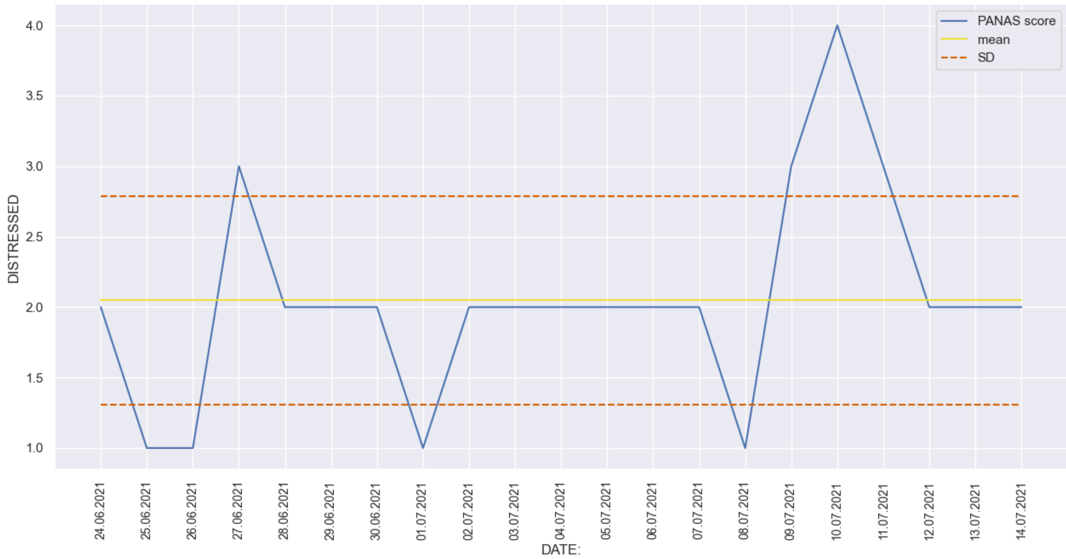
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PANAS score
mean
SD
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3.5
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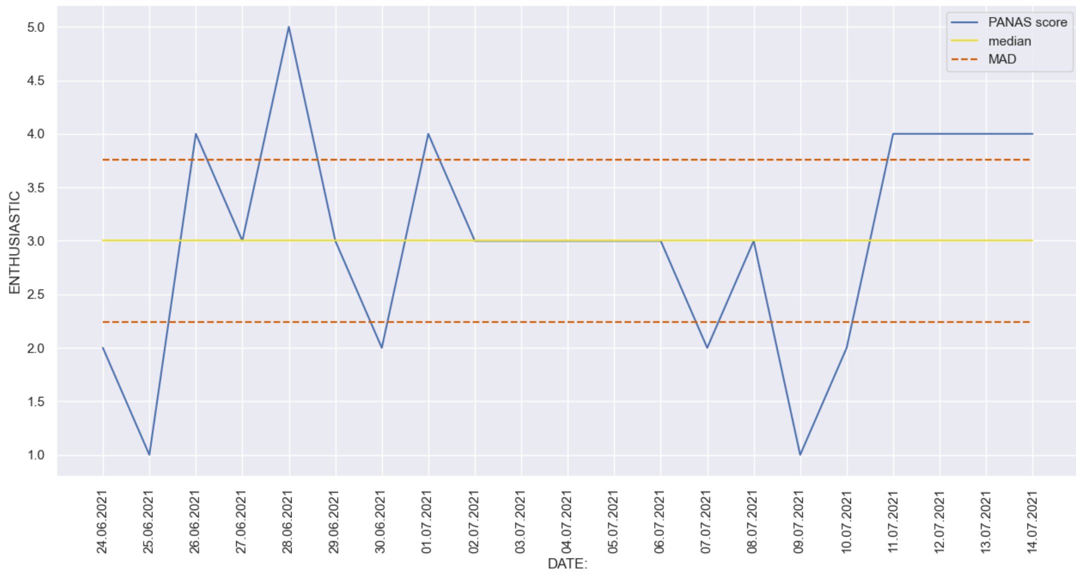
ENTHUSIASTIC
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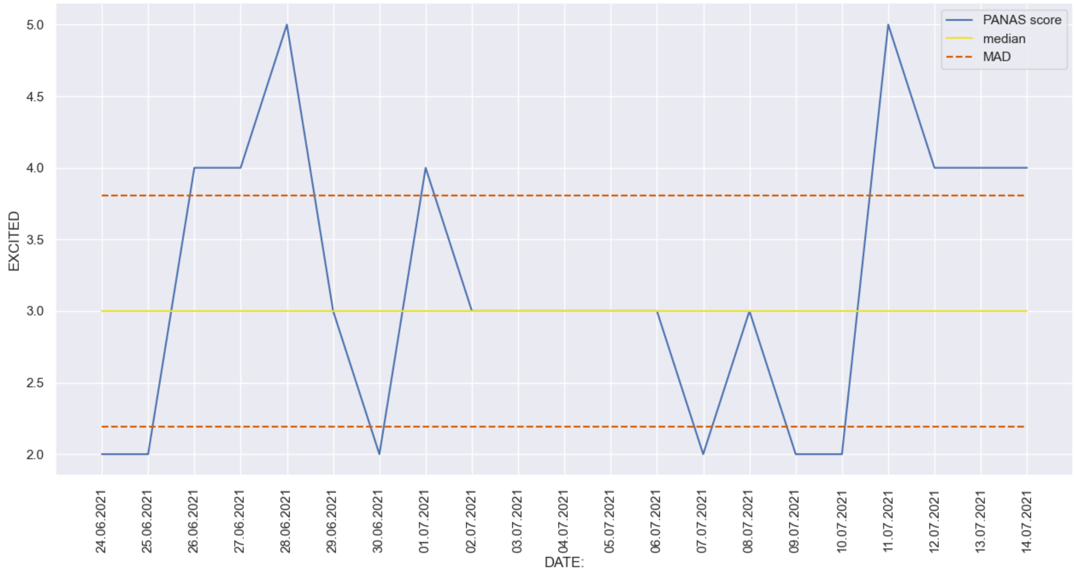
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median
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EXCITED
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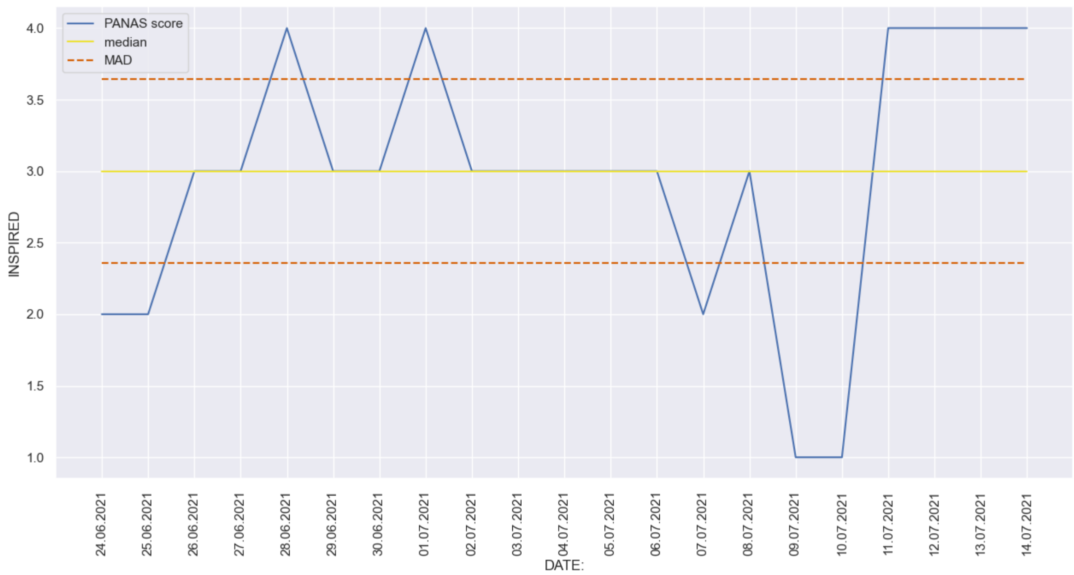
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MAD
INSPIRED
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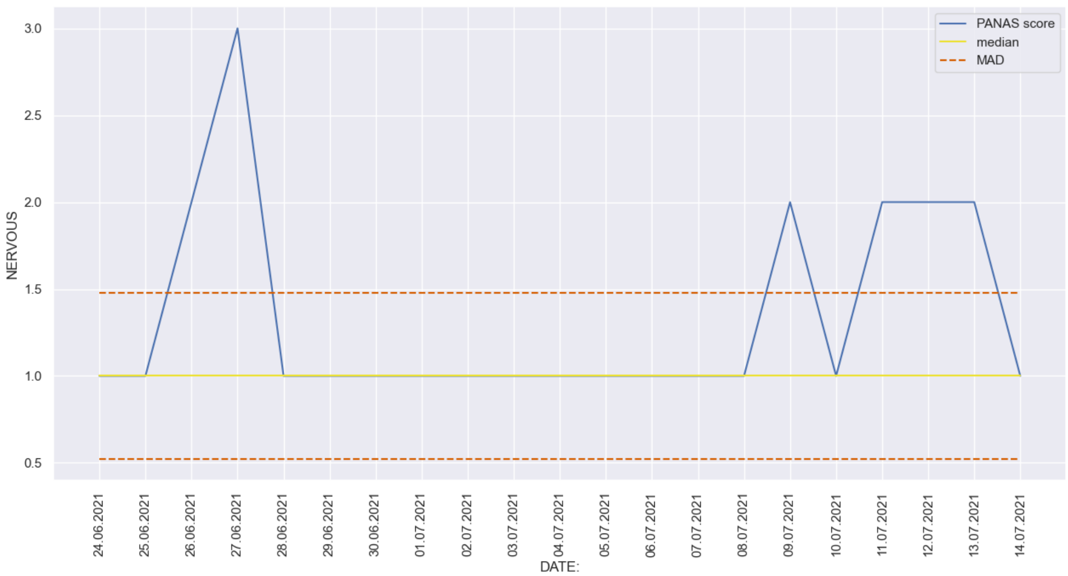
PANAS score
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MAD
NERVOUS
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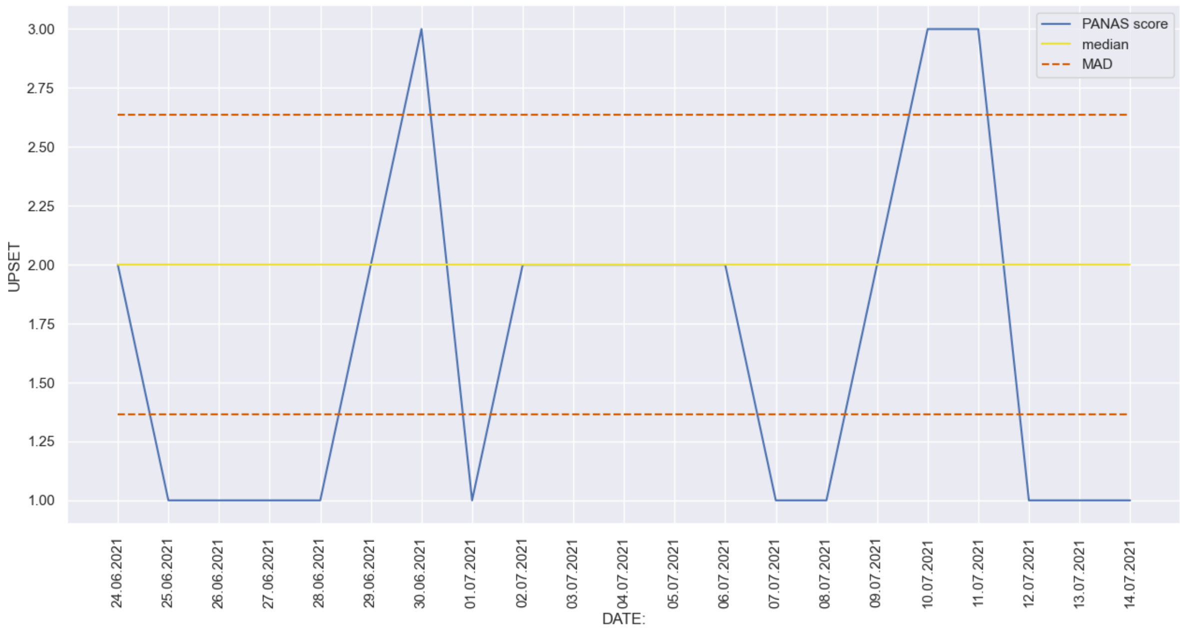
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2.00
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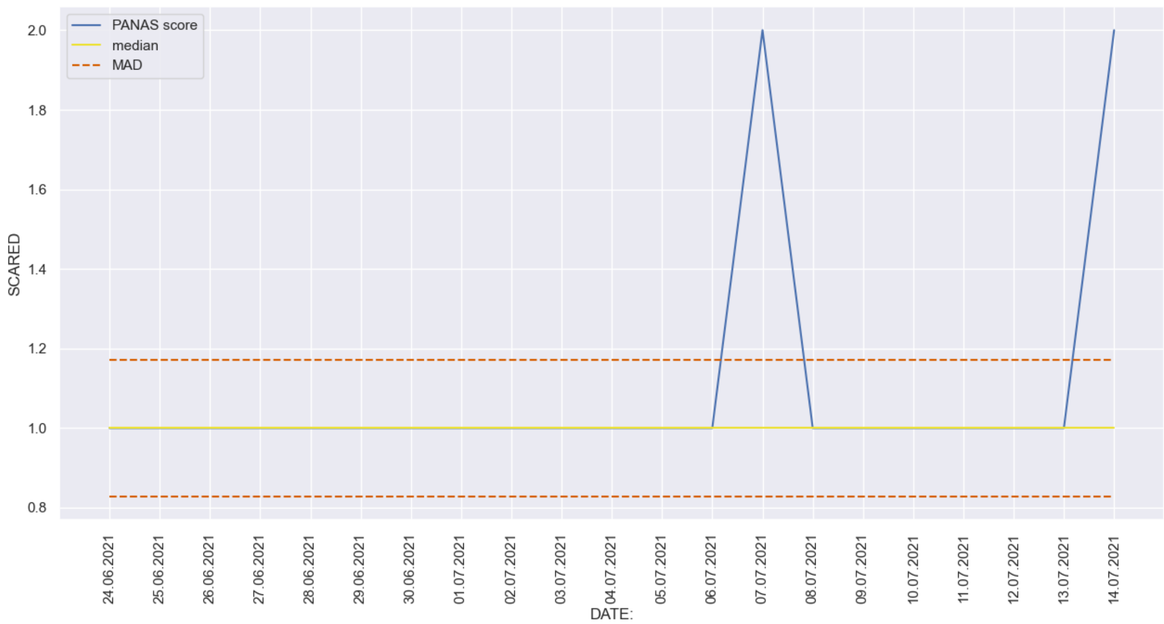
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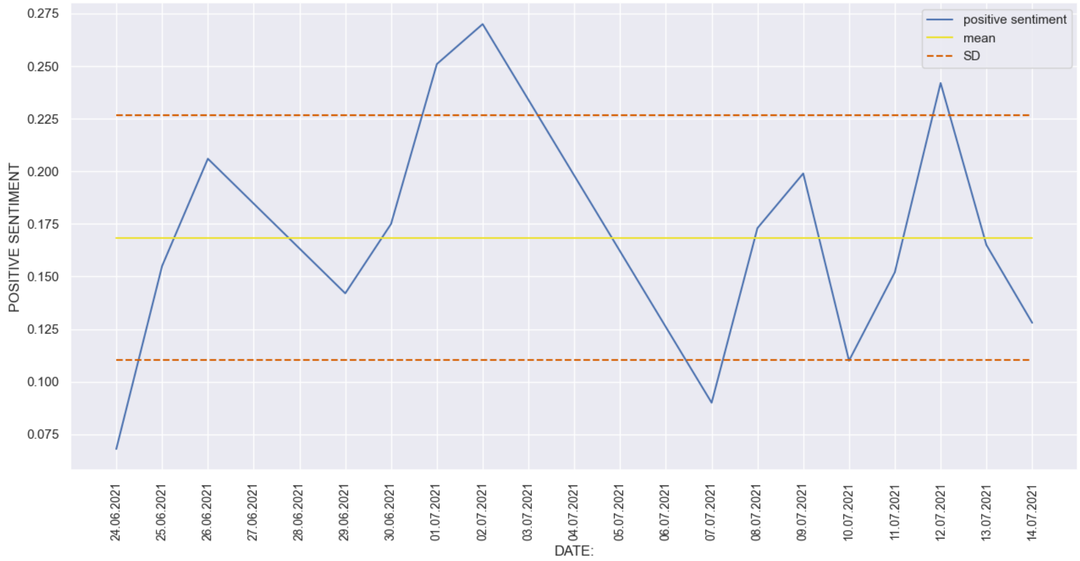
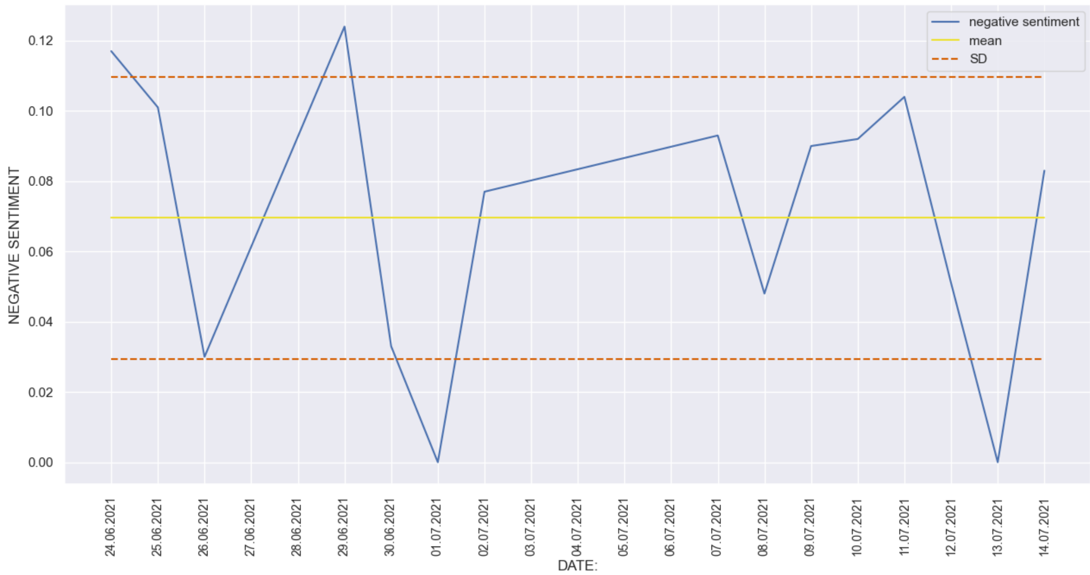
5 Sentiment graphs





Sensitivity of expected civilization longevity models

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ABSTRACT

In this paper, we analyse the parameter sensitivities of the Sandberg and Rare Earth civilization longevity models. The Sandberg model relies on the Drake equation, while the Rare Earth model assumes that the Earth is a very unique planet because of rare sequence of events causing its evolution. In addition to the sensitivity of the parameters, we also analyse the importance of those parameters.

KEYWORDS

Human extinction, Drake equation, Civilization collapse, Rare Earth hypothesis, distributions

1 INTRODUCTION

After years of dealing with Fermi's question: "Where is everybody?", we still do not seem to have a good answer. After scanning more than 10 million stars [11], we have not found a single extraterrestrial life.

We know that it is inevitable that human civilization will one day die out, but what is the expected longevity and how is it related to the absence of observed civilizations? One way is to design human longevity models that use a variety of parameters to answer this question. However, it is not clear which models heavily rely on the values of parameters. In this paper we study the sensitivity of the models to the parameters and we also try to determine which parameters have the greatest impact.

In our previous papers [6, 14] we approached the topic of the extinction of human civilization and introduced the Drake equation [1]. In the first paper [6] we presented Sandberg's [8] interpretation of the Drake equation and analysed it. In the second paper [14], we presented possible causes of human extinction and used the Drake equation to estimate the longevity of human civilization. In the last paper [4], we presented four different models with some modifications of the Drake equation and considered their prospects for the time we have left. We concluded that we are most likely to survive at most 10 000 years.

In this paper, we focused mainly on two of the models from the previous paper [4]. The first model we analysed is based on Sandberg [8] and the second one represents the "rare Earth" hypothesis [12]. For both models we analysed the difference between using log-uniform and log-normal distributions of the parameters. In addition, we analysed which parameters most affect the results in each model. All in all, we dove into the structure of the models and tried to improve the accuracy of the results.

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2 RELATED WORK

Some publications suggest there are 600 to 40 000 technological civilizations in our galaxy [10], while others think there should be about 36 of them, assuming an average lifespan of 100 years [13]. However, given our ability to detect intelligent life [3] and their radio signals [2], and the fact that we have not detected anything yet, a large number of civilizations is unlikely.

In our previous paper [4], we analyzed 4 different models of the modified Drake equation to determine longevity of human civilization. From the accessible data, we concluded that the human technological civilization will most likely survive at most 10 000 years. Note that the analysis is not able to conclude anything about biological aspects of humans. Another research induces that the yearly probability for extinction is most likely less than 1 in 87 000 using four different models [9]. In [5] they explain that humanity will eventually have to move to avoid the death of our Sun.

In this paper we focused on how the parameters of the Drake equation and the choice of the various attributes in two models affect the probability of longevity of human technological civilization.

3 ESTIMATING THE LONGEVITY OF HUMAN CIVILIZATION WITH SANDBERG AND RARE EARTH MODEL

3.1 SANDBERG MODEL

The Sandberg model [8] is based on Drake equation:

$$N = R_* f_p n_e f_l f_i f_c L \quad (1)$$

- R_* being the rate of star formation per year,
- f_p the fraction of stars with planets,
- n_e the number of Earth-like (or otherwise habitable) planets per a star that has planets,
- f_l the fraction of habitable planets with actual life,
- f_i the fraction of life-bearing planets that develop intelligence,
- f_c the fraction of intelligent civilizations that are detectable,
- L the average longevity of such civilizations.

Table 1: Probability densities for the parameters in equation (1)

Parameter	Distribution
R_*	log-uniform from 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 [9]
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

From the equation we can compute N, which is the number of detectable civilizations, or longevity L:

$$L = \frac{N}{R_* f_p n_e f_l f_i f_c} \tag{2}$$

with parameters, i.e. probability densities and limits from Table 1. As Sandberg suggests, all distributions used in this model were log-uniform.

3.2 RARE EARTH MODEL

The Rare Earth model is based on the "rare Earth" theory that assumes that Earth is a very unique planet evolved under rare circumstances. This theory introduces equation:

$$N = N^* n_g f_p f_{pm} f_i f_c f_l f_m f_j f_{me} \tag{3}$$

We combined equation (3) with Drake's equation and used probability distributions from Tables 1 and 2. This instantly rules out the need of the f_p (the fraction of stars with planets) parameter. Furthermore, product $f_l * f_i * f_c$ from Drake is equal to $f_i * f_c * f_l$ from Rare Earth, which gives us the final equation:

$$L = \frac{N^* n_g f_{pm} f_m f_j f_{me}}{R_* n_e} \tag{4}$$

and some new parameters:

- N^* is the number of stars in the Milky Way galaxy (between 250 and 500 billion),
- n_g
- 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).

In the Rare Earth model we also used log-uniform distribution, in order to compare it to the Sandberg model results.

4 EXPERIMENTS

4.1 Issues with log-uniform distribution

In analysing the two models, we focused primarily on how different distributions affect the results. Due to the shape of log-uniform distribution (see Figure 2), the part of the graph that is very close to zero has a significant impact on the final result. Since we have a logarithmic scale, the part from zero to one on the logarithmic scale corresponds to the range from zero to one percent, while the part from one to two percents corresponds to the range between one and one hundred percent, even though they appear to have the same weight on the logarithmic scale. The high values near zero therefore make it very sensitive to changes in parameter ranges and can even cause numerical errors when multiplications occur or at least strongly influence the final result.

For this reason, distributions whose values are close to zero at the boundaries of the parameter range are more stable with respect to changes in the parameters. We compared the stability of the log-uniform distribution with the log-normal distribution by slightly changing the lower bound of some parameters and observing the corresponding change in the distribution. The results in Figures 1 and 2, and later 3 and 4 indicate that the change of log-uniform distribution is much larger than that of log-normal distribution. Therefore, the log-normal distribution is much less dependent on the choice of the parameter range.

Table 2: Probability densities for the parameters in equation (4)

Parameter	Distribution
N^*	log-uniform from 10.7 to 12.7
n_g	log-uniform from -1.3 to -0.8
f_{pm}	log-uniform from -3 to -0.7
f_m	log-uniform from -2.5 to -1.5
f_j	log-uniform from -1 to 0
f_{me}	log-uniform from -2.5 to -1.5

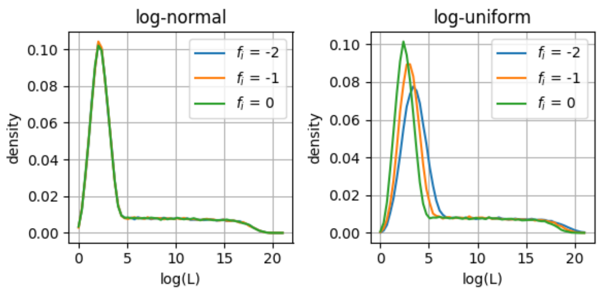

Figure 1: Change of probability distribution with respect to change of lower range limit of parameter f_i.

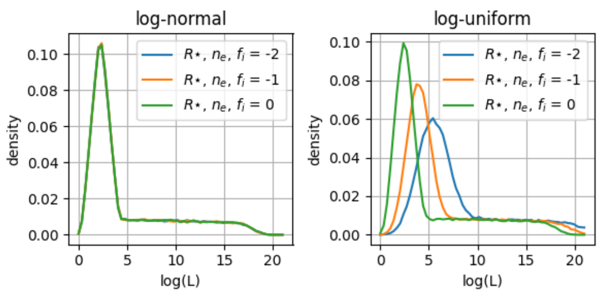

Figure 2: Change of probability distribution with respect to change of lower range limit of parameters $R*$, n_e and f_i.

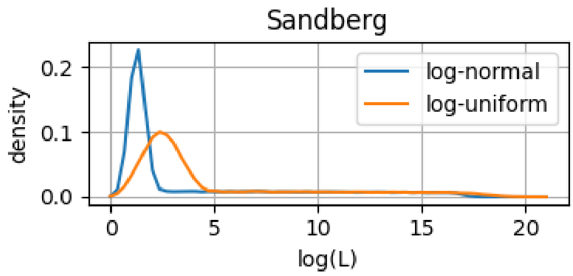

Figure 3: Difference between log-uniform and log-normal distribution in the Sandberg model.

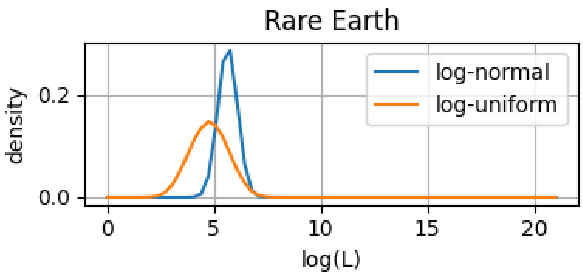

Figure 4: Difference between log-uniform and log-normal distribution in the Rare Earth model.

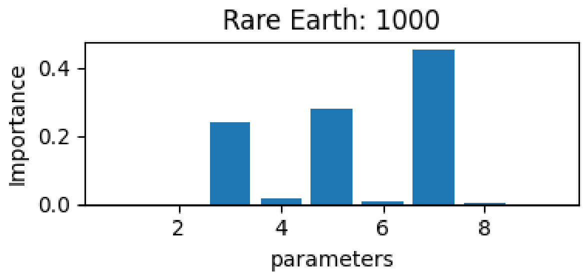

Figure 5: Importance of parameters in Rare Earth model for estimating probability of surviving 1000 years.

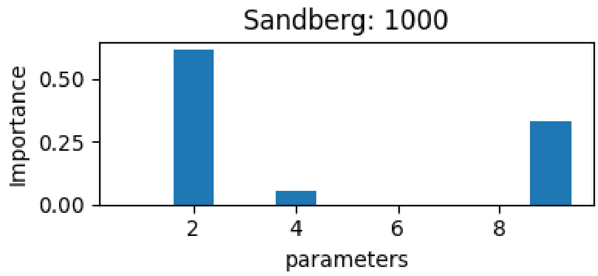

Figure 6: Importance of parameters in Sandberg model for estimating probability of surviving 1000 years.

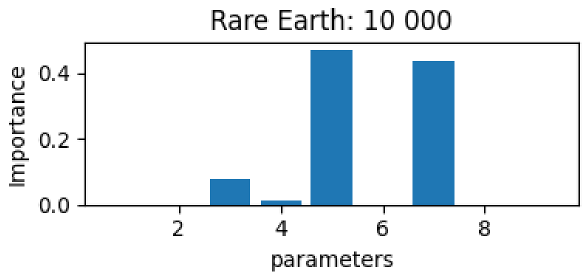

Figure 7: Importance of parameters in Rare Earth model for estimating probability of surviving 10 000 years.

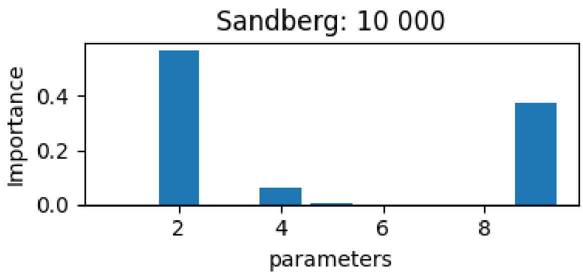

Figure 8: Importance of parameters in Sandberg model for estimating probability of surviving 10 000 years.

4.2 Parameter importance

In order to analyse the stability/sensitivity of the two models, we studied which parameters have the greatest impact on the final result. For this purpose, a dataset with different values and distributions for the parameters was created for the two models. Then, three subsets were taken, each containing only the subset with rows for which the probability that we survive at least L years is above 90%. The L options chosen were: 1000, 10 000, 100 000. The importance of the features in each of the subsets was then calculated using the Gini importance method implemented in the Python's scikit-learn decision tree regressor algorithm [7]. The feature importance scores are shown in Figures 5 to 10.

We found that in the Sandberg model, parameters 2 and 9 play the most important role, as you can see in Figures 6, 8 and 10, which show the importance of the parameters in calculating the probability that we survive 1000, 10 000 and 100 000 years.

In the model Rare Earth, on the other hand, parameters 5 and 7 are crucial for the prediction. This can be seen from Figures 5, 7 and 9, which show the importance scores of the parameters when calculating the same probabilities with the model Rare Earth.

5 DISCUSSION AND CONCLUSION

This research took two promising models from our earlier study [4] and analysed stability and sensitivity of the models and parameters. We analysed the stability of the log-uniform distribution compared to the log-normal distribution. To determine the difference between the two, Figures 1 and 2 are visually informative: changing the parameter range significantly affects the log-normal distribution, while the log-normal distribution is insensitive to these changes. Therefore, the log-normal distribution provides more reliable results, while the log-uniform distribution may cause some numerical curiosities. It seems reasonable to use distributions that rely mainly on the central values rather than the marginal values.

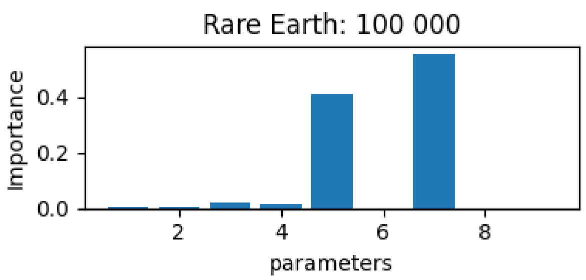

Figure 9: Importance of parameters in Rare Earth model for estimating probability of surviving 100 000 years.

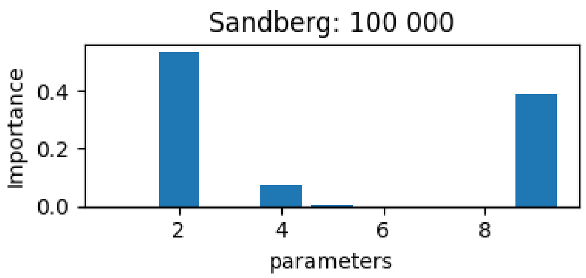

Figure 10: Importance of parameters in Sandberg model for estimating probability of surviving 100 000 years.

From Figures 3 and 4 we can observe that the Rare Earth model is considerably more optimistic than the Sandberg model. If we assume that Earth is very unique in our galaxy, we have the highest probability of living around 1 000 000 years. On the other hand, universe observations do not support well the uniqueness of our planet in terms of the large amount of suns with their planets. Further galaxy observations should provide more information which model fits the reality better.

From Figures 5 to 10, we can interpret that parameters 2, 5, 7, and 9 play the most important role in predicting the extinction of humanity. This seems novel compared to previous studies, and enables further discussion and studies regarding the causes and consequences of it. Whatever the case, while parameters seem to have numerically equal role and weight, studies of numerical relevance of the parameters of the equations (2) or (4) indicate significant differences.

Parameter 9 represents the choice of the distribution of the parameters. This is consistent with the distribution studies in this paper indicating that the probability curve for the longevity of human civilization strongly influences the obtained results.

Finally, while models do perform differently given different values of parameters, some patterns seem to emerge quite consistently if the parameters are set reasonably.

ACKNOWLEDGMENTS

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Change ahead!
Questioning and changing beliefs in online discussions

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ABSTRACT

Recent studies of persuasion and persuasibility in online discussions have predominantly focused on argument-specific features but not addressed extraneous factors that make someone question their beliefs in the first place. In this exploratory study, we sought to uncover factors underlying users' decisions to challenge their views in an online discussion forum and subsequently change them. We discovered that the examined psycholinguistic factors play a greater role in the questioning than the changing of opinions and further discuss the findings.

KEYWORDS

persuasion, ChangeMyView, reddit, belief change

1 INTRODUCTION

Social media are becoming an increasingly dominant means of exerting persuasive influence on people. However, if not done appropriately and targeted at individuals who are not susceptible in the first place, attempts at persuasion can result in backfiring, pushing people further apart [1]. As these phenomena propagate through the population, affecting and changing society at large, persuasion in online social spaces has become an important topic of scientific inquiry.

Providing an open-access, natural discursive environment with user-labeled data, the *Change My View* (CMV) Reddit forum has become a popular research subject, being investigated in at least 20 studies [2] from fields like computational linguistics, behavioral design, and discourse studies.

On the forum, users write about their views on various topics with the purpose of having their views challenged. Users can then award the arguments of others with a "delta" if they succeed in changing their initial stance.

Studies of persuasion on the forum have mostly focused on what makes an argument persuasive and, to a lesser extent, what makes the users persuadable. The studies that inspected the latter mainly focused on features of the argument itself, measuring factors like linguistic, stylistic, and topical composition, as well as user interaction [3, 4, 5].

These studies, however, all focused on features pertaining directly to the arguments, neglecting a domain of potential explanatory significance – how users behave outside the argument.

Research in computational social science has indeed shown that the behavioral and linguistic traces of online activity can carry important information about the psychology of humans and the interactions between them [6].

Observing those would enable not only a deeper understanding of susceptibilities to being persuaded once a view has been questioned but also delving into the factors that influence the questioning of one's view in the first place.

Reddit provides a unique opportunity for such investigation, as each user's history of activity is publicly available and, because of the variety of discussion communities, less dependent on topic of discussion.

That being said, despite CMV's credo stating that the forum is

"A place to post an opinion you accept may be flawed, in an effort to understand other perspectives on the issue."

only a small minority (13%) of the community's members ever post submissions on their own opinions, while the majority only participate in the discussions of others' views.

While posting on CMV does not guarantee that a person is, in fact, open to view-change and the environment is not the only one where the process takes place, the relatively small share of submitting users implies that deliberately and openly challenging one's view is a relatively unique phenomenon, even within a purposed community like CMV.

To fill the identified gap in current research on persuasion, we set out to explore the factors associated with users' decisions to, first, challenge their opinions on CMV, and second, to end up changing them.

To answer these questions, we inspected the users' activities on Reddit before they joined the CMV community. As this is an exploratory endeavor without much theoretical foundation, we focused on surface-level parameters, observing the user's posting patterns, stylistic and linguistic features, indicators of personality, and their community affiliation.

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2 METHOD

We collected submissions and comments that were posted to CMV between January 1st and December 31st, 2020, excluding those that were removed by moderators, or made by bots and deleted accounts. This left us with 31,419 submissions and 1,563,865 comments, authored by 158,724 unique users, 21,168 of whom posted submissions.

We studied users who made their first contribution to CMV in the studied period and were active on the forum over a span of at least seven days. While this threshold is somewhat arbitrary, it allowed us to exclude users who were mere passersby of the community (who may be unfamiliar, unserious, or even purposefully disruptive), while retaining a representative sample accounting for a majority (69%) of newcomer-created content.

We then downloaded the users' post histories one year before their first post (submission or comment) on CMV and imposed additional filters, keeping the users who:

a) made less than 10,000 submissions and comments, to exclude potential bots and spammers, and
b) made at least 10 posts containing 100 analyzable tokens before joining CMV, to ensure enough data.

For each user, we created two separate corpora, one of pre-CMV submissions and one of pre-CMV comments. We then analyzed their posts across various domains, excluding deleted and non-English (estimated automatically, using [7]) posts from text analysis.

2.1 Investigated features

Posting behavior. First, we collected data on the users' posting behavior, including days of activity pre-CMV activity, the number of communities they were involved with, the average length of submissions and comments, and their daily rates of posting.

Psycholinguistic characteristics. Second, we scored the post histories on selected categories of the LIWC2015 dictionary [8], a popular tool for psycholinguistic research, containing common words and word stems categorized by grammatical and semantic categories.

We selected features relating to grammar, as well as selected psychological categories. The latter included affective, cognitive, social, perceptual, and biological processes, drives, relativity, and time orientations.

Formatting and structure. Third, we looked at the outward appearance and structure of users' posts by extracting Markdown formatting features, namely the use of bold, italics, quotations, links, and un/ordered lists.

Personality. Fourth, we built a predictor of BIG5 personality traits by matching the top and bottom 100 n-grams that were shown to be associated with each personality dimension in [9] and summing their correlation-weighted scores.

Reddit communities. In addition, we also explored differences in the communities where the users were active, to see if particular communities are more or less popular within a certain population. We looked at the subreddits where the users posted and calculated the percentages of affiliated users in the studied groups.

We then set to explore the data in two problems, comparing two sets of users in each task.

2.2 Task 1: Questioning one's view

In Task 1, we explored the characteristics of CMV users who posted submissions questioning their views by comparing them to those who only commented on others' posts but never submitted posts on their own views.

After filtering by the previously mentioned criteria, the experimental group consisted of 4,639 users who posted at least one submission on CMV.

We compared those users to a control group of the same size, randomly selected from the users that passed the criteria but never posted their submission (although they may have done so after the studied period). From here on, we refer to these groups as questioning (Q) and non-questioning (Non-Q).

2.3 Task 2: Changing one's view

In the second part, we were interested in finding the characteristics underpinning one's susceptibility to view-change. For this, we divided questioning users into two subgroups: those susceptible (S) and non-susceptible (Non-S) to view-change.

We deemed a submission as ending in view-change if its author has awarded a "delta" that has been confirmed by the forum's Delta-Bot, which checks for rule compliance.

We selected CMV submissions that garnered at least 10 comments (indicating that some discussion took place) and compare authors who changed their views in either 100% (n=1,435) or 0% (n=1,204) of the submissions they posted. We opted for this distinction following [3], presupposing that the differences would be more notable between extremes.

3 RESULTS

In both tasks, we conducted a series of Bonferroni-Holm-corrected significance tests, comparing the features of the users' pre-CMV submission and comment corpora separately. We present results in Table 1 for Task 1 and Table 2 for Task 2, showing only features that yielded significant differences, due to spatial limitations.

In Task 1, we observed that questioning users, on average, posted submissions more often while having a shorter duration of pre-CMV activity.

Regarding LIWC, users differed in most of the studied categories. In most cases, the trend pointed in the same direction in both submissions and comments. In some cases, the difference was significant only in one set, and in a few, the trends in submissions and comments opposed one another.

Regarding formatting, questioning users used more ordered lists in both sets of corpora, while they used fewer quotes in the comments.

The users' posts exhibited quite inconsistent manifestations of personality, expressing lower neuroticism in submissions, while in the comments, they showed higher agreeableness, extraversion and conscientiousness, and lower openness.

Table 1. Significance testing results in Task 1. The numbers represent effect sizes (Cohen's *d*). Arrow direction represent how the feature expresses in Q users relative to Non-Q. The number of arrows denotes significance at p<.05, p<.01, p<.001, or p<.0001.

Feature	Characteristic of questioning?			
Posting features				
Submissions per day	.32	↑↑↑↑		
Days of activity	-.39	↓↓↓↓		
LIWC	*Submissions*		*Comments*	
Function words	.14	↑↑↑↑	.07	↑
Pronouns	.16	↑↑↑↑	.21	↑↑↑↑
Personal pronouns	.10	↑↑↑	.22	↑↑↑↑
1st person singular	-.03		.31	↑↑↑↑
1st person plural	-.10	↓↓	.00	
2nd person	.14	↑↑↑↑	.04	
3rd person plural	.02		-.11	↓↓↓↓
Impersonal	.15	↑↑↑↑	.06	↑
Articles	-.06		-.21	↓↓↓↓
Prepositions	-.07		-.16	↓↓↓↓
Common adverbs	.11	↑↑↑↑	.08	↑↑
Conjunctions	.13	↑↑↑↑	.11	↑↑↑↑
Common adjectives	.10	↑↑↑	-.08	↓↓
Comparisons	.12	↑↑↑↑	-.04	
Interrogatives	.26	↑↑↑↑	.12	↑↑↑↑
Numbers	-.15	↓↓↓↓	-.08	↓↓
Quantifiers	-.03		-.08	↓↓
Positive emotion	-.01		.11	↑↑↑↑
Negative emotion	.16	↑↑↑↑	-.03	
Social processes	.24	↑↑↑↑	.04	
Cognitive processes	.16	↑↑↑↑	.12	↑↑↑↑
Perceptual processes	-.04		.09	↑↑↑
Drives	.03		-.08	↓↓
Present focus	.08	↑	.08	↑↑
Relativity	-.20	↓↓↓↓	-.17	↓↓↓↓
Formatting				
Quote	.02		-.08	↓↓
Ordered list	.07	↑	.08	↑↑
Personality				
Openness	-.06		-.16	↓↓↓↓
Conscientiousness	-.04		.08	↑↑
Extraversion	.04		.16	↑↑↑↑
Agreeableness	-.06		.09	↑↑↑
Neuroticism	-.15	↓↓↓↓	.03	

In Task 2, there were fewer differences compared to Task 1. Regarding posting features, susceptible users exhibited a lower rate of posting submissions. There were no observable differences in LIWC categories, while in formatting, susceptible users exhibited a slightly higher use of ordered lists in the comments. Regarding personality, susceptible users expressed higher agreeableness and neuroticism in the comments.

We also inspected if the user groups in both tasks differ in the communities they contribute to. Table 3 presents ratios between the percentages of users who were affiliated with the community in each group, with a bottom threshold of 2%.

Table 2. Significance testing results in Task 2. Arrow directions represent feature expression in S users relative to Non-S.

Feature	Characteristic of susceptibility?			
Posting features				
Submissions per day	-.17	↓↓		
	Submissions		*Comments*	
Formatting				
Ordered list	.08		.14	↑
Personality				
Agreeableness	.01		.15	↑
Neuroticism	.11		.20	↑↑↑↑

In Task 1, for example, questioning users had a 2.37 times higher likelihood to post on *r/askphilosophy* (a forum for discussion of philosophical ideas) and a relative likelihood of 0.3 to post on *r/bestof* (a forum where users share their favorite comments across all Reddit). Similarly, in Task 2, susceptible users were 2.7 times more likely to post on *r/getdisciplined* (a support community for self-improvement) but had a likelihood of 0.58 to post on *r/socialism*.

Table 3: Quotients of subreddit association rates between Q and Non-Q users in Task 1 and S and Non-S users in Task 2.

Task 1		Task 2	
subreddit	ratio	subreddit	ratio
askphilosophy	2.37	getdisciplined	2.70
SuicideWatch	2.08	woooosh	2.33
FreeKarma4U	1.96	confidentlyincorrect	2.31
ask	1.95	ShitAmericansSay	2.31
findareddit	1.90	antimeme	2.28
…		…	
The_Mueller	0.36	AbruptChaos	0.62
LeopardsAteMyFace	0.35	sports	0.62
MaliciousCompliance	0.33	PoliticalDiscussion	0.61
LivestreamFail	0.33	PS4	0.59
bestof	0.30	socialism	0.58

4 DISCUSSION

In this study, we sought to uncover parameters that might carry explanatory information about a user's tendency to openly question and then change their views. First, we compared users who posted submissions on CMV to those that only commented. Second, we compared the submitters who always ended up changing their views to those that never did.

We first observed that the users who posted submissions to CMV also had a higher rate of posting submissions elsewhere, before they joined the forum, indicating that the users who submit to CMV are in general more inclined to post submissions, which could be due to many factors. We observe a similar albeit weaker discrepancy in Task 2, where a higher rate of posting submissions was characteristic of non-susceptible users.

We then noticed that the time of the questioning users' activity or Reddit before their first contribution to CMV was shorter on average. One explanation could be that the submissions were posted from secondary accounts, perhaps to anonymize one's expression of a view they would not feel comfortable sharing otherwise. Despite our intentions to limit such "throwaway" accounts by imposing a limit of minimum activity, enough might have remained to have affected the data.

We further observed that questioning users have a significantly different linguistic profile, as significant differences appeared in several measured LIWC categories. Of those, function words and pronouns in particular have been studied the most and are known to bear psychological relevance, as they reveal the focus of the author's attention and the relations between the entities discussed [10]. Higher (personal) pronoun use, which was characteristic of questioning users, generally points towards more personal and people-oriented language. However, when it comes to interpretation, it is important to also consider the different contexts of submissions and comments, which differ in who they're directed to. In submissions, where users address a general audience, we observed that questioning users used more second person ("you") and less first-person plural ("we") pronouns. The role of second person has been predominantly studied in close relationships, where it is likely to entail confrontation [10]. However, in the context of submissions, this is not likely to be the case. As they are directed towards an unspecified reader, it is probably more likely that the use of "you" is meant in a manner that is inquisitive or directing (e.g., "What do you guys think?", "You should try this!"), showing initiative and an interest in others. This interpretation is also in line with the observation that questioning users used more interrogatives.

Next, the lesser use of first-person plural ("we") in submissions could indicate a lower degree of community affiliation and belonging. It has previously been suggested that binding one's view to a group disperses the feeling of responsibility for it [5]. If questioning users hold beliefs as their own rather than representing a group they identify with, they may be more likely to question their views.

In the comments, we observed two further pronoun-related trends. In particular, questioning users used more first-person singular ("I"), which entails greater self-focus, perhaps as a means of explaining oneself, and less third-person plural ("they"), indicating a lesser focus on an outgroup or people in general.

Furthermore, we observed differences in several other grammatic and semantic categories in both submissions and comments. These point towards thematic and topical discrepancy between the users' use of language. As a general observation, questioning users used fewer numbers, articles, prepositions, and relativity, which indicates a lesser propensity for complex, analytic, and concrete language. This is contrasted by a higher use of words in the psychological process categories, supporting the previous explanation that questioning users tend to be more personal in their expression.

This considered, it is important to note that the effect sizes of observed differences are minimal, and without a deeper examination of context, nuanced interpretation is difficult.

An interesting observation is that across all features, the groups differed a lot more in Task 1 than in Task 2. This shows that the psycholinguistic characteristics underpinning one's tendency to challenge their view on CMV play greater importance compared to the ones behind their susceptibility to award "deltas". At the same time, they show that the users who decide to submit to CMV might gravitate towards a certain type of user, begging the question of generalizability of studies of the forum.

The personality measures showed several differences in both tasks but were inconsistent when comparing expressions in submissions and comments. Given that differences for each dimension were shown only in one set of corpora, this might high indicate contextual dependency. Research has indeed shown that word correlation-based measures of personality depend on communication contexts [11], which could also apply to those of submitting and commenting. The second contextual consideration is that the tokens used for personality estimation were taken from a study of posts on Facebook and might therefore not translate well to the social environment on Reddit.

We also observed that certain subreddits were more or less likely to be visited by the studied groups, indicating some kind of community preferences, although it is not obvious what underlies them. Going forward, it would be interesting to examine if these differences are driven by topic or by specific social characteristics.

The main takeaway from this study is that the explored factors, particularly those regarding language, have a greater role in underlying questioning one's views on CMV, than changing them. However, as noted in the beginning, questioning users posted more submissions overall. It is important to note that although we interpreted our findings through the lens of questioning beliefs, this might not be the main explaining factor behind the observations. It could be that the differences we observed are driven more by this general propensity to post submissions than a wish to challenge one's views.

In the future, it would therefore be necessary to explore this question further. For example, one could investigate if similar differences exist between submitters and non-submitters in other communities or if these effects scale with the users' rates of posting submissions. To better understand the mechanisms behind challenging beliefs, we would have to control for such factors, as well as discern how motivations for submitting in general interact with those specifically relating to questioning views.

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Kaj se lahko naučimo od Jacques Mehlerja, klasičnega kognitivnega znanstvenika

What can we Learn from Jacques Mehler, a Classical Cognitive Scientist

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POVZETEK

Prispevek prikazuje življenjsko delo Jacquesa Mehlerja, ki je bil eden uspešnejših evropskih raziskovalcev razvoja človeške kognicije, še posebej zgodnjega razvoja govora. Ob tem predstavi glavne predpostavke klasične kognitivne znanosti – modularnost uma ter vlogo narave in vzgoje pri razvoju in delovanju miselnih procesov – in opiše, katere vpoglede je omogočilo empirično raziskovanje teh predpostavk v preteklih desetletjih. Na kratko tudi oriše nova spoznanja, ki so kognitivno znanost v zadnjih dveh desetletjih dodobra spremenila in ki so deloma vplivala tudi na njegovo delo. Način, kako je Mehler ta nova spoznanja vedno znova integriral v svoje delo, lahko predstavlja enega od modelov sinteze empiričnega in teoretskega raziskovanja.

KLJUČNE BESEDE

klasična kognitivna znanost, modularnost uma, razvoj govora, Jacques Mehler

ABSTRACT

The article shows the life work of Jacques Mehler, who was one of the most successful European researchers in the field of the development of the human mind, especially early language acquisition. The article presents the main assumptions of classical cognitive science – the modularity of the mind and the role of nature and nurture in the development and functioning of the mind – and describes which insights have been enabled by Mehler's empirical research of these assumptions over the past decades. New findings are also briefly presented that have changed cognitive science over the last two decades and that have partly influenced his work. The way in which Mehler has repeatedly integrated these new insights into his work can represent one of the models of the synthesis of empirical and theoretical research.

KEYWORDS

classical cognitive science, modularity of mind, language acquisition, Jacques Mehler

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1 Klasična kognitivna znanost in Mehlerjev doprinos

V letu 2020 je v Parizu v starosti 83 let po dolgi nevrodegenerativni bolezni umrl Jacques Mehler, eden izmed pomembnih mladih akterjev tako imenovane kognitivne revolucije, ki se je zgodila v 60-ih letih prejšnjega stoletja in je pomenila odmik od takrat prevladujočega behaviorizma k proučevanju vrojenih lastnosti kognicije. Od leta 1975 do 2001 je vodil psiholingvistični laboratorij v Parizu (Laboratoire de Sciences Cognitives et Psycholinguistique, EHESS-ENS). Zaradi po njegovem mnenju prezgodnje upokojitve v francoskem CNRS se je leta 2001 lotil še vzpostavitve laboratorija Language, Cognition and Development Lab na SISSA-ISAS v Trstu, ki ga je vodil do končne upokojitve leta 2016.

Mehler je kot direktor pariškega laboratorija veljal za klasičnega kognitivnega znanstvenika, ki je človeško kognicijo raziskoval v skladu z osnovnima predpostavkama, da je um modularen ter da je večina miselnih procesov vrojenih. Ideja o modularnosti uma se je deloma napajala iz raziskav zgodnje nevrologije, vendar pa jo je v drugi polovici 20. stoletja najbolje izpeljal Jerry Fodor. Fodorjeva različica teorije o modularnosti uma, ki jo je povzel tudi Mehler, ne nudi neposredne navezave na fiziološke procese, predpostavlja pa, da na vsakem področju (modulu) uma/kognicije veljajo drugačni načini učenja in zaznavanja (angl. domain specificity), ki niso neposredno vezani na drug modul (angl. information encapsulation) in ki niso nujno vezani na eno samo čutilo [1]. Ideja o vrojenosti miselnih procesov je, podobno, izhajala iz spoznanja o visoki specializaciji nekaterih delov kognicije že zelo zgodaj v razvoju, še najbolj izrazito v razvoju govora [2]. Skladno s to idejo je učenje pravzaprav zgolj sprožanje nastavitev parametrov, ki so sami po sebi vrojeni [3] Kognitivna znanost, ki je predpostavljala modularnost uma in vrojenost miselnih procesov je pomenila neposredno kritiko behaviorizma, ki je predpostavljal splošne mehanizme učenja za vse miselne procese in po katerem je učenje vedno neposredni odziv na zunanje dražljaje [4]. Razprava o vlogi narave in vzgoje je sicer stara tisočletja, in mnenja o tem, da so nekateri miselni procesi vrojeni, saj jih lahko opazujemo takoj po rojstvu ali še pred njim, se še danes silovito krešejo z mnenji, da so ti procesi posledica učinkovitih splošnih učnih mehanizmov.

V teh teoretskih okvirih je Mehler izpeljal vrsto empiričnih raziskav o tem, kako je človeško zaznavanje selektivno in pogojeno z vrojenim znanjem tudi na področju prepoznavanja in učenja maternega jezika. Ugotovil je, da je zlog osnovna zaznavna enota v govoru in da je prepoznava zloga kot osnovne zaznavne enote pomembna pri učenju in segmentaciji besed [5], [6], in to že od rojstva naprej [7]. Vendar pa so že novorojenčki pozorni tudi na druge pomembne elemente govora, kot so premori in spremembe v intonaciji [8], [9]. Skupaj s študenti je raziskoval zmožnost razločevanja različnih jezikov ob rojstvu in ugotovil, da novorojenčki prepoznajo materin glas ter ritem jezika, ki so ga poslušali že pred rojstvom, ter ga ločijo od jezika z drugačnim ritmom, vendar pa ne ločijo dveh ritmično podobnih jezikov [10], [11]. Kljub določeni meri skepse glede neposredne povezave med (vrojenimi) miselnimi procesi in njihovo fiziološko (nevrološko) podlago je bil zavezan eksperimentalnemu delu ter sodelovanju pri metodoloških inovacijah, potrebnih za raziskave zgodnjega razvoja. To je kasneje omogočilo tudi nekatera dognanja s področja nevrologije kognitivnih procesov, ki jih je preučeval. Med drugim je prvi uporabil NIRS (angl. near-infrared spectroscopy) tehniko optične topografije pri novorojenčkih ter tako prvi pokazal, da človek že ob rojstvu procesira govor v levi možganski polovici [12].

2 Mehlerjeva integracija novih idej v klasično kognitivno znanost

Kognitivna znanost se je na prelomu tisočletja zopet začela korenito spreminjati. Bolj množično so se začele zbujati kritike teorije o modularnosti uma ter selektivnih zaznavnih in učnih mehanizmov. Naraslo je tudi zanimanje za vlogo splošnih statističnih učnih mehanizmov pri učenju govora, na primer zaznavanja pogostosti pojavitve osnovnih gradnikov jezika, fonemov, zlogov, besed, ter pogojnih verjetnosti sopojavljanja teh gradnikov v jeziku [13], [14]. To je po naključju sovpadlo tudi z Mehlerjevim premikom iz Pariza v Trst leta 2001. Novi laboratorij v Trstu se je začel ukvarjati z odnosom med statističnim učenjem in osnovnimi predpostavkami klasične kognitivne znanosti. S skupino mladih sodelavcev je Mehler preučeval lastnosti in omejitve statističnega učenja pri segmentaciji in učenju besed. Statistično učenje recimo deluje drugače na samoglasnikih kot na soglasnikih [15], [16], kadar pa so si statistične in prozodične informacije v nasprotju, se človeški um bolj zanaša na prozodične [17]–[19].

Opažanje, da je zaznavanje selektivno, je pripeljalo tudi do študij bolj ali manj specializiranih mehanizmov zaznavanja, npr. zaznavanje identitete (ponavljanja, npr. ponavljanja zlogov) in zaznavanje robov (npr. boljše pomnjenje zlogov na robovih besed), ki v veliki meri olajšajo zgodnje učenje jezika [20]–[22]. Obenem pa so v laboratoriju potekale tudi raziskave o tem, kako razvoj govora, kot specializiranega znanja, vpliva na druge dele človeške kognicije, na primer na centralne nadzorne in izvršilne funkcije. Na primer, vsakodnevno poslušanje dveh ali več jezikov vpliva na izvršilne funkcije že kmalu po rojstvu: dojenčki iz dvojezičnih družin že pri 7 mesecih izkazujejo boljšo kontrolo in inhibicijo kot njihovi enojezični vrstniki [23], [24].

Mehlerjeva izhodiščna pozicija je bila torej jasna in večina objavljenih del se je ukvarjala z omejitvami splošnih učnih mehanizmov ter visoko specializiranimi mehanizmi, ki so po njegovem prepričanju najverjetneje vrojeni (specializirani mehanizmi zaznavanja, stavčni ritem in prozodija, soglasniki-samoglasniki). Vendar pa je pri svojem delu ostajal trdno zavezan empiričnemu preverjanju glavnih teoretskih vprašanj s pomočjo čim bolj objektivnega in nepristranskega opazovanja človeških odzivov od rojstva naprej, pravzaprav podobno kot Piaget, čeprav so ju ločevala nesoglasja. Ker mu je empirično raziskovanje omogočalo vsaj delno distanco od teoretskega dela, ostaja odprto vprašanje, kako bi na razvoj kognitivne znanosti gledal danes.

3 Kognitivna znanost danes v odnosu do Mehlerjevega dela

Predstavljena teoretska vprašanja kognitivne znanosti so bila v zadnjih letih soočena z novimi podatki, ki so kazali na to, da lahko splošni kognitivni primanjkljaji zaradi spremenjenega vnosa podatkov pripeljejo do specifičnih razvojnih motenj. Na primer, specifična jezikovna motnja bi bila lahko posledica centralnega primanjkljaja v procesiranju hitrih zvočnih dražljajev [25]. Podobno sosledje morda velja tudi za disleksijo [26], [27]. Vendar pa mnenja o izvoru učnih razvojnih motenj ostajajo deljena in zato še vedno prevladujejo kognitivni modeli, ki predvidevajo modularnost posameznih področij kognicije [28], [29].

Ker so kognitivni procesi nujno posledica dejavnosti možganov, ideja modularnosti uma tudi v svojih novejših različicah vselej predpostavlja, da so specializirani procesi tisti, ki zasedajo nek točno določen predel možganskega tkiva [30]. To idejo so nedavna spoznanja v nevroznanosti dodobra načela z dokazi, da so posamezni možganski moduli, ki so bili tradicionalno razumljeni kot osnovni kognitivni moduli, v resnici deli nevronskih mrež, ki pa so v možganih pogosto uporabljene večkrat in za različne namene (angl. neural reuse, neural redeployment) [31], [32]. Še več, bistvo specializacije nevronskih mrež verjetno ni v njenih osnovnih gradnikih, možganskih modulih, temveč v načinu, kako so ti gradniki povezani. Zato je mogoče za iste kognitivne funkcije opazovati dejavnost različnih nevronskih mrež, ali pa obratno, dejavnost istih (ali vsaj navidezno istih) nevronskih mrež za različne kognitivne funkcije [33]. Primer za slednje so ekspertne veščine, ki jih eksperti lahko navidezno opravljajo avtomatizirano, vendar pa obenem ohranjajo centralni nadzor nad dinamiko dogajanja, kar bi lahko nakazovalo, da je za dva procesa odgovorno eno (ali vsaj na videz eno) nevronsko omrežje [34].

Čeprav so se kognitivni modeli delovanja kognicije v preteklosti lahko ogradili od modelov nevrološkega delovanja, ker ti niso bili v neposrednem nasprotju s prvimi, ima ponujeni model organizacije nevronskih mrež neposredne posledice tudi za kognitivne modele, saj predpostavlja, da so vsa specializirana znanja modularna samo v zelo abstraktnem smislu, ter da so nujno posledica učenja in ne vrojena. Vendar pa obenem ponudi svežo rešitev uganke, s katero se že dolgo soočajo raziskovalci specifičnih razvojnih motenj, ki se jim izmika enoznačna razlaga izvora teh motenj. Možno je namreč, da kognitivni profili in razvojne motnje niso posledica lastnosti in pomanjkljivosti v posameznih možganskih modulih, temveč predvsem načina, kako so organizirane nevronske mreže [35], [36]. Organizacija nevronskih mrež pa je v veliki meri odvisna od dogodkov v času nastajanja človeškega bitja.

To pa je pravzaprav pot, ki ji je sledil tudi Mehler, ko je zametke razvoja govora iskal in razpoznaval v obdobju globoko pred prvo besedo, že takoj po rojstvu. Na novorojena človeška bitja je vedno gledal kot na aktivne, zavedajoče se soudeležence pri lastnem razvoju, in logična posledica tega pogleda je bila, da so se nekateri njegovi študentje in sodelavci lahko spustili na področje raziskovanja izkušenj in znanj, ki jih zarodki pridobijo že pred rojstvom. Nove raziskave tako med drugim ugotavljajo, kako lahko pri zarodkih merimo in spodbujamo njihovo zmožnost slušne (glasba, govor, glas) ali vidne prepoznave (obrazne poteze) ter pomnjenja in kako lahko to učinkuje na organizacijo nevronskih mrež že pred rojstvom [37], [38]. In tako se nadaljuje naloga, ki si jo je zadal Mehler: ugotoviti, koliko lahko prispeva dejavnost in stimulacija na zmožnost zaznavanja in razločevanja ter na učenje, vendar pa ne več pri novorojenčkih, kot je to počel on, temveč že pred rojstvom.

4 Sklep

Jacques Mehler je svoje področje zapustil v času, ko je gotovosti v zvezi z razumevanjem kognicije na videz manj, saj so se zrahljali klasični kognitivni modeli. Vendar pa se zdi, da so nedavna spoznanja o povezljivosti možganov odprla nove možnosti za razumevanje razvoja in delovanja uma. In prav mogoče je, da bi se tudi Jacquesovo delo, če bi bil še vedno dejaven, usmerilo v raziskovanje nevronskih omrežij, ki sodelujejo pri procesiranju jezika od rojstva naprej ali pa še pred rojstvom. Gotovo pa je, da bi ga radovednost in natančnost, ki ju je gojil pri svojem delu, še naprej vodila v tehtno pretresanje mej ter omejitev modelov razvoja in delovanja človeškega uma.

In prav to je vodilo, ki je lahko koristno za vsakogar, ki ga zanima razvoj človeškega uma. Z natančnim pretresanjem možnosti, ki jih odpira vsak model delovanja človeškega uma, in možnih odgovorov, ki jih nudijo človeški odzivi na dražljaje, lahko vsakdo od nas prispeva delež novega vedenja o pomenu in funkciji modulov – vrojenih ali priučenih, anatomskih ali kognitivnih – ki omogočajo specializirana znanja, lastna človeku.

ZAHVALA

Za pomoč pri zbiranju informacij za prispevek se zahvaljujem kolegom, ki so v istem času pisali retrospektivne članke o življenju in delu Jacquesa Mehlerja: Jean Remy Hochmann, Judit Gervain, Agnes Kovacs, Stanislas Dehaene.

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Vpliv informacije o ceni na subjektivno oceno zvoka violin

Influence of Price Information on the Subjective Evaluation of Violin Sound

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POVZETEK

V raziskavi sem analizirala, v kolikšni meri informacija o ceni inštrumenta vpliva na posameznikovo subjektivno oceno zvoka. Zanimalo me je tudi, ali so subjektivne ocene zvoka pri glasbenikih bolj povezane s ceno violin v primerjavi z ocenami poslušalcev, ki se z glasbo ne ukvarjajo. S poskusom sem preverjala, če bo lažna informacija o ceni vplivala na subjektivno oceno zvoka. Pri poskusu, ko cena ni bila podana, sem zaznala šibko do zmerno povezanost med ceno violine in subjektivno oceno zvoka. Pri poskusu, ko je cena bila podana, sem zaznali visoko povezanost med ceno in subjektivno oceno zvoka.

Posameznikovo vrednotenje zvoka je tako pri glasbenikih kot tudi pri udeležencih, ki se z glasbo ne ukvarjajo močno povezano z informacijo o ceni. Violina, ki sem jo enkrat predstavila z njeno realno prodajno ceno, drugič pa kot bistveno dražjo, je bila drugič ocenjena zaznavno boljše. Najcenejša violina je bila v poskusu, v katerem je bila cena podana, ocenjena zaznavno slabše.

KLJUČNE BESEDE

placebo efekt, marketing, vplivi na zaznavanje, ocenjevanje violin, informacija o ceni

ABSTRACT

In this study, I investigated the extent to which an instrument's price information affects a person's attitude toward its sound. I was also interested in whether musicians' ratings of sound aesthetics were more strongly related to violin prices than were the ratings of participants who were not involved with music. I experimented with whether misinformation about price would influence ratings of sound. In the experiment in which price was not mentioned, I found a low to moderate correlation between violin price and sound ratings. In the experiment where price was mentioned, I found a high correlation between price and sound ratings.

Sound ratings correlated strongly with price information for both musicians and non-musicians. The violin we presented once with its actual retail price and a second time as being significantly more expensive was rated significantly better the second time. The cheapest violin was rated significantly worse in the experiment in which the price information was given.

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KEYWORDS

placebo effect, marketing, effects on sound perception, assessment of violins, price information

1 UVOD

Drage stvari so nam pogosto všeč. Mogoče višjo ceno povezujemo z boljšo kakovostjo izdelka, za nekatere pa je posedovanje dragega izdelka statusni simbol. Zdi se, da že sama cena vpliva na naše vrednotenje izdelkov. V raziskavi sem opazovala, kako informacija o ceni vpliva na mnenje poslušalca o zvoku violine. Zanimalo me je, če in v kolikšni meri je poznavanje cene povezano s subjektivno oceno zvoka šestih violin popolnoma različnih cenovnih razredov.

Osnovna predpostavka v ekonomiji je, da je stopnja ugodja pri uživanju nekega produkta odvisna le od lastnosti tega produkta in stanja posameznika. Tako naj bi na primer užitek, ki izhaja iz uživanja pijače bil odvisen le od molekulske sestave pijače in stopnje žeje posameznika [6]. Pretekle raziskave pa so pokazale, da informacije iz okolja vplivajo na naše **pričakovanje in zaznavanje** na senzoričnih področjih: bolečina, vid, vonj in tudi sluh. Kljub temu ni popolnoma znano, kako možgani spremembe pričakovane vrednosti pretvorijo v spremembe izkušene vrednosti [10].

V raziskavi na Stanfordski Univerzi leta 2007 so testirancem povedali, da bodo degustirali pet različnih vin in, da je namen poskusa preučiti vpliv časovnega trajanja degustacije na zaznan okus. Eno izmed vin je bilo degustirano dvakrat: enkrat z realno informacijo o ceni in drugič z (lažno) nizko ceno. Testiranci so bili pozvani, naj poročajo o všečnosti in intenzivnosti okusa vin. Rezultati so pokazali bistvene razlike v oceni všečnosti okusa dveh degustacij istega vina predstavljenega z dvema različnima cenama. Sklepamo, da informacija o ceni znatno vpliva na všečnost okusa. Poskus so izvedli še enkrat, le da so tokrat opazovali delovanje različnih možganskih centrov ob poskušanju vina. Izkazalo se je, da je delovanje možganskih centrov povezanih z sprejemanjem senzoričnih signalov in njihovo predelavo različno pri dveh degustacijah istega vina, ko je informacija o cenah podana [6]. Tudi raziskava z energijskimi pijačami na Stanfordski univerzi iz leta 2005 je predhodno pokazala, da imajo določene marketinške poteze, kot je določanje in spreminjanje cen vpliv na naše zaznavanje, presojo in vedenje [9]. Pojav je bil poimenovan »marketinški placebo efekt«, saj je zelo podoben znanemu fenomenu placebo efekta v farmaciji [6], [9].

2 TEORETIČNE OSNOVE

V prispevku nas, podobno kot v prej opisanih poskusih, zanima fenomen »placebo efekta«, le da se osredotočamo na zaznavanje prijetnosti zvoka.

Placebo efekt je definiran kot »sprememba bolnikovega stanja, ki jo je mogoče pripisati simboličnem vnosu zdravljenja in ne farmakološkim ali fiziološkim lastnostim zdravljenja« [3, pp.1]. Kljub temu, da je pojem placebo efekt ponavadi uporabljen v povezavi z zdravili, je povezan z našim problemom, saj opisuje vpliv informacijskega nabora iz okolja na čutne izkušnje. Opisala bom tudi katere lastnosti zvoka zaznavamo.

2.1 Teorija pričakovanja

Teorija pričakovanja pravi, da testirančeva pričakovanja in prepričanost v dober rezultat sprožijo placebo efekt. V skladu s to teorijo bi na primer testiranec iz skupine, ki pozna ceno pričakoval boljši zvok violin, ki so bile predstavljene kot dražje. S prepričanostjo v dober rezultat in pristranskostjo bi jih zato ocenil kot boljše [3].

2.2 Klasično pogojevanje

Teorija predvideva, da je placebo efekt pogojni refleks zaradi ponavljajočih se povezav med pogojnim dražljajem (nevtralna komponenta) in brezpogojnim dražljajem (aktivni element) [3]**.** V našem primeru je pogojni dražljaj **informacija o** cen**i** in brezpogojni dražljaj zvok, oziroma **kakovost** zvoka. Testiranci bi lahko **nezavedno prevzeli**, da imajo dražje violine boljši zvok in jih je posledično bolj prijetno poslušati (brezpogojni odziv). Tako bi že sama informacija o višji ceni (pogojni dražljaj) sprožila večjo všečnost do poslušane violine. Seveda velja tudi obratno: če bo imel testiranec negativne izkušnje z cenejšimi violinami, bo nižjo ceno podzavestno povezal z slabšim zvokom.

2.3 Socialni vplivi na zaznavanje in vedenje

Pomembno lahko vplivajo na zaznavanje tudi članstvo in procesi v skupini [6]. Kljub temu, da poskus ni bil izveden v skupinah, ampak ga je vsak testiranec reševal sam, menim, da so socialni dejavniki imeli močan vpliv na rezultate. Veliko ljudi je namreč prepričanih, da visoka cena violine kaže, da večina visoko vrednoti to violino. Predvidevam, da bodo namesto, da bi se odločili avtonomno prilagodili mnenje skupini, oziroma temu, kar menijo da je mnenje večine.

2.4 Lastnosti zvoka violin

Kljub temu, da se v raziskavi ukvarjam z vplivom informacije o ceni na všečnost zvoka violin in ne sámo kakovost zvoka, ne moremo zanemariti precejšnje verjetnosti, da imajo dražje violine dejansko bolj kvaliteten zvok. Violine se ocenjuje po treh dimenzijah: odzivnost, enakomernost in »glas«. Slednji je izrazito subjektiven, zato vrednosti violin in kakovost zvoka ni mogoče objektivno oceniti [1].

Kljub temu, da se zaznavanje zvoka razlikuje od posameznika do posameznika raziskava na UWE Bristol iz leta 2005 kaže na določeno stopnjo strinjanja pri kvalitativnih opisih lastnosti zvoka inštrumentov pri skupini glasbenikov [4]. Glasbeniki za opis »barve« zvoka (tembre) določene violine pogosto uporabijo »diferencialne pridevnike«. Primeri teh so: svetlost, trdost, jasnost, tankost, polnost, nazalnost, odprtost, ostrina, celo »kovinskost« in »lesenost« zvoka. Glasbenik bi zvok izbrane violine ocenil na dimenzijah: svetel – temen, trd – mehek, jasen – nejasen (»umazan«), tanek – širok, poln – prazen (»na površju«), nazalen – usten, zaprt – odprt. Umestitev zvoka violine na prej-naštetih dimenzijah omogoča glasbenikom bolj poenoteno oceno zvoka izbrane violine v primerjavi z laiki. Uporaba naštetih lasnosti pri ocenjevanju s strani glasbenikov je v raziskavi nakazana pri odgovorih na vprašanje kombiniranega tipa »Kaj je vplivalo na vašo odločitev?«. Na to vprašanje so glasbeniki večkrat odgovorili s pridevniki »čistost«, »mehkoba«, »jasnost«, »odprtost«. Pri posameznikovi oceni pomembno vlogo igrajo osebne preference, a v splošnem velja, da ima dobra violina svetel, mehek, jasen, širok, poln, usten in odprt zvok [1].

3 OPIS RAZISKAVE

Kot merski instrument sem uporabila spletni anketni vprašalnik, ki je vseboval poseben tip vprašanja, ki je omogočilo testirancu razvrščanje violin glede na njihovo subjektivno oceno zvoka. Vprašalnik je vseboval tudi zvočni zapis narejen z visoko kakovostnim snemalnikom zvoka Zoom h1. Zvočni zapis je predstavljal posnetke lestvice in melodij, zaigranih na 6 različnih violin (Tabela 1). Vse violine so bile posnete v istem prostoru (predavalnica 212, UL PeF), na njih pa sem igrala z istim lokom.

Vprašalnik je bil sestavljen iz dveh delov: v prvem delu (Poskus 1) so bili podani zgolj posnetki melodij: izseki iz skladb Bacha, Paganinija, Glazunova ter Mozarta. Bach je skladatelj baroka, Glazunov romantike, Mozart klasicizma, Paganini pa sicer spada v romantiko, vendar igranje njegovih Cappricciov ponazarja zmožnost inštrumenta, da se odzove na tehnično zahtevnih delih. Želela sem namreč predstaviti zvok vsake violine v različnih glasbenih slogih. Med glasbeniki namreč velja prepričanje, da nekatere violine bolje »ustrezajo« določenim slogom kot drugim.

Poslušalci so s funkcijo »povleci in spusti« razvrstili šest različnih violin glede na njihovo subjektivno oceno zvoka posamezne violine. Udeleženci so violine med sabo primerjali in jih razvrstili od najboljše do najslabše glede na njihovo oceno estetike zvoka (Slika 1). Povprečne ocene so bile izračunane po naslednjih formulah:

$$nenormirana\_ocena(violina_i) = \frac{\sum_{j=1}^{N}(MAX_{ocena} - ocena_j(violina_i)}{N}$$

N – Število razvrstitev za $violina_i$

MAX_{ocena} – pri Poskus 1 je enaka 6, pri Poskus 2 je enaka 7

$ocena_j(violina_i)$ – razvrstitev violine i na določeno mesto

Ker pa sta bili MAX_{ocena} pri Poskus 1 in Poskus 2 drugačni (pri Poskus 1 je bila MAX_{ocena} 6, ker so testiranci razvrščali 6 posnetkov 6 različnih violin, pri Poskus 2 pa 7, saj so se posnetki

Violine 3 ponovili), je bilo ocene potrebno normirati. Povprečne ocene so bile normirane od 1 do 100 po naslednji formuli:

$$normira\ ocena(violina_i) = \\ = ROUND(\frac{MAX_{nov} - MIN_{nov}}{MAX_{ocena} - MIN_{ocena}} \\ * (nenormirana\_ocena(violina_i) \\ - MAX_{ocena}) + MAX_{nov})$$

$ROUND$ – zaokroženo

$MIN_{nov} = 1$

$MAX_{nov} = 100$

$MIN_{ocena} = 1$

V drugem delu (Poskus 2) so bili poleg posnetkov melodij podani tudi posnetki lestvice a-mol in informacija o ceni. Pri tem so bili enaki posnetki iste violine (VIOLINA 3) podani dvakrat: enkrat z resnično informacijo oceni (3000 evrov) in enkrat z lažno informacijo o ceni (30.000 evrov). Posnetki lestvice so bili dodani zato, da preusmerijo testirančevo pozornost od dejstva, da je v Poskusu 2 navidezno bila predstavljena ena violina več.

Na koncu obeh poskusov so bili testiranci vprašani o tem, kaj je vplivalo na njihovo odločitev. Vprašanje je bilo kombiniranega tipa, nanj pa so lahko odgovorili z več odgovori:

- »jakost zvoka«
- »barva zvoka (tembre)«
- »dinamične razlike«
- »cena«
- »drugo« (odprtega tipa)

Testirance sem razdelila v dve osnovni skupini: glasbeniki in neglasbeniki. Kot glasbeniki so bili označeni vsi, ki so na vprašanje »Kateri stavek vas opisuje?« odgovorili z enim izmed stavkov:

- »Sem profesionalen–i/-a glasben–ik/-ica in igram inštrument – godalo.«
- »Sem profesionalen–i/-a glasben–ik/-ica in ne igram inštrumenta, ki je godalo.«
- »Obiskujem akademijo za glasbo in igram inštrument – godalo.«
- »Obiskujem akademijo za glasbo in igram inštrument, ki ni godalo.«
- »Obiskujem glasbeno šolo in igram inštrument – godalo.«
- »Obiskujem glasbeno šolo in igram inštrument, ki ni godalo.«
- »Končal-a sem osnovno [in srednjo] glasbeno šolo.«

Kot ne-glasbeniki so bili označeni vsi, ki so na vprašanje »Kateri stavek vas opisuje?« odgovorili z enim izmed stavkov:

- »Obiskoval-a sem nekaj let osnovne glasbene šole.«
- »Ljubiteljsko se ukvarjam z glasbo.«
- »Z glasbo se ne ukvarjam.«

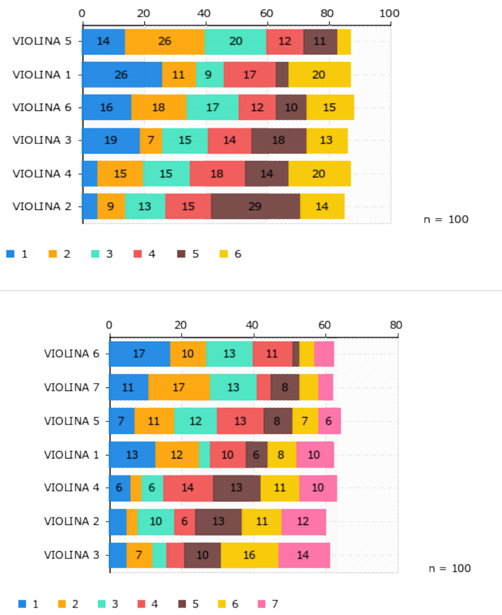
Zanimala so me naslednja raziskovalna vprašanja:
Vprašanje 1: Ali se zaznavanje estetike zvoka glede na informiranost o ceni pri obeh skupinah (glasbeniki, ne-glasbeniki) razlikuje?
Vprašanje 2: Ali so subjektivne ocene zvoka pri skupini glasbenikov v poskusu brez informacije o ceni bolj povezane s ceno violin v primerjavi z ocenami estetike zvoka v skupini ne-glasbenikov?
Vprašanje 3: Ali bo napačna informacija o ceni violine (lažna informacija, da je cenejša violina draga) vplivala na subjektivno oceno zvoka pri tako glasbenikih kot tudi ne-glasbenikih?
Da bi odgovorila na Vprašanje 1 sem primerjala rezultate Poskusa 1 in Poskusa 2. Odgovor na Vprašanje 2 sem iskala v rezultatih Poskusa 1. Pri odgovarjanju na Vprašanje 3 sem uporabila rezultate Poskusa 2.

Tabela 1: Maloprodajne cene violin

	Cena (EUR)
VIOLINA 1	16 500
VIOLINA 2	7 200
VIOLINA 3	3 000
VIOLINA 4	13 500
VIOLINA 5	15 200
VIOLINA 6	20 000
VIOLINA 7 (VIOLINA 3)	30 000 (3 000)

3.1 Opis vzorca

Poskus je v večini potekal preko spleta, delno pa tudi v živo na Gimnaziji Bežigrad in Akademiji za glasbo. Vprašalnik je do konca izpolnilo 100 ljudi, od tega 40 glasbenikov in 60 ne-glasbenikov. Reševan je bil v Sloveniji, Makedoniji, Rusiji, Nemčiji in Avstriji. Anketni vprašalnik je v celoti rešilo 4o žensk in 31 moških. Anketni vprašalnik je bil objavljen na neuradni Facebook strani dijakov in bivših dijakov Gimnazije Bežigrad, rešili pa so ga tudi dijaki Konzervatorija za glasbo in balet Ljubljana, študenti in profesorji Akademije za glasbo Ljubljana in Univerze za umetnost Gradec ter člani simfoničnega orchestra RTV Slovenija.

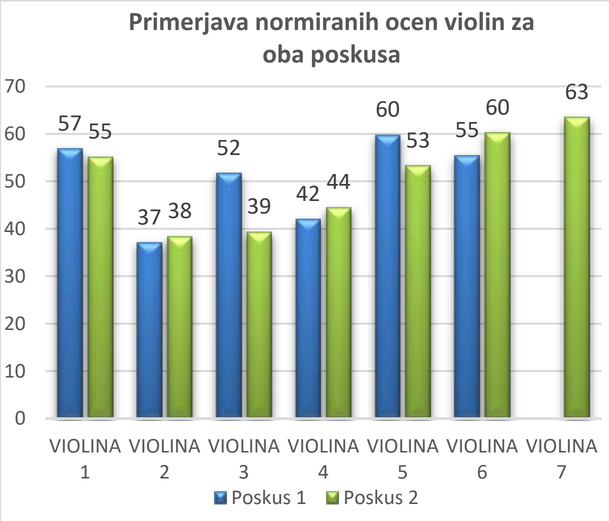


Slika 1: Razvrščanje violin po okusu od 1 do 6 (7). Zgornja slika kaže frekvence, oz. kako so udeleženci razvrščali violine brez informacije o ceni. Spodnja slika kaže frekvence, oz. kako so udeleženci razvrščali violine z informacijo o ceni.

4 REZULTATI IN UGOTOVITVE

Vpršanje 1: *Ali se subjektivne ocene zvoka violin glede na informiranost o ceni pri obeh skupinah (glasbeniki, ne-glasbeniki) razlikujeje?*

Graf, ki ga prikazuje Slika 1 prikazuje povprečne normirane ocene violin na lestvici od 1 do 100, ki so izračunane na podlagi ocen violin v celotnem vzorcu (torej glasbeniki in ne-glasbeniki).



Slika 2: Povprečne ocene violin vseh testirancev za oba poskusa (z in brez informacije o ceni

Da bi ugotovila, če se ocene violin, ki so jih dali testiranci pred in po informiranju o ceni (torej rezultati Poskusa 1 in Poskusa 2) statistično značilno razlikujejo, sem uporabila Wilcoxonov test predznačenih rangov. Ta je pokazal statistično značilno razliko med rezultati Poskusa 1 in Poskusa 2 pri violinah 1, 3, 4, 5 (p < 0,05). Test ni pokazal statistično značilne razlike med rezultati Poskusa 1 in Poskusa 2 pri Violini 2 in Violini 6 (p > 0,05). Teh izjem ne morem pojasniti.

Rezultati Wilcoxonovega testa predznačenih rangov nakazujejo, da se ocene večine violin glede na informiranost o ceni v celotnem vzorcu razlikujejo.

Tabela 2: Wilcoxonov test predznačenih rangov za pare ocen violin, ki so jih dali testiranci pred in po informiranju o ceni. Stat. pomembne vrednosti so označene krepko.

Wilcoxonov test	*Brez informacije o ceni/ Z informacijo o ceni*
VIOLINA 1	***z* = 2,119** ***p* = 0, 034**
VIOLINA 2	*z* = 1,678 *p* = 0,092
VIOLINA 3	***z* = 3,910** ***p* = 0,0001**
VIOLINA 4	***z* = 2,208** ***p* = 0,027**
VIOLINA 5	***z* = 2,951** ***p* = 0,003**
VIOLINA 6	*z* = 0,528 *p* = 0,597

Uporabila sem Spearmanov koeficient korelacije za oceno povezanosti med ceno violin in oceno zvoka violin v celotnem vzorcu. V Poskusu 1 ni bilo statistično značilne korelacije med spremenljivkama cena violin in ocena zvoka violin, r_s = 0,564; p = 0,188; N = 6. Korelacija med spremenljivkama je bila v Poskusu 1 zmerna. V Poskusu 2 sem zaznala statistično značilno korelacijo med spremenljivkama cena in subjektivna ocena zvoka, r_s = 0,964; p = 0,0004; N = 6. Korelacija med spremenljivkama je bila v Poskusu 2 zelo močna.

To indicira, da je bila ocena zvoka v celotnem vzorcu pri Poskusu 2 povezana z informacijo o ceni violin.

Spearmanov koeficient korelacije za oceno povezanosti med ceno violin in oceno zvoka violin sem izračunala za vsako skupino posebaj. Pri skupini glasbenikov pri Poskusu 1 ni bilo statistično pomembne korelacije med spremenljivkama cena in subjektivna ocena zvoka, r_s = 0,771; p = 0,072; N = 6. Korelacija med spremenljivkama je bila v Poskusu 1 močna. V Poskusu 2 sem pri skupini glasbenikov zaznala statistično pomembno korelacijo med spremenljivkama cena in subjektivna ocena zvoka, r_s = 0,886; p = 0,019; N = 6. Korelacija med spremenljivkama je bila v Poskusu 2 zelo močna.

Pri skupini neglasbenikov pri Poskusu 1 ni bilo statistično pomembne korelacije med spremenljivkama cena in subjektivna ocena zvoka r_s = 0,314; p = 0,544; N = 6. Korelacija med spremenljivkama je bila v Poskusu 1 šibka. V Poskusu 2 sem pri skupini glasbenikov zaznala statistično pomembno korelacijo med spremenljivkama cena in subjektivna ocena zvoka, r_s = 0,943; p = 0,005; N = 6. Korelacija med spremenljivkama je bila v Poskusu 2 zelo močna.

To indicira, da je bila ocena zvoka v vsaki od skupin pri Poskusu 2 povezana z informacijo o ceni violin.

Tabela 3: Spearmanov koeficient korelacije za oceno povezanosti med ceno violin in oceno zvoka violin pri skupinah glasbenikov in neglasbenikov. Statistično pomembne korelacije so označene krepko.

Spearmanov koeficient za 6 violin	*Brez Informacije o ceni*	*Z informacijo o ceni*
Glasbeniki	r_s = 0,771, p = 0,072	**r_s = 0,886,** **p = 0,019**
Neglasbeniki	r_s = 0,314, p = 0,544	**r_s = 0,943,** **p = 0,005**

Na vprašanje »Kaj je vplivalo na vašo odločitev?« pri Poskusu 2 so testiranci lahko odgovorili z več odgovori. Prikazan delež testirancev je izbral naslednje odgovore:

- »jakost zvoka« - 26,15%
- »barva zvoka (tembre) – lestvica« - 44,25%
- »barva zvoka (tembre) – melodije« - 49,28%
- »dinamične razlike« - 24,14%
- »cena« 15,8%
- »drugo« (odprtega tipa) -17,10%

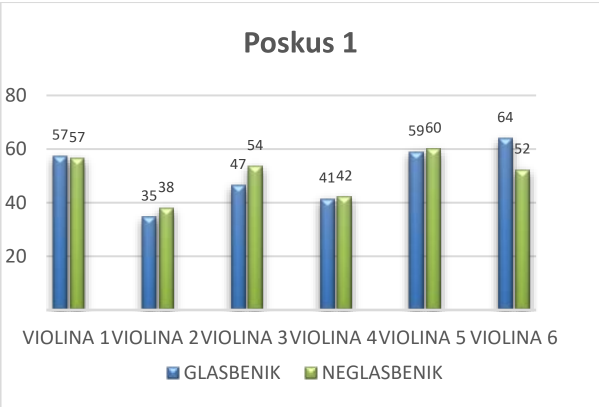
Dejavnik, ki je po mnenju testirancev najbolj vplival na njihovo razvrstitev je bila barva zvoka (tembre) pri posnetkih melodij (43 odgovorov). Veliko vlogo naj bi igrala tudi barva zvoka (tembre) pri lestvicah (38 odgovorov). Pod »drugo« so bili pogosti odgovori: »alikvoti«, »izenačenost registrov«, »odzivnost« ter »intonacija«. Zanimivo je, da je cena med dejavniki, ki po mnenju testirancev vplivajo na njihovo razvrstitev, po pogostosti na zadnjem mestu z le 14 odgovori..

Vprašanje 2*: Ali so subjektivne ocene zvoka violin pri skupini glasbenikov v poskusu brez informacije o ceni bolj povezane s ceno violin v primerjavi z ocenami estetike zvoka v skupini ne-glasbenikov?*

Izračunan Spearmanov koeficient korelacije med ceno violin in oceno zvoka violin pri skupini glasbenikov je pri Poskusu 1 kazal močno korelacijo (Tabela 3).

Spearmanov koeficient korelacije med ceno violin in oceno zvoka violin je pri skupini neglasbenikov pri Poskusu 1 kazal zgolj zmerno korelacijo med spremenljivkama (Tabela 3).

Ker pa noben od omenjenih koeficientov ni statistično značilen, ne morem poročati o povezanosti med spremenljivkama pri obeh skupinah.



Slika 3: Primerjava povprečnih normiranih ocen violin skupin glasbeniki in ne-glasbeniki pri Poskusu 1

Vprašanje 3: *Ali bo napačna informacija o ceni violine (lažna informacija, da je cenejša violina draga) vplivala na oceno zvoka pri tako glasbenikih kot tudi ne-glasbenikih*?

Da bi ugotovila, če je razlika v ocenah zvoka pri celotnem vzorcu pred in po informiranju o ceni (enkrat z resnično informacijo oceni in enkrat z lažno) statistično značilna sem uporabila Wilcoxonov test test predznačenih rangov.

Wilcoxonov test predznačenih rangov je nakazoval na statistično značilno razliko v ocenah zvoka pri celotnem vzorcu pred in po informiranju o ceni, ko je bila podana resnična informacija o ceni. Ocena zvoka po informiranju o resnični ceni je bila zaznavno nižja, z = 3,886; p = 0,0001.

Presenetljivo pa je, da Wilcoxonov test predznačenih rangov ni indiciral statistično značine razlike v ocenah zvoka pri celotnem vzorcu pred in po informiranju o ceni, ko je bila podana lažna informacija o ceni (zlagano visoka). Ocena zvoka po informiranju o lažni ceni ni bila zaznavno višja, z = 0,247; p = 0,802.

Tabela 3: Wilcoxonov test za VIOLINO 3/7 celoten vzorec. Stat. pomembne vrednosti so označene krepko.

Wilcoxonov test	*Brez informacije o ceni/ Z informacijo o ceni: 3000*	*Brez informacije o ceni/ Z lažno informacijo o ceni: 30.000*
VIOLINA 3/7	***z* = 3,886** ***p* = 0,0001**	*z* = 0,247 *p* = 0,802

Wilcoxonov test predznačenih rangov za pare ocen violin, ki so jih dali testiranci pred in po informiranju o ceni sem izračunala tudi za vsako skupino posebej.

Wilcoxonov test predznačenih rangov ni indiciral statistično značilne razlike v ocenah zvoka pri skupini glasbenikov pred in po informiranju o ceni, ko je bila podana resnična informacija o ceni. Ocena zvoka po informiranju o resnični ceni ni bila zaznavno nižja, z = 0,809; p = 0,381.

Zanimivo je, da je Wilcoxonov test predznačenih rangov indiciral statistično značilno razliko v ocenah zvoka pri skupini glasbenikov pred in po informiranju o ceni, ko je bila podana lažna informacija o ceni. Ocena zvoka po informiranju o resnični ceni je bila zaznavno višja, z = 2,505; p = 0,012.

Wilcoxonov test predznačenih rangov je indiciral statistično značilno razliko v ocenah zvoka pri skupini neglasbenikov pred in po informiranju o ceni, ko je bila podana resnična informacija o ceni. Ocena zvoka po informiranju o resnični ceni je bila zaznavno nižja, z = 4,139; p = 0,000003.

Presenetljivo je tudi, da Wilcoxonov test predznačenih rangov **ni** indiciral statistično značilne razlike v ocenah zvoka pri skupini neglasbenikov pred in po informiranju o ceni, ko je bila podana resnična informacija o ceni. Ocena zvoka po informiranju o resnični ceni ni bila zaznavno nižja, z = 1,267; p = 0,205.

Rezultati nakazujejo, da je lažna informacija o ceni bolj vplivala na glasbenike v primerjavi z neglasbeniki.

Tabela 4: Wilcoxonov test za VIOLINO 3/7 za glasbenike in neglasbenike. Stat. pomembne vrednosti so označene krepko.

Wilcoxonov test za 3/7 violino	*Brez informacije o ceni / Z informacijo o ceni 3.000 EUR*	*Brez informacije o ceni / Z lažno informacijo o ceni 30.000 EUR*
Glasbeniki	*z* = 0,809 *p* = 0,381	***z* = 2,505** ***p* = 0,012**
Neglasbeniki	***z* = 4,139** ***p* = 0,000003**	*z* = 1,267 *p* = 0,205

5 MOŽNE IZBOLJŠAVE

Dejstvo, da je bil anketni vprašalnik večinoma reševan preko spleta in ne v živo pa ima nekaj pomanjkljivosti. Testiranci so pri poslušanju zvočnih posnetkov violin imeli različno kakovostno opremo (zvočniki). Testiranci z boljšo opremo so tako lahko bolj natančno slišali razlike v lastnostih zvoka med violinami. Nekaj pomanjkljivosti pa je bilo tudi v pripravi samega vprašalnika: izpolnjevanje vprašalnika je zaradi dolžine posnetkov vzelo vsaj 12 minut. Posledično del testirancev ni rešil vprašalnika v celoti, kar je močno zmanjšalo obseg vzorca. Možna posledica je tudi to, da je udeleženim proti koncu poskusa zmanjkovalo pozornosti (in potrpljenja) in so zato violine ocenjevali naključno ali po informaciji o ceni. Razlog za daljše posnetke je bila želja, da pri vsaki violini predstavim njen zven v različnih stilih preko melodij iz različnih obdobji glasbene umetnosti.

Kot moteča spremenljivka, bi lahko deloval tudi vpliv izvajalca: ker sem bila sama izvajalka, nisem bila enako »navajena« na vse igrane violine. Nekatere violine so bile redno servisirane, strune na njih so bile nove in bile so »igrane«, druge pa ne. Vsi našteti faktorji zaznavno vplivajo na kakovost zvoka violine.

Da bi poskus izboljšala, bi ga izvedla še enkrat, z nekaj spremembami: vse violine bi servisirala in »uigrala«. Da izničim vpliv lastne afinitete do določenih violin, bi tokrat posnela igranje violinista, ki na vse violine igra prvič. Uporabila bi bolj kakovosten snemalnik zvoka. Poskus bi najraje izvedla v živo in tako zagotovila, da vsi udeleženci poslušajo posnetke pod enakimi pogoji (enako kakovostne slušalke/zvočnik). Zanimivo bi bilo tudi razširiti poskus na področje nevro-ergonomije in z slikanjem možganov z metodo funkcijske magnetne resonance (fMRI) opazovati razlike v delovanju možganov testirancev pri poslušanju violin in odločanju.

Ob ponovnem izvajanju poskusa bi v anketni vprašalnik vključili več vprašanj o lastnostih testirancev. Tako bi vzorec razdelili na več smiselnih podskupin, ki bi jih primerjali med seboj. (Npr. "Na testirance, mlajše od 25 let, je informacija o ceni vplivala bolj/manj, kot na testirance starejše od 25 let.")

Znano je, da je ocena kakovosti zvoka inštrumenta zelo kompleksna tema: pri njej igrajo vlogo barva, jakost, dinamične razlike, idr. Veliko vlogo igrajo tudi osebne preference, zato je določanje vrednosti violine nekakšna »siva cona«. V poskusu sem opazovala vpliv faktorja, ki ni neposredno povezan z lastnostmi zvoka: informacija o ceni. Raziskava zato omogoča nekoliko provokativen pogled v svet prodaje in kupovanja violin, ter je uporabna tako za izdelovalce in prodajalce kot za kupce violin.

Uporabna je tudi na področju psihologije v marketingu, saj nakazuje, da informacije iz okolja vplivajo na naša pričakovanja povezana z vrednostjo in na to kako poročamo o izkušnjah na senzoričnih področjih, natančneje na področju sluha. Predvidevam, da bi spoznanja raziskave lahko prenesli še na druga senzorična področja, kot so okus, vid, vonj.

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AI Art: Merely a Possibility or Already a Reality?

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ABSTRACT

The paper discusses the compatibility of AI art with various definitions of art within the analytic tradition, namely functional, historical, and institutional ones. For every definition, we first offer a general overview, discuss whether AI art could be compatible with it, detect possible problems, and finally offer real-life examples that could arguably serve as an example of AI that fits the given definition. In the final section, we address the issue of intentionality for AI art, which seems to be in one way or another part of all discussed definitions and which seems to be the biggest challenge for AI art.

KEYWORDS

Artificial intelligence, art, functionalism, historicism, institutionalism, intentionalism.

1 Introduction

Today, there are hardly any doubts that artificial intelligence (AI) can perform many tasks much better than us, all the way from playing chess, backgammon, or checkers to intelligent scheduling and pricing systems in airline reservations, proving theorems, or solving equations. And as the AIs are getting better and better at these domain-specific tasks, we, with more and more uncertainty, diligently move the goalposts, stating that AI will surely not be able to beat us at the next mark. No wonder then that one of the last bastions of human uniqueness, i.e. creativity, best shown through art and its creations, is fiercely defended against the possibility of AI art. What should philosophy say about that? Are there any definitional obstacles to admitting AI art? Are there already existing examples of AI art that might fit various definitions of art?

Definitions of art remain a controversial subject in analytic philosophy. There has been much discussion about the value of the definition of art and many sceptical concerns about its existence in the first place, starting all the way back in the 1950s [1]. Nevertheless, the AI art debate is a debate about whether AI can produce art, so it has to presuppose that there are in fact works of art and that there is an intelligible way or definition that can capture this phenomenon. Not presupposing this would render the entire debate meaningless.

However, to remain as metaphysically non-committing as possible, we decided to analyse the compatibility of AI art with various most popular definitions. We excluded some more basic definitions, namely single property definitions, such as representational, expressive, and formal definitions; these seem to have fallen out of fashion, undoubtedly because they are “not difficult to find fault with” [1].

Thus, we first analyse the compatibility of AI art with functional definitions, followed by historical and institutional definitions of art, and offering existing AI art examples along the way. Afterwards, we also offer a response to probably the biggest obstacle to AI art, i.e. intentionality.

2 AI and functional definitions of art

Functional definitions of art define art in terms of some function or intended function. Usually, the function is connected with some aesthetic properties, such as the aesthetic experience we undergo when admiring a work of art, e.g., catharsis or simply some aesthetic judgments or experiences. In this sense, functional definitions are more traditional, and have issues accommodating, e.g., modern art, like Duchamp’s ready-mades (although some have argued that ready-mades have aesthetic properties [2]). Despite their flaws, such definitions seem to be perfect for accommodating AI art. Beardsley’s definition can serve as a good example of a functional aesthetic definition. It states that an artwork is “either an arrangement of conditions intended to be capable of affording an experience with marked aesthetic character or (incidentally) an arrangement belonging to a class or type of arrangements that is typically intended to have this capacity” [3].

But which conditions evoke such feelings and experiences? To our knowledge, a satisfactorily account of them has not been given. Nevertheless, in the context of AI art, there seem to be no formal obstacles against AI creating (art) works that meet such conditions. In fact, this is not only conceivable, but has arguably already been done. A prime example is the “Creative Adversarial Network” (CAN) [4], the design of which was motivated by Berlyne’s theory [5] inspired by his most significant arousal-

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raising properties for aesthetics: “novelty, surprisingness, complexity, ambiguity, and puzzlingness”.

The CAN project proved very successful. The authors ran a series of experiments (Turing style tests with human subjects) with the created artworks to test how the AI measures up to human artists. The experiment III is the most relevant for functional definitions. In it, they asked human subjects to rate the artworks by CAN and artworks by human artists (set of paintings from a display at Art Basel 2016). The paintings were rated on a scale of 1-5 (5 being the best) on intentionality, visual structure, communication, and inspiration. Not only did the human subjects fail to notice that CAN paintings were not made by human artists, they outperformed human artists in all metrics. Of course, the size of the experiment was rather small (21 participants), so the results are not statistically powerful; however, as the authors state, “the fact that subjects found the images generated by the machine intentional, visually structured, communicative, and inspiring, with similar levels to actual human art, indicates that subjects see these images as art!” [4]

Functional definitions do not require anything but the realization of certain functional, i.e. aesthetic, properties, which makes them tailor-made for AI art. We believe it is safe to claim that if one subscribes to such a definition, they would be hard-pressed to find an argument against including the already-existing AI artworks.

3 AI and historical definitions of art

Historical definitions are another popular way of understanding art. The core message of historical definitions is that an artwork “is standing in some specified art-historical relation to some specified earlier artworks” [1], which is similar to family-resemblance theories in certain aspects [6]. Moreover, and this is what distinguishes historical definitions from functional or institutional definitions: proponents of historical definitions do not commit to a trans-historical concept of art, i.e. the concept that would capture commonalities across various classes of artworks in distinct historical periods, e.g. some stable core of aesthetic properties that are present in all art movements throughout the history. Thus, historical definitions present “an alternative to the definitional approach” [7]. One of the most recognised historical definition of art is offered by Levinson, who defines a work of art as “something that has been intended by someone for regard or treatment in some overall way that some earlier or pre-existing artwork or artworks are or were correctly regarded or treated” [8].

There seem to be two common elements in historical definitions (even though proponents of historical definitions understand their reasoning as an alternative to the definitional approach, we will refer to historical “definitions” as definitions for the sake of simplicity and because our argument does not hinge on this): let us call the first one the family-resemblance element, and the second one the intentional element, despite the fact that some historical definitions do not require the intentional element [9].

In this section, we will focus on the family-resemblance element; however, we will address intentionality as a problem for AI art in the final section. The question that we have to answer is thus whether AI artworks could stand in an appropriate relationship to established artworks and, more importantly, whether they already do. Similar to the problem in functional definitions, this should not present an insurmountable problem for AI art. It is not only conceivable that AIs could use a family-resemblance process to create artworks, AIs already utilize a process that looks extremely similar. Alexander Mordvintsev, the software engineer behind DeepDream, Google’s neural network, writes as follows, “We train an artificial neural network by showing it millions of training examples and gradually adjusting the network parameters until it gives the classifications we want” [10].

The already mentioned CAN is an even better example: it uses a slightly different approach because its purpose is to create artworks that would be indistinguishable from human artworks. The CAN is comprised of two adversary networks, a discriminator and a generator. A discriminator is “trained” on human art samples, so it has a reference of art images, accompanied with styles and labels. The generator then creates new works of art, trying to accomplish two things: the first is to generate works that the discriminator would recognize as works of art, i.e., it tries to create art that fits into the already-existing styles. However, if it did only that, it would just emulate artworks, similar to an art forger. So, the second task of the CAN generator is to confuse the discriminator regarding the style of the work created. So, “on one hand it tries to fool the discriminator to think it is ‘art’, and on the other hand it tries to confuse the discriminator about the style of the work generated” [4]. In other words, the neural network has to navigate between the Scylla, which is getting recognized as art, and Charybdis, which is generating works that are “style-ambiguous”, trying to find the sweet spot where the painting still resembles other works of art but it is still original. And considering the experimental results introduced in the previous section, CAN is apparently doing an extremely good job at it.

The idea of AI art being compatible with the historical definitions is thus not only conceivable or possible; just like with functional definitions of art, we could reasonably state that there are already examples of AI art that fit the criteria of historical definitions.

4 AI and institutional definitions of art

The institutional definition of art is probably one of the most influential and simultaneously one of the most criticized definitions of art of the 20th century. Many have argued that “the definition’s obvious circularity is vicious” [1]; nevertheless, it has remained fairly popular. The groundwork for institutionalism was laid by Danto [11]; however, Dickie’s institutional definition is probably the most influential. The spirit of institutionalism can be summed up by the following quote: “a work of art is an artifact which has had conferred upon it the status of candidate for appreciation by the artworld” [12]. In other words, something is a work of art if people within the artworld grant it such a status. The definition is more elaborate, and has been expanded by Dickie in his more recent work, so it now consists of five interlocking conditions: "(1) An artist is a person who participates with understanding in the making of a work of art. (2) A work of art is an artifact of a kind created to be presented to an artworld public. (3) A public is a set of persons the members of which are prepared in some degree to understand an object which is presented to them. (4) The artworld is the totality of all artworld systems. (5) An artworld system is a framework for the presentation of a work of art by an artist to an artworld public" [12].

For brevity's sake, we will only focus on the premises that seem problematic for AI art, i.e., premises (1) and (2). Premise (1) seems problematic, as AI is obviously not a person. However, the context has to be considered here; the authors of the 20th century assumed that "the artist is always human, without exploring much whether non-humans can create art" [13]. This seems fairly anthropocentric in this day and age, and we are confident that most theorists would agree that a being with the same or greater understanding in the making of a work of art (e.g., aliens) would still be considered artists. Therefore, the problem does not seem to be not being human, but rather not possessing the capacity to understand and partake in the making of a work of art. This is closely (if not completely) related to intentionality, which we address in the next section, so we will put it aside for now.

The second premise might also pose some problems. There seem to be two separate questions here: what counts as an artifact and is an AI made object an artifact. So what is an artifact? Hilpien's definition should serve our goals: "artifacts are physical objects which have been manufactured for a certain purpose or intentionally modified for a certain purpose" [14]. Notice that such a definition "does not rule out the possibility that at least some things made by non-human animals are artifacts" [15]. E.g. "[b]eavers /…/ might be thought to intentionally construct dams in order to create ponds" [15]. On the other hand, some more rigid behaviours of other animals, like webs woven by spiders, might not count as artifacts. Paths can serve as an even more ambiguous example. They are often created unintentionally, when people take the same short-cut across the university lawn over and over again: but, as Preston argues, "/…/ what is the point of saying that such a path is not an artifact, whereas an identical one that was created intentionally by exactly the same process is? Moreover, what would it take to make the erstwhile non-artifactual path into an artifact? Would it be enough to notice and approve it? Or would I have to intentionally maintain it, by sweeping it clean of leaves, for instance?" [15] The line has to be drawn somewhere, and it is hard to imagine that the line will not be, in some sense, arbitrary.

So, are AI made objects artifacts? If we dismiss the artifacts debate because it seems arbitrary, then it does not matter. If one insists on the artifact/non-artifact distinction, a proponent of such distinction has to first offer a good reason in favour of it. Even if such a reason could be provided, they have to answer the following question: how to classify AI object that are indistinguishable from human artifacts? If someone not familiar with The Painting Fool [16] discovered a painting made by it, they would, without a doubt, classify it as a (human) artifact. So why should we revoke that status once we discover that there was no intention involved in the production of the image? It would be almost as difficult as arguing that the path that was created unintentionally somehow differs as an artifact from the intentionally created path. In short, if humans recognize something as an artifact and behave as if it is an artifact, then why should we not count it as one? The idea that something is an artifact if recognized as an artifact is also compatible with Dickie's institutionalism since, according to him, "anything brought into an art space as a candidate for appreciation becomes thereby 'artefactualized'" [17].

The only question that remains to answer is whether there are examples of AI art that pass fit the institutional definition. And, in fact, there are. Jeff Clune decided to test the level of artworks produced by Evolving Artificial Intelligence Lab's deep neural networks (DNN), submitting the artworks to the University of Wyoming's 40th Annual Juried Student Exhibition, "which accepted 35.5% of its submissions" [18]. Its artworks were not only accepted, but also among the "21.3% of submissions to receive an award" [18], and, what is perhaps most important for an institutional definition of art, were displayed at the university's art museum. So not only can we say that there does not seem to be a good reason against AI art in the framework of the institutional definition of art, we could arguably claim that AI art is already here.

5 AI and intentionality

Some sort of intentionality component was present in almost all analysed definitions. The idea that something can only count as art if it was produced intentionally could thus be compatible with all analysed definitions. Intentionality is aboutness, it is "power of minds and mental states to be about, to represent, or to stand for, things, properties and states of affairs" [19]. It is hard to imagine that an organism or a system would possess such powers without consciousness. Even consciousness is not sufficient for intentionality: we agree that animals (most animals) are conscious, but they (or babies) do not possess intentionality, as intentionality belongs to higher order cognition. So, we cannot possibly ascribe intentionality to AI, as we have no reason to think it is even conscious.

Nevertheless, we believe intentionality is problematic as a condition for artworks. Here's why. Definitions of art usually include intentionality to exclude natural phenomena being art. However, intentionality can be understood in two ways. We can understand it in the narrower sense of producing and expressing a particular idea that the artist has, or we can understand it in a much broader, abstract sense of simply creating a work of art. If one stick to the former, this already excludes many art movements. Surrealism greatly emphasized automatism, which is "perhaps the most famous of their [surrealists's] techniques for evading conscious control of the artistic process" [20]. Breton defines Surrealism as "Psychic automatism in its pure state, by which one proposes to express /…/ the actual functioning of thought /…/ in the absence of any control exercised by reason, exempt from any aesthetic or moral concern" [21]. So not only did the surrealists want to create artworks in the absence of reason and intention, they saw "reason as a guard barring entry to this storehouse" [20].

Defenders of intentionality can quickly offer the following retort: even if one admits that surrealists' process for creating art was not intentional in the narrow sense, they nevertheless had intention to produce art in the broader sense; they had the more abstract "impulse" or "urge" to create a work of art, which AI lacks. However, not all artists throughout the history demanded or valued such broad intentionalism; in fact, some have been explicitly against it. Advocates of Primitivism, a widespread trend in the modern art, celebrated "primitive works", which "came from an unconscious source of creativity rather than from artistic traditions, an idea which suited many modern artists /…/ modern artists also praised the 'primitivism' of art produced by children, the insane and untrained, 'naïve' adults." [20]. Even though one could argue that "primitive" art had a source of inspiration, a sort of intentionality, it would be hard to argue that what they had in mind was this broader concept of creating art. Such a broader claim would be even harder to defend in case of children or the "insane".

Two conclusions can be drawn from all this: if one demands intention in the narrow sense then this would exclude movements like Surrealism, and therefore should not be a necessary condition for artworks; and if one demands intentionality in the broader sense then such a concept will differ massively over cultures and individuals, especially if we find value in "primitive" art. If modern artists cherished and valued art produced by children and the "insane", which lack intentionality in the broader sense altogether, then this should also not be a necessary condition for artworks.

Throughout this paper, we have shown examples of AI artworks that were not only appreciated as art, but which also won prizes, and arguably outperformed human artists. Spectators recognized such works as intentional, inspiring, and communicative. Similar to "primitive" art, AI was able to achieve this without intentionality in the narrow or broader sense. Understanding intentionality in the narrow sense excludes too much from the world of art, and understanding it in the broader sense does not allow an objective definition of art: the concept of this artistic impulse, as seen with Primitivism, just varies too much across cultures and individuals to enable an unbiased description of art. As such, it would seem more appropriate to judge works of art on their external properties, not the intentions of the artists.

We can confidently say that AI (art) works can already pass some kind of the so-called Turing test in the world of art, something that perhaps many post-modern or contemporary human works of art would not. And whereas some people see AI art as blasphemous, we see it as potentially offering us new insight into our understanding of art. Nevertheless, it seems that whatever objection AI defeats, the goal-post always moves further away. Simon Colton wrote (about his creation, the Painting Fool) that "it is our hope that one-day people will have to admit that the Painting Fool is creative because they can no longer think of a good reason why it is not" [16]. Similarly, hopefully one-day people will have to admit that AI can produce art, because they can no longer think of a good reason why it could not.

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Compliance with COVID-19 preventive behaviors and proneness to cognitive biases

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ABSTRACT

Due to common non-compliance with behavioral hygiene recommendations to contain the SARS-CoV-2 virus, the younger generation has often been regarded as a catalyst of the current pandemic. Therefore, the aim of the present study is to determine the connection between proneness to specific cognitive biases and compliance with COVID-19 preventive recommendations in high school students. Our results indicate that decision myopia is positively correlated to non-compliance with COVID-19 containment measures. Surprisingly, no link has been found between risk aversion and compliance to self-protective recommendations, whilst individuals who are more prone to belief bias report greater compliance with COVID-19 preventive behaviors. The results clearly indicate that proneness to cognitive biases is somewhat important but not a decisive factor of adherence to preventive measures.

KEYWORDS

COVID-19, preventive behavioral measures, compliance, cognitive biases, high school students

1 INTRODUCTION

1.1 Theoretical background

Known psychological correlates to compliance with behavioral interventions

With the rise of novel coronavirus SARS-CoV-2 variants and related vaccine hesitancy trends, basic behavioral hygienic measures (such as wearing masks, frequent hand washing, as well as physical distancing) have remained the fundamental tools to contain the spread of the virus. However, evidently certain individuals do not comply to these behavioral recommendations [1], thus probably contributing to the spread of the coronavirus. Identifying factors that are linked to compliance with behavioral recommendations and restrictions is thus extremely important.

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Research so far has extensively focused on linking certain personal traits to compliance with behavioral recommendations. Extraversion has therefore been negatively correlated to compliance with COVID-19 social distancing measures, whereas conscientiousness is believed to be positively correlated to compliance [2]. At the same time, low levels of empathy and antisocial traits are linked to noncompliance with containment measures [3, 4]. On the other hand, current literature has offered inadequate understanding of the cognitive factors of behavioral non-compliance. In this study, we try to theoretically and empirically bridge this research gap. We therefore undertake to examine certain cognitive biases we believe might be related to engaging in self-protective behavior.

Cognitive biases and their possible correlation with preventive behavior

Framing is defined in the framework of prospect theory, which predicts that people are inconsistent when evaluating losses and gains. In particular, when faced with losses, people typically tend to engage in more risk-seeking behavior than when faced with gains [5, 6]. In consequence, more negative, loss-emphasizing information may result in greater risk-taking decision making. Adherence to even the most basic hygienic measures which aim to limit the spread of the coronavirus SARS-CoV-2, is to a certain extent a decision based on one's risk attitude. In the current pandemic, the most recurrent example of framing losses is enumerating the number of lives lost due to COVID-19. Emphasizing saved lives, is on the other hand, an example of framing gains.

However, in addition to this typical framing context, some authors have already pointed out other framing types. There have been indications that different countries framed the outbreak differently at the beginning of the coronavirus outbreak in 2020. Whilst Western countries focused more on framing COVID-19 as a respiratory disease, similar to the seasonal flu, Asian countries compared the novel coronavirus to the SARS virus – a difference in framing that supposedly contributed to the great success of Asian countries in flattening the initial curves of new infections [7].

Risk aversion is another important notion, defined in the framework of prospect theory. It is a cognitive bias, best described as a constant inclination to select the most certain and reliable option, even when there are more profitable (but at the same time riskier) options available [8]. Current theory stipulates that people more prone to this bias, tend to be more compliant with COVID-19 measures [9].

On the other hand, not engaging in self-protective behavior may not only be connected to one's risk attitudes, but also to their lack of reasoning and unwillingness to incorporate new evidence into their thought processes. In syllogistic reasoning, belief bias is described as the tendency "to rely on prior beliefs rather than to fully obey logical principles [10]." In other words, it means being constrained by your own opinions and predispositions. In response, acquiring new, accurate, and unbiased information can be extremely difficult for individuals who are especially prone to this cognitive bias [11]. And since the COVID-19 pandemic has often been referred to as a pandemic of misinformation [12], possessing factual evidence that may be connected with our health-related decisions is surely of utmost importance.

In contrast, decision myopia or the present bias "is the nonlinear and inconstant tendency of many individuals to prefer a smaller sooner pay-off over a larger future pay-off [13]." Favoring smaller and sooner rewards over long-term ones has been a recurrent phenomenon of the pandemic. During the pandemic, we have witnessed how many people have disproportionately ignored social distancing guidelines in order to socially interact with others. However, since social gatherings are known to lead to a spike in coronavirus cases, this a very short-sighted move on various levels since it is believed to additionally contribute to lives lost. In addition, long-lasting draconian lockdowns to contain the spread of the virus limiting in-person contacts are often imposed to restrict such gatherings.

1.2 Overall aim and hypotheses

The key objective of the study is to shed light on the relationship between framing, belief bias, risk aversion, and decision myopia to non-compliance with behavioral recommendations[1] to contain the spread of the coronavirus. According to the presented theory, we introduce several hypotheses. On account of framing effects and their role in risky decision making, we hypothesize:

H1a: Participants who are exposed to the framing of losses, will make riskier choices than participants who are exposed to the framing of gains in the neutral condition.

H1b: Participants who are exposed to the framing of losses when seasonal flu is mentioned, will make riskier choices than participants who are exposed to the framing of gains when virus SARS is mentioned.

H1c: Participants who are exposed to the framing of gains in the neutral condition, are less likely to opt for the riskier option than participants who are exposed to the framing of gains when the SARS virus is mentioned.

H1d: Participants who are exposed to the framing of losses in the neutral condition, are less likely to opt for the riskier option than participants who are exposed to the framing of losses when the SARS virus is mentioned.

Moreover, our other hypotheses are as follows:

H2: Participants, prone to belief bias, report lower compliance with COVID-19 containment behavioral recommendations.

H3: There is a positive correlation between compliance with behavioral guidelines and loss aversion.

H4: Decision myopia is negatively correlated with compliance with behavioral recommendations to contain the spread of COVID-19.

2 METHODOLOGY

2.1 Participants and procedure

To determine the cognitive factors of non-compliance with behavioral guidelines in the younger generation, the generation often proclaimed to be reluctant towards the epidemiological restrictions [1], our study exclusively focused on this age group. The study thus included 83 participants – all students at Poljane Grammar School, aged from 15 to 19 years old. However, as three participants failed to complete the study, their results were excluded from the final analysis. The majority (75%) of participants identified themselves as female, 24% defined themselves as male, whilst the remaining 1% did not wish to disclose their gender. Although this gender structure is not typical of the general population, it is typical of Poljane Grammar School.

The empirical study was conducted on 18th and 19th February 2021 via the Slovenian survey tool *1ka*. Since the study took place during the national COVID-19 lockdown and in-person learning restrictions, the subjects completed the study in the course of their class meetings that were held online, and were a part of their distance-learning schedule. All participants were informed about and consented to the general purpose of the study, and were acquainted with the fact that their participation in the research was entirely voluntary and anonymous.

While completing the empirical questionnaire, they were supervised by the researcher via Zoom, the online video conferencing platform used by their high school. Whilst the research was being carried out, all participants were required to turn on their camera. Moreover, all the participants were notified that any communication among them was prohibited since it could adversely affect the results. To prevent interpersonal communication among the participants, we carefully set the Zoom chat settings so that they prevented participants from communicating with each other. At the same time, a direct online chat communication channel between each participant and the researcher was established. Thus, students participating in the study were able to point out certain technical issues or other concerns directly to the researcher without disrupting others. Furthermore, students were not externally motivated in any way

[1] In this paper, we distinguish between *basic behavioral recommendations* to contain the spread of the coronavirus (for instance, hand washing, mask wearing, and maintaining physical distance from others) and *restrictive measures* (such as lockdown, curfews, and regional restrictions). In our study, we overall address non-compliance to basic behavioral recommendations, but not non-compliance to restrictive measures. Partially our decision is based on the fact that restrictive measures are of limited use when individuals are non-compliant with the basic behavioral recommendations. A study [27] has, for instance, indicated that basic behavioral recommendations can be epidemiologically as successful as restrictive containment measures, provided that individuals adhere to these recommendations, we add. On the other hand, our decision to focus on behavioral interventions rather than on restrictive measures was also largely based on the fact that an international extension of the current study will probably be carried out. As epidemiological (restrictive) measures vary from country to country, a goal of the present study was also to lay out the measurements for our later studies.

to participate in the study: they were not given a fee nor were their results classified or publicly disclosed in any way. We therefore believe that the current results are the best possible representation of the participants' proneness to cognitive biases.

2.2 Tasks and measures

Compliance with COVID-19 behavioral recommendations

To measure reported compliance with the COVID-19 behavioral containment recommendations, we used an adapted form of the *Compliance with COVID-19 prevention guidelines scale* [14]. The adapted 4-point Likert scale includes 13 items, which predominantly focus on determining the extent of compliance with basic hygiene guidelines (such as mask wearing or hand washing) rather than on compliance with more restrictive measures (for instance curfews or lockdown).

Framing

In the framing section of the questionnaire, participants were randomly assigned into two groups. We measured the impact of framing with two similar tasks. The first task was the original task used by Kahneman and Tversky [6]. In this paper, we often refer to this task of framing as framing in the *neutral condition*. The instructions of the task were identical in both experimental groups and are, as follows:

Imagine that Slovenia[2] is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed.

Participants of both tasks were then asked to peruse scientific estimates of how many people would die / live if a certain program is accepted and make a decision on which program should be imposed. In both experimental groups, programs actually predict the same number of lives lost / lives saved. However, as indicated below, gains (lives saved) were framed in the 1st experimental group, whilst losses (lives lost) were framed in the 2nd experimental group. That is:

Group 1: If Program A is adopted, 200 people will be saved.

If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

Group 2: If Program A is adopted, 400 people will die.

If Program B is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die.

In addition to the task in the neutral condition, another task was added to measure how specifying the disease impacts risk-seeking behavior. The text of the second task was slightly modified in comparison with the first task. Participants in the experimental group 1 (the group with framing of gains) were given the information that the disease of the outbreak is similar to diseases, caused by the SARS virus. In contrast, participants in the group with framing of losses were provided with the comparison of the disease with the seasonal flu.

Belief Bias

To measure a participant's proneness to belief bias and its connection to compliance with behavioral recommendations, we used adapted tasks of Markovits and Nantel [15]. Although the original toolkit to measure this cognitive bias was comprised of eight tasks, we used only seven of them as we believed that participants would generally not be acquainted with the individual mentioned in one task[3], and hence unable to respond to the question. All seven questions used were in fact syllogisms – combinations of three statements. The participants were instructed to assume that the first two statements (premises) are true; their task was to estimate whether or not the third statement is the right conclusion derived from the first two statements.

In four tasks, the conclusion that is correctly derived from the two premises is contradictory to general knowledge. As such, proneness to belief bias is in these tasks determined as the willingness to estimate conclusions as inaccurate due to their dissimilarity to generalized facts. This can be illustrated by the following task used in the study:

Premise 1: All things that are smoked are good for your health.

Premise 2: Cigarettes are smoked.

Conclusion: Cigarettes are good for the health.

If we were to ignore the premises and read only the conclusion, we would correctly proclaim it to be false. However, the conclusion is in accordance with the premises, hence it is correct in the context of the given task. A person, susceptible to belief bias will, consequently, likely struggle to reflect on the intuitively-suggested responses and in the particular case incorrectly answer that the conclusion is false.

On the other hand, the other three tasks we used had seemingly reasonable conclusions. However, these conclusions could not have been made on the basis of the given premises and were, as a result, incorrect. Here, proneness to belief bias is regarded as the decision that the conclusion is right. This can be exemplified by the following task:

Premise 1: All flowers have petals.

Premise 2: Roses have petals.

Conclusion: Roses are flowers.

Risk aversion

We used a truncated Holt-Laury Task [16][4] to measure risk aversion. The task is formulated as a set of paired lottery choices and was initially designed to measure financial risk aversion. However, it is applicable to non-financial fields as well, and as such useful for the purpose of our study, as people are consistent in their preferences regarding risk-taking in all areas of life [17].

The original task contains ten rounds of paired choices, whilst ours included only nine due to the complexity and length of the study. In every round, participants are required to opt for either option A or option B; both options are profitable. Nevertheless, their profitability and risk level differ. The potential profits of both options remain constant throughout all nine rounds (thus,

[2] The original text of the task predicted that the U.S., and not Slovenia was preparing for an outbreak. For the purpose of this study, this detail was changed.

[3] This individual was John D. Rockefeller.

[4] In comparison with the original task, the currency was also changed to familiarize the participants with the task.

option A can potentially bring either €2.00 or €1.60, whereas the predicted payoff of option B is €3.85 or €0.10; [16]). Generally, option A is regarded as the "safe" option, meanwhile option B is regarded as the "riskier" option as the potential profits in option B vary more than potential profits in option A [8]. The course of the task can be demonstrated by its first three rounds:

Table 1: First three rounds of Holt-Laury Task

Round	Option A		Option B	
1	10% chance of receiving €2.00	90% chance of receiving €1.60	10% chance of receiving €3.85	90% chance of receiving €0.10
2	20% chance of receiving €2.00	80% chance of receiving €1.60	20% chance of receiving €3.85	80% chance of receiving €0.10
3	30% chance of receiving €2.00	70% chance of receiving €1.60	30% chance of receiving €3.85	70% chance of receiving €0.10

The average behavior of the majority of participants in initial rounds is to opt for the safer option, option A. This trend is, however, expected to alter when the likelihood of receiving larger payments as a result of choosing option B substantially increases [16]. One's willingness to engage in risk-taking behavior is measured by the number of "risky" decisions – the selections of option B.

Decision myopia

An adapted [5] measurement of intertemporal choice by Frederick [18] was used in this study in order to link decision myopia to non-compliance with behavioral recommendations to contain the spread of SARS-CoV-2. In total the measurement included eleven items. As with the risk aversion task, the intertemporal choice measurement was structured as a combination of paired lottery choices.

In the first eight rounds, participants had to choose between two profitable options, option A and option B. Option B was always more lucrative than option A. However, the payoff of option A was always immediate or at least chronologically sooner in comparison with the payoff of option B. For instance:

If you choose option A, you will receive €3000 this month. If you choose option B, you will receive €3400 next month.

In such tasks, short-sighted individuals are therefore expected to select instant gratification by persistently choosing option A [18]. In the 9th and 10th round, participants were asked to choose between the two given options once again. This time both options were loss-making: option A predicted a more immediate, but financially lower loss, whilst option B involved a greater, but deferred loss. Decision myopic individuals are believed to prefer deferred losses even when it is not financially profitable for them [18], as indicated in the following example:

If you choose option A, you will lose €1000 this year. If you choose option B, you will lose €2000 next year.

The 11th round was in fact not a lottery choice task – it was a question, also used in the original intertemporal choice measurement [18], which asked the participants to indicate whether they would be prepared to pay more for overnight shipping of a chosen product.

3 RESULTS

All acquired data were statistically analyzed in Microsoft Excel 2016.

3.1 Framing

To measure the impact of framing gains/losses, we used a chi-squared test. Our data indicate that there is no statistical difference in risk taking behavior when losses are framed as opposed to gains in the neutral condition, X^2 (1, N = 80) = 0.03, p = 0.87. Moreover, no significant difference in risk attitude has been found when comparing the framing of gains when SARS is mentioned and the framing of losses when seasonal flu is mentioned, X^2 (1, N = 80) = 0.00, p = 0.99.

Nevertheless, the results demonstrate that participants who were exposed to framing of gains in the neutral condition were more risk averse than participants who were exposed to framing of gains when the SARS virus was mentioned, X^2 (1, N = 80) = 26.53, p = 0.00. On the other hand, the difference in risk attitudes is statistically significant when comparing framing of losses in the neutral condition to framing of losses when the seasonal flu was mentioned; when the flu is mentioned, participants tend to acquire select the risk-taking option more commonly, X^2 (1, N =80) = 4.82, p = 0.03.

3.2 Cognitive biases and compliance

Correlations between belief bias, loss aversion, decision myopia, and compliance with COVID-19 preventive recommendations are measured with the Pearson correlation coefficient. Data analysis showed that proneness to belief bias and compliance with behavioral recommendations are positively correlated (r = 0.35, p < 0,01). However, there is no statistically significant correlation between proneness to risk aversion and compliance (r = 0.09, p = 0.42). Furthermore, a negative correlation has been found between decision myopia and compliance to COVID-19 preventive behavioral recommendations (r =-0.53, p < 0.01).

4 DISCUSSION

Our study has offered a more profound understanding of behavior during the ongoing pandemic. To provide an accurate insight, we exclusively focused on the correlation between proneness to certain cognitive factors and compliance with preventive measures. However, we acknowledge the fact that our

[5] In addition to the fact that the task was shortened (original task to measure intertemporal choice included 17 items), we also changed the currency – as with the risk aversion task.

results might have been affected by other equally important factors correlated to compliance, such as demographic characteristics, socioeconomic status, personality, individual differences in the perception of and emotional responses to the pandemic, resilience, political ideology, conspiracy mentality etc. Furthermore, our study has also shed light on some results that differ from those in the current literature.

Our results, for instance, did not confirm that in the neutral condition, participants exposed to framing of losses were, in consequence, more in favor of engaging in risk-taking behavior than their peers exposed to framing of gains. This is contrary to the pre-existing theory [5, 6]. Similarly, no significant results were found when comparing framing of losses and framing of gains with regard to seasonal flu and the SARS virus. We were thus not able to confirm our first two hypotheses. In our opinion, there are several possible reasons for such results. Firstly, participants in our study were high school students, who are not often represented in gain-loss framing research. It is therefore possible that the impact such framing has on high school students is limited. At the same time, we must acknowledge that the students, representatives of the younger generation, were perhaps not so familiar with the SARS virus, which might impact their uptake of risky / safe options. Secondly, the experiment took place during the ongoing COVID-19 pandemic. It is possible that participants were either very disturbed by reading the outbreak scenario (which might have been, to a certain extent, reminiscent of the current pandemic) or indifferent towards it, as people may become when unable to help others in need [19].

In contrast, it is very interesting that participants' risk attitudes noticeably change when a specific disease is mentioned. Analyzed data indicate that specifying the disease as very similar to either the SARS virus or the seasonal flu contributes to subjects engaging in risk-taking decision making, no matter whether losses or gains are framed. Since our study included only high school students, we cannot transpose these findings to the general population. However, it seems that in the risk-loss framework our subjects understood every specification of the disease as a loss, which caused them to engage in more risk-taking behavior.

Our results are unanticipated in terms of other hypotheses as well. Contrary to our initial expectations, individuals who are more prone to belief bias express greater level of compliance with COVID-19 behavioral recommendations. This might be linked to the fact that, during the pandemic, compliance with COVID-19 behavioral recommendations and regulations has, in many cases, become a political matter [20]. Previous research has shown that people who overall tend to reflect less on their decisions (a characteristic of belief bias) often support populistic leaders [21]. In that regard, the decision to comply with behavioral recommendations and containment measures might be more politically motivated than health-related. This is additionally confirmed by the pre-existing literature in social psychology: individuals who support the group imposing the conformity, are more likely to conform to their social norms as well [22]. Furthermore, a handful of studies in the field report similar results - participants who are less reflective in their decision making (that is, they rely more on their intuition than on analytical deliberation when making decisions) are reportedly more compliant with preventive measures [23, 24]. Such results remain unaccounted for: it is not clear whether they can be directly linked to the use of heuristics, mental shortcuts, as simply complying rather than questioning the measures often requires less cognitive effort, or there is an indirect correlation between cognitive reflection and proneness to biases, compliance, and other noteworthy psychological factors, such as social norms [24].

Similarly unexpected was the finding that students prone to risk aversion bias were not more inclined to comply with behavioral recommendations. The current literature on preventive behaviors suggests that the perceived threat that COVID-19 presents to an individual is a significant factor of compliance to preventive measures [25]. In other words, when feeling threatened, people typically engage in more risk-averse behavior than when they feel there is no danger. According to the national tracking data of the spread of coronavirus SARS-CoV-2 in Slovenia, COVID-19 presents a relatively low threat to the population of high school students [26]. This may, in turn, impact their risk attitudes and compliance with preventive measures. At the same time, it is important to stress that the measuring tool used to estimate the extent of participants' risk aversion was designed to measure financial risk attitudes. Although inclination towards risk-taking behavior has been found to be consistent in every behavioral aspect [17], there is a possibility that we would have obtained significant results, if we had introduced a measuring tool for health-related risk attitudes. This is certainly an important fact we need to consider before planning our future research in the field.

Our finding that impulsive satisfaction of needs is linked to non-compliance with COVID-19 preventive measures is in line with the current literature. It has been suggested that the proneness to this cognitive bias should be used to promote stay-at-home restrictions and recommendations by providing free internet access or benefit packages for vulnerable groups [13].

Overall, our study offers an intriguing and thought-provoking insight into cognitive correlates of COVID-19 preventive behaviors and is a valuable starting point for future research in the field.

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The ecological rationality of probabilistic learning rules in unreliable circumstances

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ABSTRACT

In today's flood of information in many fields we do not know which sources are reliable and which are not. On what basis can we draw conclusions? Whom to trust? We could say each of us has a belief system that updates based on the arrival of new relevant evidence. In our research we used a computer model where we were investigating which learning rule is more reliable when we do not have a trustworthy source. The main goal is to discover the truth and to do so quickly. Our results show that different probabilistic learning rules may be preferable in different situations and environments.

KEYWORDS

ecological rationality, belief updating, reasoning, learning rules, uncertainty

1 INTRODUCTION

We cannot fully rely on our senses nor on other external sources of information (e.g., testimony provided by others). In addition, it seems that there are multiple types of reasoning under uncertainty in the sense that we use different learning (or reasoning) rules that guide the process of reasoning. For instance, in trying to reach a conclusion about some question (e.g., a doctor is trying to diagnose a patient) on the basis of some evidence/information (e.g., diagnostic tests) an agent might follow a principle of inferring to the best explanation (e.g., of the tests and their sensitivity and specificity). Another agent might consider other aspects of the situation and hence follow different learning rules like, e.g., how confirmatory the evidence is of some hypothesis that is being reasoned about (e.g., if a patient had a disease X, how likely it would be that the tests would be such and such given the objectively known information about the reliability of the test). A question that may be raised could then be put as follows: Given that there are multiple ways of reasoning under uncertainty (represented by different learning rules as described above), are some types of reasoning under uncertainty better than others and how may we even tell whether one type is better than another? That is, how can we compare the performance of various learning rules that guide our reasoning?

It is quite clear that in answering this question we need to consider what the goals of reasoning are. To name a few possibilities: perhaps the goal of reasoning is to increase the understanding of the phenomenon that is the subject of reasoning, or the goal may be to uncover whether some statement holds. In fact, it seems that there are countless aspects that could be considered as valuable outcomes of reasoning and that could as such be used in comparing which rule that guides reasoning is better (or better in some context).

In our investigation we focused on two valuable outcomes: (i) uncovering the truth, and (ii) the speed of reasoning. The former, (i), considers how certain one is of true propositions due to reasoning according to a specific (learning) rule. If (i) is our guide, then we take a rule to be better if it makes one more certain of true propositions. The latter, (ii), considers how quickly one can reach conclusions while reasoning. Similarly, if a rule is quicker in making an agent more certain (it quickly lessens uncertainty), then it performs better on this count.

Ideally, both (i) and (ii) would go hand in hand: a reasoner would reach true conclusions and would also reach them quickly. However, it seems that they do not usually go hand in hand: rules that are especially conducive of (i) seem to typically not be so conducive of (ii), and vice-versa (see, e.g., [1], [2]): more conservative learning rules (i.e., not jumping to conclusions too quickly) are usually such that lead to more accurate conclusions.

For instance, one could excel on count (i) but fail on count (ii): e.g., a learning rule could lead to mostly true conclusions but only after a vast amount of evidence is considered. An example of this would be a medical doctor that identifies the correct disease in her patient but needs to conduct a large number of diagnostic tests before she is able to do so. Similarly, one could underperform on (i) but excel on (ii): such a case would be a doctor that makes a diagnosis on the basis of a single or few tests but her diagnosis is wrong. What we aimed to answer in our research project was which learning (or reasoning) rules are the most conducive of (i) and (ii), and how the two valuable goals (truth and speed) could be balanced when we compare different learning rules.

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Additionally, we wanted to keep in mind that the sources of information need not be fully reliable -- they could even be completely misleading.

2 BACKGROUND

Our research project actually starts from an investigation of learning on the basis of partial lying, i.e., learning in cases where one asserts information that she believes to be likely but not necessarily false. Another agent then learns based on both (a) such statements and (b) observations of whether the statements are true or false. This provides the basis for estimating the reliability of the source: if statements are (mostly) true, the source is more reliable and vice versa, if statements are mostly false, the source is taken to be more unreliable. We were interested in reliability/trustworthiness of the source under uncertainty more generally (e.g., diagnostic tests in a medical setting might be unreliable too, not just our interlocutors who may want to mislead us intentionally), but a previous research project of partial lying (see [3]) turned out to be a good starting point because it provided a useful formal description of the mechanisms on how to estimate reliability/trustworthiness of a source and how to incorporate this estimate in a learning rule (there: Bayesian learning, although our research project also includes other learning rules). Before we can explain why partial lying is very similar to the topic we were investigating, let us briefly explain the issue of what partial lying even is.

Philosophers define lying with four conditions: (1) a statement, (2) the belief that the statement is false, (3) the addressee, and (4) the purpose of misleading the addressee (see [3] and the references therein).

If someone is constantly lying to us, this individual can be simply deemed unreliable and ignored or even taken as if they are telling us the opposite of truth (saying "A" could be taken as evidence for "not A"). If, however, truth and lies are mingled in varying proportions, choosing whether to trust this individual, and if so to what degree, becomes increasingly difficult. This fact has been emphasized by Trpin and colleagues [1], which pointed out that the definition for lying misses out on many similar cases because the second condition is too strict. They broadened the second condition – we usually also consider someone a liar when they believe their statement to be more likely false than true. However, as they discovered through several computer simulations, estimating the trustworthiness of the source then becomes more difficult, hence such medium-strong lies (that is, those where the liar is only somewhat certain that they are asserting falsehoods) do us more epistemic harm. Following Bayes' learning rule to model lying, the research conducted by Trpin and colleagues [1] sparked debates as to whether it is sensible to consider partial lies at all, if one aims to reduce epistemic harm. What they found is that this approach is only useful when the goal is to quickly avoid believing false propositions.

As we can see from this brief explanation of the background, they already considered both valuable outcomes of reasoning that we were also interested in: (i) epistemic aspects: how close to truth we get due to learning/reasoning under uncertainty, and (ii) pragmatic aspects: how quickly we manage to form strong beliefs on the basis of learning. Moreover, they considered unreliable sources similarly as we did.

Another related research project was conducted by Douven (see [4]). In that research, the focus was not so much on unreliable sources of information but rather on how different probabilistic learning rules compare. In the first part of his research, which was based on computer simulations of learning, he found that the rules diverged on both aspects. In the second part, he devised an interesting method for balancing the two aspects (accuracy and speed) and to estimate natural selection of the best rules for a given environment (viz. ecological rationality of different probabilistic learning rules). Specifically, he considered that we can simulate an intensive care unit (hereafter: ICU) in which doctors are trying to help a patient. There are three options: the doctor either intervenes correctly, wrongly, or - in case she remains uncertain - does not intervene at all. The probability of the patient's survival changes through time and depends on the decision: as time passes, the survival becomes less likely. Similarly, at any point, the correct intervention increases the probability of survival, the wrong intervention decreases it and not intervening at all puts the probability of survival in between the two other options.

Douven demonstrated that using a method of natural optimization can provide another argument in favor of probabilistic inference to the best explanation: although it is a bolder learning rule -- it leads to quicker conclusions and may therefore suffer from inaccuracy -- it is still quick and reliable enough, so that it will typically provide the best trade-off between the two valuable outcomes of reasoning: speed and accuracy. Specifically, in this case he was simulating 200 doctors, 50 learning from diagnostic tests according to each of the 4 learning rules. Then each of them would get 100 simulated patients and would be able to conduct a number of tests on them (100 tests) to diagnose their disease. At the end of a run we can see what the probability of survival was for each of the 200 simulated doctors and the top 100 doctors were duplicated and the bottom 100 erased from the population. This then went on for 100 generations when mostly explanationist doctors remained.

Although his research project included reasoning under uncertainty and an insightful way of balancing the valuable speed and accuracy of reasoning, it did not consider the trustworthiness of information sources and it also did not consider that information (here: diagnostic tests) might be false. Hence, a combination of the research on partial lying (as described above and in [3]) and that of natural optimization for comparing different probabilistic learning rules (as just described, see also [4]) appeared to be an interesting topic that needed to be tackled.

3 METHOD: PART 1

A computer model was created on the basis of other projects described in the previous section. The model included a trust system in which updating was simulated.

Specifically, in the first part we simulated a game of coin bias detection. Agent A is observing the coin and reasoning about its bias, i.e., A is trying to learn how biased the coin is. The simulations consisted of 500 throws of 11 different coins - hypotheses. Each of the 11 coins had its own bias, with probability from 0 to 1 in .1 increments for it to land on heads.

The experiment was repeated a thousand times. In addition to coin throws we also simulated another Agent B, who may be taken as an information source. Agent B was there to provide unreliable and potentially misleading information to A, viz. B is telling A which side the coin is supposedly going to land on, although B does not necessarily provide true information ("B lies to A"). There were also three lists of lies according to the following principles: simple lying (the player states the least probable outcome of the coin, i.e., if the coin is biased to land on heads, agent B will state that it will land on tails), gambler's lying (the player turns the coin secretly and states the opposite of the outcome) and clairvoyant lying (the clairvoyant knows the exact outcome and states the opposite). Bayes's learning rule, Good's learning rule, Popper's learning rule and Explanatory learning rule were used to learn from these data (observations of coins and statements + dynamic trust) to see which belief system update is causing the least epistemic damage. Learning rules offer a way to update the beliefs in the light of the arrival of new relevant evidence. Specifically: Bayes' learning rule requires that the new probability distribution (after learning) corresponds to the prior conditional probability distribution (conditional on the learned piece of evidence and the level of trust in the source). The other three rules are all based on Bayes' but deviate in various ways: the explanatory learning rule adds extra weight to the hypothesis that provides the best explanation. That is, if a coin lands heads 5 times in a row, the best explanation is that it is fully biased towards heads, so this hypothesis gets a probabilistic "push" compared to what Bayes' rule would require. Good's and Popper's rule are similar, except that instead of looking at the best explanation, they award those hypotheses that provide the most confirmatory theories according to measures of confirmation developed by Good and Popper, respectively (see [4] for formal details about the updating rules).

After the simulations are conducted, we then look at the collected data. Specifically, we were interested in the epistemic performance of the rules (how close to the truth they bring an agent) and the speed of convergence towards true hypotheses. To measure how accurate the rules were, we used a measure called Brier's score (or Brier's penalty). The idea is that we can look at mean squared error of the probability distribution: effectively, if a forecast is perfect, the score is 0, and the more off it is, the higher the score, which is also the reason why the score is sometimes called Brier's penalty.

In our simulations, we used it to compare the accuracy of ascribed coin biases. If the simulated coin has a .7 bias to land heads, then ideally our reasoner would assign probability 1 to the hypothesis that the coin is .7 biased. As this is unlikely to happen, we then measure mean squared error of the discrete probability distribution from this ideal outcome. In turn, we can use this to compare the performance of different learning rules.

Similarly, for measuring speed we can simply compare how long it took each reasoner to assign a probability above some threshold value (e.g., above .9) to the true hypothesis about the coin's bias. Note that both the speed of convergence and the accuracy (Brier's score) also depend on the coin that is used in simulations. This is because it is easier to determine the bias of a fully biased coin than of a fair coin: if it always lands on the same side, it is easier to conclude it is fully biased than when it is landing on various sides (note that a fair coin may also land on the same side many times in a row, although such a pattern is more expected from a fully biased coin).

4 RESULTS: PART 1

Results mainly show differences in probabilistic learning rules in simple lying when the probability of lying is 1.0 - constant lying, which is also the only part that we are including in this extended abstract. It was found that the best probabilistic learning rule, in this case, is Explanatory learning rule with the lowest Brier penalties (i.e., the lowest inaccuracy). This result has interesting implications: it shows that if the data is misleading, then it may make more sense to use non-Bayesian alternative probabilistic rules.

Note, however, that the accuracy is even greater when we look at control runs, that is, the cases where the information source was ignored, so that the learning agent was merely observing which side the coin landed on without considering what the liar was asserting. This seems to suggest that when we are dealing with unreliable sources of information, it might be best to immediately ignore such sources, e.g., a doctor who notices that her diagnostic tests are unreliable could stop conducting these tests. However, when we look at the speed of convergence, we observe that it makes sense not to ignore such sources if we are also interested in quickly recognizing true hypotheses: control runs were slower than others at least for some of the simulated coins.

Moreover, inference to the best explanation was, contrary to previous research, the fastest but also the most accurate, i.e., it was able to combine both accuracy and speed of reasoning, the two values that previously appeared to be mutually exclusive.

5 METHOD: PART 2

The second part of our research followed the approach used by Douven (see [4] and the section on background above). Particularly, we were interested in simulating an ICU with doctors trying to diagnose their patients when the tests are potentially unreliable/misleading. The situation is very similar to part 1: instead of coin biases we deal with diseases that may show some symptom with 0, .1, .2, ..., 1 probability and tests that correspond to partial lying in various lying styles: they are not fully reliable and our doctors estimate the reliability of the tests. We can then look at what the survival rates were for each of the doctor's patients and replicate the top performing half doctors and repeat this for 100 generations. Hence, we combine the research from the first part and the research described in the background section.

6 RESULTS: PART 2

The results are interesting: if we look at tests that are constantly misleading (i.e., all of them are unreliable to some degree that needs to be estimated) and if they correspond to what would be akin to simple lying (if it is more likely that a patient has a symptom X than not at the time of the testing, the test will not show the presence of X), then the doctors that infer to the best explanation prevail through generations (see Figure 1 for an example of a simulation and Figure 2 for average percentage of different doctors in our simulations). However, if the tests correspond to being unreliable in what is akin to gambler's or clairvoyant lying we get different results: tests that are unreliable in the gambler's lying style favor both Good's and explanationist reasoning (Figure 3), while those that are like clairvoyant's (always the wrong result) favor Bayes's rule: see Figure 4.

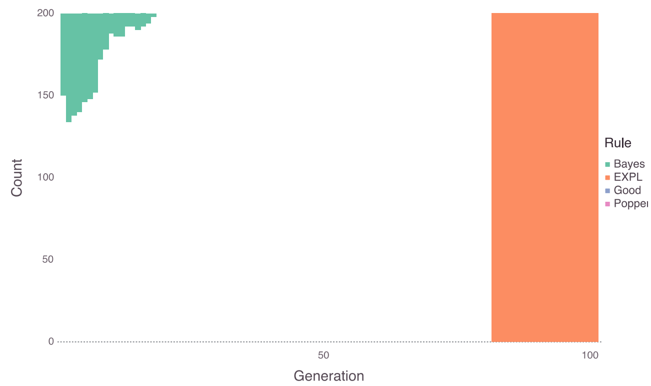

Figure 1: Example of different agents in a single simulation

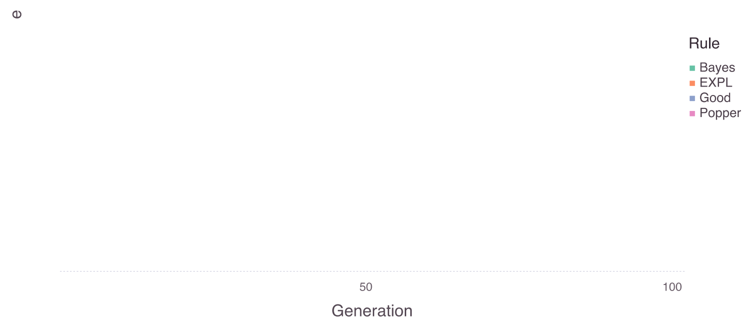

Figure 2: Average percentage of agents ("simple" lying)

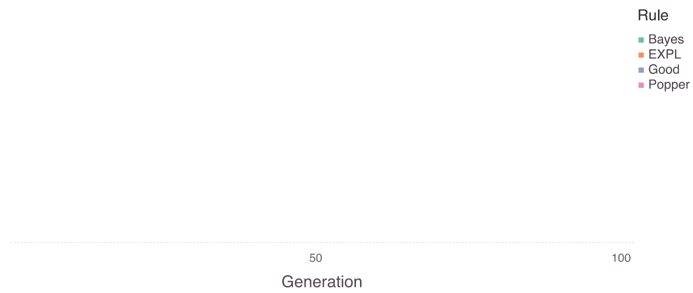

Figure 3: Average percentage of agents ("gambler's" lying)

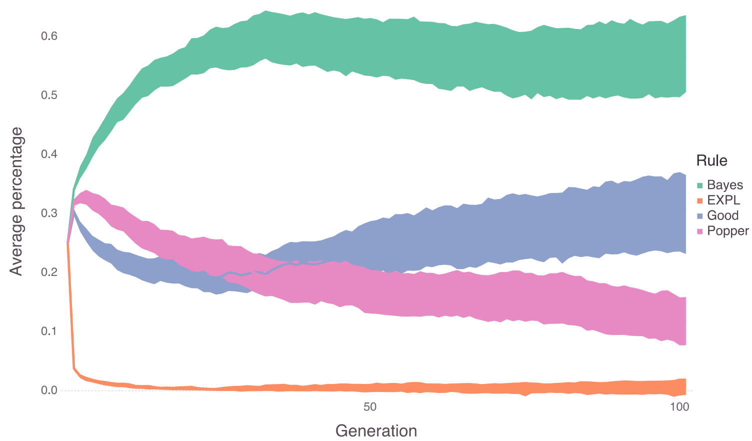

Figure 4: Average percentage ("clairvoyant" lying)

7 CONCLUSIONS

The results, especially those of Part 2, are very interesting because they suggest that different probabilistic learning rules that have been addressed in literature may be preferable in different situations and preferable in various environments. Ecological rationality then suggests that if we happen to be in an environment with specific features, which we plan to identify in our future research work, then Bayes' rule might be the best way to proceed. Similarly, explanationist learning or Good's or Popper's learning might be preferable in other situations. It remains an open question what features of the information environment determine the choice of a learning rule, but our results suggest that a pluralist approach to learning rules under uncertainty is needed. Our results also provide one possible explanation why we seem to have different reasoning patterns under uncertainty in a descriptive sense, that is, because different environments call for different reasoning strategies. Further research could also provide some insights into pluralist reasoning strategies, i.e., strategy-switching.

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Ljubljana, Slovenia

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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OBSERVING ODOR-RELATED INFORMATION IN ACADEMIC DOMAIN

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ABSTRACT

In this paper, we demonstrate an approach for observing olfactory related information in an academic publications environment (such as Microsoft Academic Graph) based on semantic technologies. We present an Odor Observatory tool that enables several usage scenarios, such as observing odor-related papers and topics, viewing institutions conducting olfactory research, defining top journals and key countries in the olfactory domain.

Validation of the proposed approach on a collection of academic publications from 1800 until 1925 confirms applicability of the proposed approach on large data collections with a wide span of time. In usage scenarios we observed the odor-related publications in Microsoft Academic Graph by topic, discovered the journals with historical olfactory publications and found that the most popular terms in odor-related research content are: method, olfactory, odor, device, invention, smell, preparation, utility model.

KEYWORDS

Odor, Olfactory information, Microsoft Academic Graph (MAG), Data mining.

1. INTRODUCTION

Olfaction, or the sense of smell, is the sense through which smells (or odors) are perceived [1]. Olfactory science involves studying olfaction and odor-related topics, the sensory system, physiology, and pheromone signals.

The Odeuropa project [2] gathers and integrates expertise in sensory mining and olfactory heritage. The project partners are developing novel methods to collect information about smell from (digital) text and image collections.

The Odeuropa project partners apply state-of-the-art AI techniques to text and image datasets in order to identify and trace how 'smell' was expressed in different languages, with what places it was associated, what kinds of events and practices it characterized, and to what emotions it was linked.

In this paper we present an approach for mining olfactory information from scientific research collections, such as the Microsoft Academic Graph (MAG) [3].

The olfactory mining approach combines data processing, modelling and visualization methods in order to develop applicable tools for data analysis.

We present an Odor Observatory tool [4] targeted at several visualization scenarios. In particular, the Odor Observatory allows exploring olfactory related papers from the MAG over time, and along with current data, provides historical information starting with the early XIX century.

The data-driven functionalities of Odor Observatory are:

- Possibility of exploring top ranked topics in the olfactory academic domain;
- Possibility of exploring top ranked institutions conducting olfactory research;
- Possibility of exploring key countries and defining top ranking journals in the olfactory academic domain;
- Odor-related search functionalities;
- Word cloud visualization for odor-related terms.

2. RELATED WORK

Olfactory science covers different aspects of research related to odors, therefore exploring odor related information and data can be viewed as complex multidisciplinary area.

Lötsch et al. [5] considered machine learning approaches for human olfactory research. The authors state that the complexity of the human sense of smell is reflected in complex and high-dimensional data, which supports the applicability of machine learning and data mining techniques. The use of machine learning in human olfactory research includes the following aims:

1. The study of the physiology of pattern-based odor detection and recognition processes;
2. Pattern recognition in olfactory phenotypes;
3. The development of complex disease biomarkers including olfactory features;

4. Odor prediction from physico-chemical properties of volatile molecules, and
5. Knowledge discovery in publicly available large databases.

The authors provide review of key concepts of machine learning and summarizes current applications on human olfactory data.

At the same time, linguistic and semantic communities focused on studying the language of smell [6]. Iatropoulos et al. developed a computational method to characterize the olfaction-related semantic content of words in a large text corpus of internet sites in English. They also introduced novel metrics, such as olfactory association index (OAI) and olfactory specificity index (OSI).

Tonelli [7] describes olfactory information extraction and semantic processing from a multilingual perspective. The author states that in several studies it was found that languages seem to have a smaller vocabulary to describe smells as compared to other senses.

In our work we apply data mining and machine learning, as well as semantic approaches for enriching textual data. We use data from Microsoft Academic Graph and our methodologies can be regarded as being in the context of semantic and text processing research. Our approaches can cover cross-lingual and multilingual data and allow for tracking olfactory trends in time.

3. PROBLEM DEFINITION

3.1 DATA SOURCES

The Microsoft Academic Graph (MAG) [3] is a heterogeneous graph containing scientific publication records, citation relationships between those publications, as well as authors, institutions, journals, conferences, and fields of study.

Since this research is conducted in line with the Odeuropa project (targeted at olfactory heritage), the time frame used for MAG data is set to range from the early publications in the 19th century to the present time. The Odeuropa project is interested in particular in the data available up to 1925. Though the project is focused on the historical datasets, the developed Odor Observatory tool allows users to explore recent olfactory publications as well. The dataset is updated on a monthly basis and new available data is uploaded into the observatory.

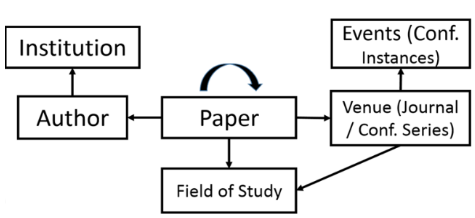

Figure 1: The Conceptual Schema for MAG

The Microsoft Academic Graph data schema is based on the list of following entity types: publication, author, author affiliation (institution), publication venue (journals and conferences), field of study (topic). It contains information about publication dates, as well as citation pairs and co-authorship data (see Figure 1).

Figure 2 illustrates an entry in MAG for a historical publication tagged with several odor-relevant topics.

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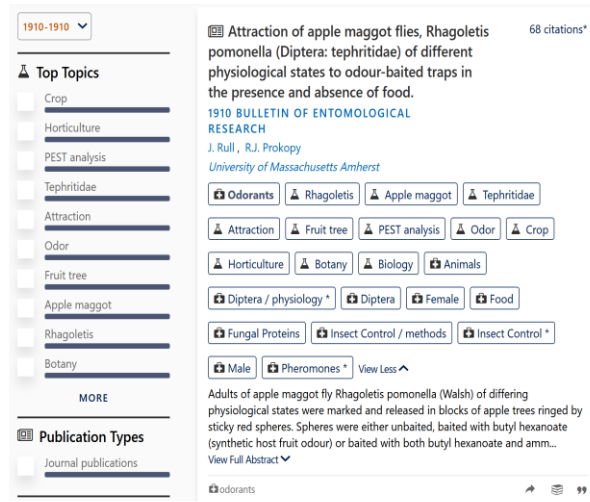

Figure 2: Publication in MAG

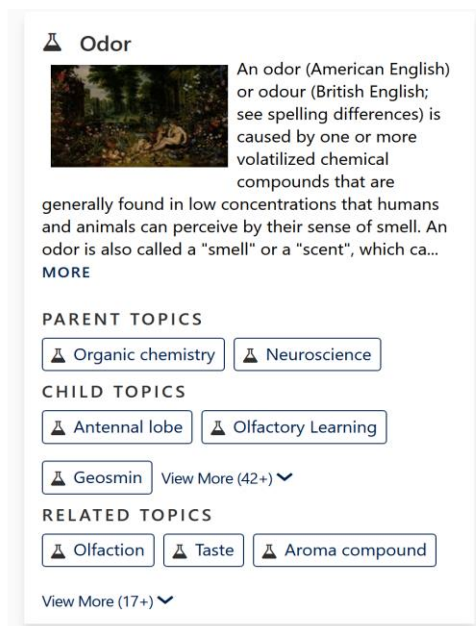

Figure 3: Odor in the MAG Taxonomy

Figure 3 shows a representation of Odor in the MAG taxonomy, with parent topics (Organic chemistry and Neuroscience) and child topics (Olfactory learning, Geosmin etc.)

An important functionality while exploring the literature is the ability to expand searches by looking at related topics to a topic of interest. Figure 4 displays topics about/related to Olfaction/Odor/Smell in MAG taxonomy.

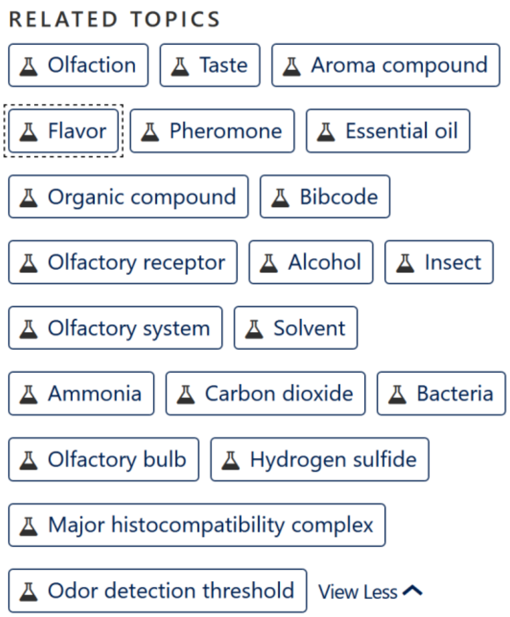

Figure 4: Odor-related Topics in MAG

3.2 METHODOLOGY

The methodology for observing olfactory related information from academic publication resources includes a number of steps:

- Using the MAG taxonomy, obtain the list of research papers that corresponds to odor-related topics. Papers were filtered to those containing the topics: Olfaction, Odor, Fragrance, Fragrance ingredient, as well as the "smell" keyword;
- Ingest the extracted corpus into the Elastic Search tool[1];
- Provide visualization functionalities, such as MAG time series per term.

The key challenges of the development techniques include:

- Interpretability and explainability of the results – the aim is for the visualizations to be able easily interpretable by humans;
- Given the large scale of the incoming data streams, it is essential that building visualizations are scalable. The MAG contains more than 265 million records (August 2021), including several types of publication, such as journal articles, conference papers, books, book chapters, and papers from other repositories. In addition, MAG also indexes a large corpus of patents.

3.3 USAGE SCENARIOS

We present a couple of usage scenarios for the Odor Observatory tool, cast as questions asked by scholars studying the field.

1. What are the historical trends in odor-related publications?

Figure 5 shows the number of odor-related historical publications in MAG over time. This scenario assumes observing trends in different olfactory topics throughout a time interval.

It is possible to observe that the highest number of publications are in the domains of biology and psychology.

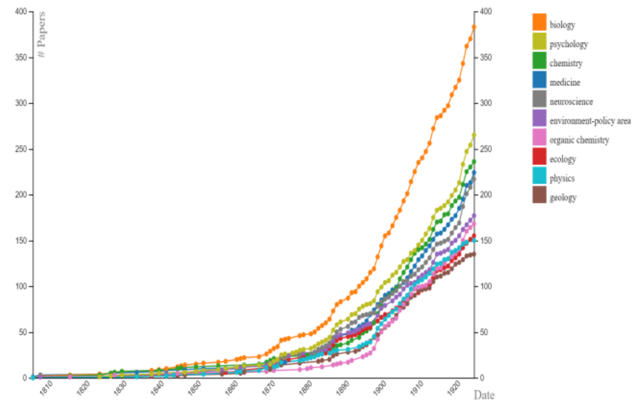

Figure 5: Odor-related Publications in MAG (from year 1800 until year 1925, cumulative) by topic

2. What are the most popular terms used in odor-related publications?

This use case helps the user to visualize term usage by displaying a word cloud with the most popular olfactory terms used in the publications in the period of interest (see Figure 6).

Figure 6: Odor Terms Word Cloud in MAG

3. Which venues were mostly used when publishing odor-related research articles?

This use case shows a number of journals that had historical publications about smells (see Figure 7).

The figure shows that JAMA and Nature journals are the most popular journals regarding historical olfactory publications.

[1] https://www.elastic.co

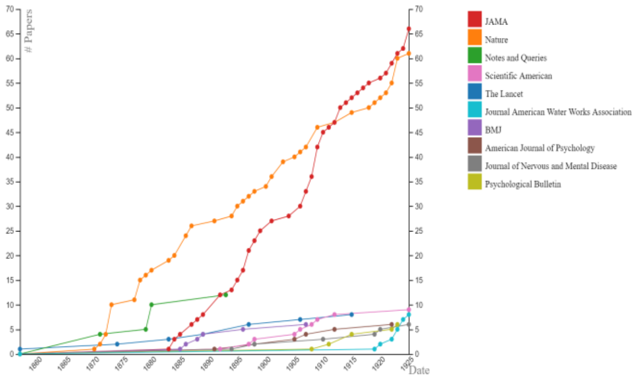

Figure 7: Journals with Olfactory Publications in MAG (from year 1800 until year 1925, cumulative)

4. Which are the publications about smell (from a contextual point of view)?

The Research Explorer tool is a search engine that enables exploring the individual articles in the corpus of odor-related publications.

Figure 8: List of Olfactory Publications in MAG (from year 1800 until year 1925) that contains the keyword "smell"

The tool is built on Elastic Search and provides search by keyword and by date. It also supports smart navigation through the results by clustering the results and re-ranking the results by moving the focus of search through the cluster space (see Figure 8). The goal of the tool is to enhance a search engine by providing the users multiple rankings of the results for each query. It is achieved by generating topics for the given query and its result set, and visualizing these topics on the "Ranking Space" panel. When the focus is set near a given topic, results that are on or closer to that topic are ranked higher.

The figure shows a ranked list of relevant publications on the topic of "smells", in the period from 1900 to 1925. The list is modified by changing the context on the right side - the focus is changed by placing the cursor over a cluster, and publications associated with this cluster are displayed.

4. CONCLUSION

In this paper we demonstrated an approach towards observing olfactory related information in scientific publications, as recorded in the MAG.

In addition, we present an Odor Observatory tool that enables several usage scenarios for exploring historical and present olfactory research.

The future work will include the exploration of other textual datasets applicable for olfactory research, with an accent on olfactory heritage information.

In line with the Odeuropa project, the relevant information extracted from textual sources will be, following semantic web standards, aligned with the 'European Olfactory Knowledge Graph' (EOKG).

5. ACKNOWLEDGMENTS

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Understanding Text Using Agent Based Models

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ABSTRACT

The paper proposes a novel approach to text understanding and text generation focusing on short stories. The proposed approach attempts to understand and generate stories by creating an explainable, agent-based world model of the story. The world model is defined through agents, their goals, actions, attributes and relationships between them. We demonstrate our approach on the story of 'Little Red Riding Hood', simulating it as a sequence of 48 actions, involving 7 main agents and 14 goals.

KEYWORDS

Text understanding, agent-based approach, world model, agent-based model

1 Introduction

With recent advancements in deep learning and overall increases in computing power, artificial intelligence systems are now able to make commonsense inferences from simple events, as proposed in research such as COMET [1] and MultiCOMET [2]. While the aforementioned commonsense inferences can be made with a high degree of precision, they lack an explainable and comprehensive structure capable of storing and predicting future events with such inferences. Agent-based models (ABMs), while capable of simulating complex interactions between agents, rarely focus on understanding stories in greater depth. Moreover, they cannot perform commonsense reasoning on agent's goals, actions or attributes. In our research, we draw from existing work on ABMs to create a system capable of understanding short text-based stories, with the potential to incorporate commonsense inferences in the future.

Related work such as 'Automated Storytelling via Causal, Commonsense Plot Ordering' [3] and 'Modeling Protagonist Emotions for Emotion-Aware Storytelling' [4] makes use of COMET to tackle automated story plot generation. As the stories are generated using COMET's commonsense causal inferences, they lack explainability. In our work, we focus on generating explainable stories.

Other related work [5] focuses on story understanding using manually supplied commonsense rules, concept patterns and story text. Our system aims to understand and simulate a story, given the story text, goals and initial attributes of its agents.

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The main contributions of this paper are (1) a novel approach to explainable story understanding, (2) a system generating stories given a set of agents with attributes and goals, and (3) implementation of the proposed approach, with publicly available source code [7] allowing users to create and analyze their own stories.

The rest of this paper is organized as follows: Section 2 provides a problem description. Section 3 describes the approach used to tackle the problem. Section 4 demonstrates the functioning of our approach. The paper concludes with discussion and directions for future work in Section 5.

2 Problem Description

The problem we are solving is, given the text of a short story, convert it into a machine understandable and actionable description representing the dynamics of the story being told. Such an actionable description should encode the implicit knowledge assumed by the text in the form of an agent-based world model.

The world model should include enough representational power to fully represent the story. This includes agents, their environment and the relationships between them. The world model should be actionable enough to simulate the dynamics of an input story with all the key elements, and relevant details mentioned in the input text.

As the world model can represent a story given its text, it should also be able to represent and simulate other stories within the world model's constraints.

Some of the key operations the resulting system should support:

1. representation of the story
2. simulation of the story's dynamics
3. question answering about explicit and implicit elements written or assumed within the story
4. creating alternative stories, given their context

3 Approach Description

The general aim of our approach is to provide deep text understanding of the input story. Not all the steps are automatable at this stage. In particular, the biggest challenge is to automatically translate the story text into the knowledge based representation aligned with the world model. We are looking forward to eventually automate all of the steps in the approach.

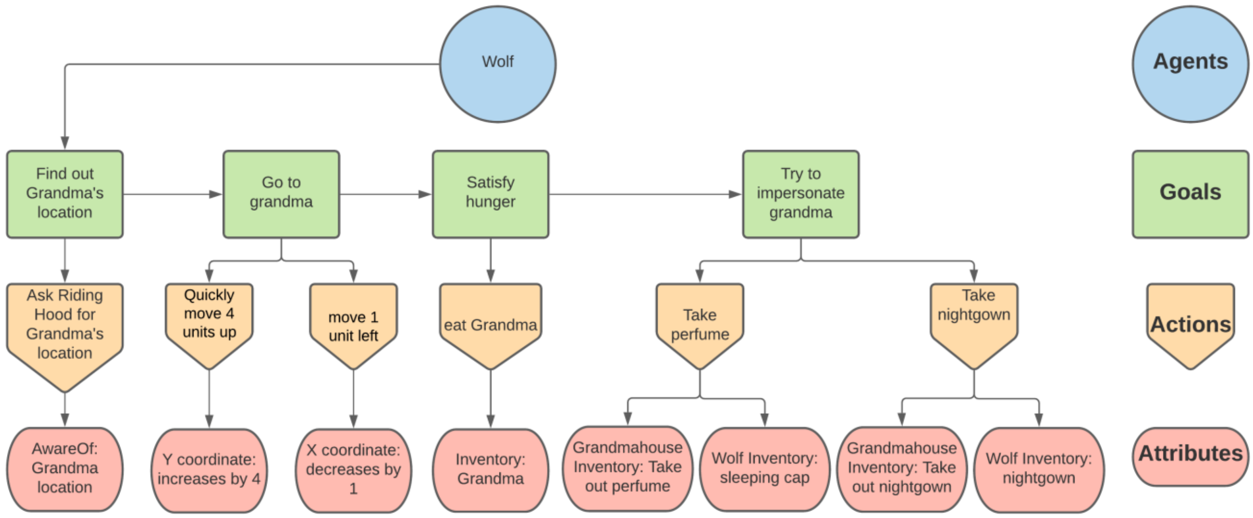


Figure 1: A partial representation of the Wolf agent's goals, actions and attributes.

As a running example of the input story, we selected the popular children's story 'Little Red Riding Hood' [6]. In the first stage, we restructured the original story into 73 simplified sentences where we identified 23 key events involving 7 main agents:

1. Mother
2. Riding Hood
3. Flower Field
4. Butterfly
5. Wolf
6. Grandma
7. Woodsman

Each agent is represented by its goals, actions and attributes (see Figure 1 for an example involving the Wolf). All goals cause actions and all actions change at least one agent's attributes.

As depicted on Figure 2, an agent's goal is defined by a goal state (a set of agents with specific attribute values) and 'pre-goals' (goals that must be completed and act as preconditions for an agent to start working towards the goal).

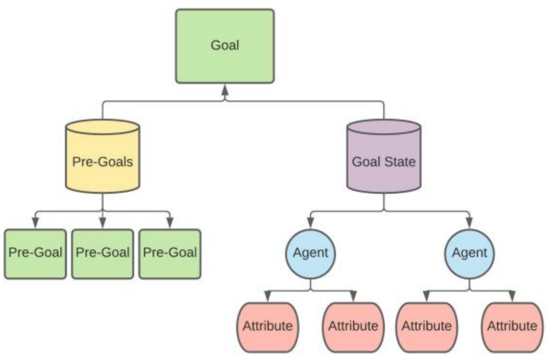


Figure 2: An example representation of a goal

To define actions, we use an action schema proposed as part of 'UCPOP: A Sound, Complete, Partial Order Planner for ADL' [8] where each action consists of a set of parameters, preconditions and effects. We show two example action representations in Figure 3 and Figure 4. The duration of each action corresponds to the passing of one time unit.

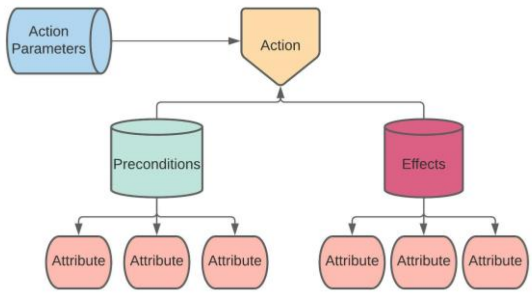


Figure 3: An example representation of an action

```
      action: Eat (?monster, ?victim, ?location)
precondition: knows(?monster, ?victim),
              alive(?monster), alive(?victim),
              ¬eaten( ?victim),¬full(?monster),
              at(?monster, ?location),
              at(?victim, ?location),
              ?monster ≠ ?victim
      effect: eaten(?victim)
              in(?victim, ?monster), full(?monster),
              ¬at(?victim, ?location)
```

Figure 4: An example pseudocode representation of a concrete action, taken from [9]

An attribute is simply defined as any information relating to the agent. For instance, the agent's location, inventory of items and awareness of other agents.

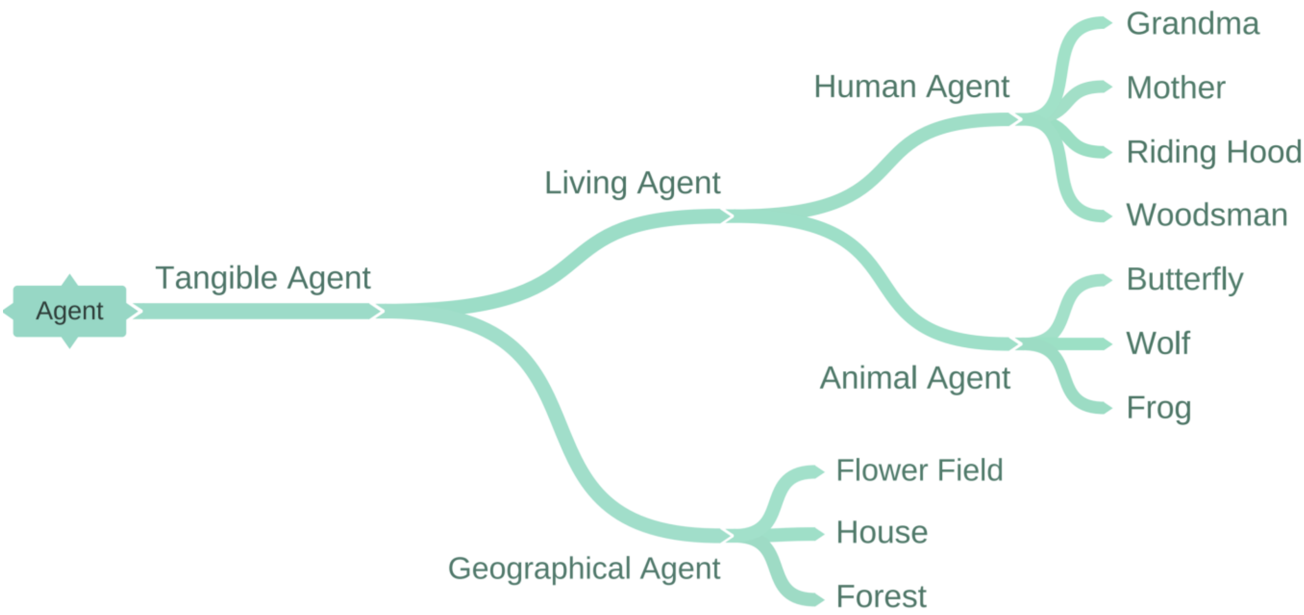


Figure 5: Hierarchy of agents for the Little Red Riding Hood story

The agents are defined through a hierarchy, ensuring consistency across agent goals, actions, attributes and providing a clear overview of the agent types as observed in Figure 5.

Throughout the story simulation of 'Little Red Riding Hood' 3 key agents jointly had 14 goals, causing them to perform a total of 48 actions composed of 12 unique action types.

We propose a simple textual description of each performed action, stating why the agent executed the action and which other agents were involved. See Figure 8 for an example.

At the highest conceptual level, we randomly select an agent and simulate all of its possible next actions. We then select the action that brings the agent closest to all it's currently active goals, and execute this action. We repeat this until there are no more agents with active goals in our world model, as depicted in Figure 6.

```
Until All Active Goals Not Complete
  For Random Agent
    For All Possible Actions
      Simulate Action
      If Action brings Agent closest to its Goals
        Set this as new Best Action
    Execute the Best Action
```

Figure 6: High level pseudocode of the simulation within the world model

4 Approach Demonstration

```
********************|grandmahouse,grandma|************forest13|*******forest14,wolf
*************forest1|********************|*************forest5|************forest12
****forest4,woodsman|********************|*************forest8|************forest10
*************forest3|********************|*************forest7|************forest11
*************forest2|********************|***forest6,butterfly|*************forest9
******flower field 1|******flower field 2|******flower field 3|********************
********************|********************|********************|********************
********************|********************|********************|********************
********************|******rhhouse,mother|********************|*********riding hood
```

Figure 7: Initial state of the agents' locations within the world model; each X, Y slot includes a list of agents at that location

We first initialize the world model to an initial setting similar to that of 'Little Red Riding Hood', illustrated in Figure 7. For instance, agents 'forest4' and 'woodsman' are in the same location, 1 unit above agent 'forest3'. The model is initialized with the agents, their initial attributes with values and their goals in the story. Once initialized, we can run the model and see the agents interact with each other within their environment. For an example, see Figure 9.

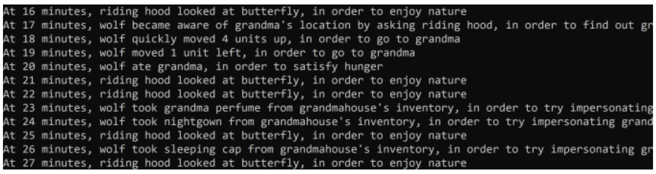
One could divide the story into the following 5 main segments:

1. Riding Hood discusses visiting Grandma with Mother **(6 actions)**
2. Riding Hood meets Wolf and goes to Grandma **(23 actions)**
3. Wolf eats Grandma and tries to impersonate her; Riding Hood arrives at GrandmaHouse and cries for help **(6 actions)**
4. Woodsman saves Grandma and takes Wolf away, Riding Hood gifts Grandma **(13 actions)**

As an example, in the third story segment the actions occur in the following order:

1. Wolf eats Grandma to satisfy hunger.
2. Wolf took perfume from GrandmaHouse's inventory to try impersonating Grandma.
3. Wolf took nightgown from GrandmaHouse's inventory to try impersonating Grandma.
4. Wolf took sleeping cap from GrandmaHouse's inventory to try impersonating Grandma.
5. Riding Hood moved 1 unit up to visit Grandma.
6. Riding Hood cried for help to get help.

The system is able to automatically generate the textual description of the story simulation over time, as depicted in Figure 8.



```
At 16 minutes, riding hood looked at butterfly, in order to enjoy nature
At 17 minutes, wolf became aware of grandma's location by asking riding hood, in order to find out gr
At 18 minutes, wolf quickly moved 4 units up, in order to go to grandma
At 19 minutes, wolf moved 1 unit left, in order to go to grandma
At 20 minutes, wolf ate grandma, in order to satisfy hunger
At 21 minutes, riding hood looked at butterfly, in order to enjoy nature
At 22 minutes, riding hood looked at butterfly, in order to enjoy nature
At 23 minutes, wolf took grandma perfume from grandmahouse's inventory, in order to try impersonating
At 24 minutes, wolf took nightgown from grandmahouse's inventory, in order to try impersonating grand
At 25 minutes, riding hood looked at butterfly, in order to enjoy nature
At 26 minutes, wolf took sleeping cap from grandmahouse's inventory, in order to try impersonating gr
At 27 minutes, riding hood looked at butterfly, in order to enjoy nature
```

Figure 8: A part of an example story, generated by the system

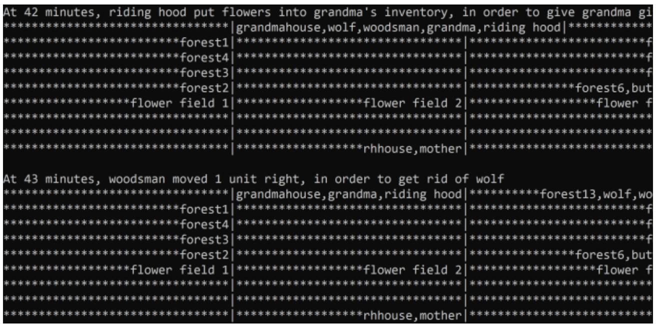


Figure 9: Screenshot of two subsequent agent location configurations on the map: (1) after Riding Hood gives Grandma flowers and (2) after Woodsman carries away Wolf

One of the more conceptually complex parts of the story was Riding Hood asking Mother for permission to visit Grandma. This required the creation of a new attribute for human agents to describe their opinions of other agents' goals.

The most complex action implemented was "cry for help". This involved the creation of a new goal "respond to cry for help" for all human agents within a certain radius of the agent crying for help, provided they were conscious and able to respond.

The story ends when Riding Hood gives Grandma the flowers she picked and the basket Mother gave her, and Woodsman carries the Wolf "deep into the forest where he wouldn't bother people any longer" [6].

The system was implemented in about 3,000 lines of C++ code, available on GitHub [7].

5 Discussion

In our research we expanded on and adapted existing work on agent-based models, providing an alternate approach to text understanding and generation involving short stories. As a proof of concept, we applied our approach on the children's story of 'Little Red Riding Hood', describing it through a series of 48 highly explainable actions involving 7 main agents.

Adapting the system to another story using our source code is relatively easy, provided the action and attribute types of the agents in the story are similar to those in the 'Little Red Riding Hood'. If the story requires the implementation of new actions or attributes, this can be done by extending the class structure in C++ using already implemented actions and attributes as examples.

In our future work we intend to integrate commonsense inferences, such as those from MultiCOMET into our model to further the system's degree of textual understanding. Our system could also benefit from the addition of dynamic and simultaneous goals that change based on the agent's environment. Another possible future line of work is to use our approach in other domains to describe more complex phenomena, such as real-world events or geopolitics. Lastly, a user evaluation of our system's performance on a variety of stories and scenarios could provide further insight into the efficacy of our approach.

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News Stream Clustering using Multilingual Language Models

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ABSTRACT

In this paper, we propose a news stream clustering algorithm which directly outputs cross-lingual event clusters. It uses multilingual language models to generate cross-lingual article representations which enable a direct comparison of articles in different languages. The algorithm is evaluated using a cross-lingual news article data set and compared against a strong baseline algorithm. The experiment results show the algorithm has great promise, but requires additional modifications for improving its performance.

KEYWORDS

online news, event detection, news events, multilingual language model

1 INTRODUCTION

Online news is producing hundreds of thousands of articles per day reporting about any significant event that happened in the world. The articles cover various domains (such as politics, sports, and culture) and are written in different languages. In order to automatically identify these events, news stream clustering algorithms are used. These usually have the following steps: (1) they group articles written in the same language into monolingual clusters, and (2) form cross-lingual clusters by linking monolingual clusters that report on the same event. Both steps usually employ monolingual text features such as TF-IDF vectors; these do not allow cross-lingual comparison without using advanced statistical or machine learning methods.

In this paper, we propose a news stream clustering algorithm that directly generates cross-lingual event clusters. The algorithm uses multilingual language models for generating cross-lingual content embeddings and extracting named entities found in the articles. These are used to measure if an article should be assigned to an event. The algorithm is evaluated using a cross-lingual data set consisting of articles in English, Spanish, and German, and is compared against a strong baseline. While the experiment results look promising, there is still room for improving the algorithms performance.

The paper is structured as follows: Section 2 contains an overview of the related work on cross-lingual news stream clustering and multilingual language models. Next, we present the proposed clustering algorithm in Section 3, and describe the experiment setting in Section 4. The experiment results are found in Section 5. Finally, we conclude the paper and provide ideas for future work in Section 6.

2 RELATED WORK

News Stream Clustering. The objective of news stream clustering is to group news articles that report about the same event that happened in the world. Grouping can be a difficult task, especially if the articles are written in multiple languages. To this end, various approaches were developed for cross-lingual event clustering. A statistical approach called Generalization of Canonical Correlation Analysis is used to compare news articles in different languages [9]. Information extraction techniques, such as named entity recognition and part-of-speech tagging, are also used for event detection [6]. With the increasing popularity of neural networks, more advanced approaches are used to link event clusters. The work in [3] uses word embeddings to compare and link monolingual event clusters into cross-lingual ones. Transformer-based language models are used for event sentence coreference identification [4], a task that links parts of articles to multiple events. However, the algorithm is performed only on a monolingual data set.

To the best of our knowledge, our work is the first that uses multilingual language models for grouping articles directly into cross-lingual events.

Multilingual Language Models. Since the introduction of the transformers [11], language model development has gained traction in the research community. One of the most well known language models, BERT [2], has improved the performance of various NLP tasks. By training it using multilingual documents, the multilingual BERT [5] enabled solving tasks that require cross-lingual text representations. While these models improved the performance of various NLP tasks, they do not provide good document embeddings for tasks like clustering. This changed with the introduction of Sentence-BERT [8], which generates monolingual sentence embeddings appropriate for measuring sentence similarity. A year later, an approach for making monolingual document representations cross-lingual [7] opened a way for using sentence embeddings for cross-lingual clustering.

In this work, we employ the multilingual Sentence-BERT model to generate cross-lingual embeddings used to group articles into events.

3 THE CLUSTERING ALGORITHM

We propose a news stream clustering algorithm that directly outputs cross-lingual events. It uses cross-lingual embeddings, named entities, and temporal features to measure if an article should be assigned to an event cluster. If none of the events are appropriate, a new cluster is created and the article is assigned to it. Figure 1 shows the algorithm's workflow diagram.

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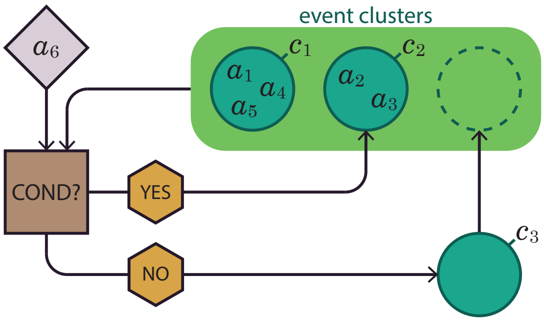

Figure 1: The algorithm's workflow diagram. The algorithm maintains a set of event clusters which are used when asessing if a new article (a_6) should be assigned to an existing event. If the conditions are met, the article is assigned to the most appropriate cluster (c_2). Otherwise, an empty event cluster is created (c_3), the article is assigned to it, and the newly created event is added to the cluster set.

In this section we describe how the algorithm represents the articles and events, and how it decides when to assign an article to the event cluster.

3.1 Article Representation

In this section we describe the different article representations used in the algorithm. Each article is assumed to have a title, body, and time attributes, which are used to (1) generate the content embedding and (2) extract its named entities.

Content Embedding. Each article is assigned an embedding that represents the article's content. Using multilingual Sentence-BERT[1], a language model designed for generating vectors used in cross-lingual clustering tasks, we get the content embedding by concatenating the article's title and body and inputing it into the language model. The output is a single 768 dimensional vector that captures the semantic meaning of the article.

Article Named Entities. For each article we extract the named entities that are mentioned in the article's body. To extract them, we developed a multilingual NER model using XLM-RoBERTa [1] and fine-tuned it using the CoNLL-2003 [10] data set.[2] Afterwards, we filter out the duplicates and store the remaining unique entities for later use.

3.2 Event Representations

An event is represented as an aggregate of its articles. This includes (1) the event centroid, (2) the named entities, and (3) the time statistics. In this section we describe how the aggregates are calculated and updated.

Event Centroid. The centroid represents the average content embedding of the articles assigned to the event. It is used to assess if an incoming article's content is similar enough to the event. Since the algorithm is intended to work on a news streams, we iteratively update the centroid with the newly assigned article's content embedding:

$$\vec{c_e}^{(0)} = \vec{0},$$
$$\vec{c_e}^{(k)} = \frac{(k-1)\cdot \vec{c_e}^{(k-1)} + \vec{c_{a_k}}}{k},$$

where $\vec{c_e}^{(k)}$ is the centroid calculated using the first k articles assigned to the event e, and $\vec{c_{a_k}}$ is the content embedding of the k-th article a_k.

Event Named Entities. Each event stores all of the unique named entities that are found in any of its articles. The named entities are used to identify if the incoming article mentions the event's entities. The event's named entities set is updated when a new article is assigned to the event:

$$r_e^{(0)} = \varnothing,$$
$$r_e^{(k)} = r_e^{(k-1)} \cup r_{a_k},$$

where $r_e^{(k)}$ is the set of named entities generated using the first k articles assigned to the event e, and r_{a_k} is the set of named entities of the k-th article a_k.

Time Statistics. The time statistics provide insights into the articles' temporal distribution. These are calculated using the articles' *time* attribute. In this experiment we measured the following statistics: the minimum, average, and maximum article timestamps. These are used to validate if an article was published at a time when it could still report about an existing event.

3.3 Assignment Condition

The most crucial part of the proposed algorithm is how to measure to which event should an article be assigned to, if any. We propose a condition that combines (1) the cosine similarity between the article's content embedding and the event's centroid, (2) the overlap between the article's and event's named entities, and (3) the time difference between the article's time and one of the event's time statistics.

Let $E = \{e_1, e_2, \ldots, e_j\}$ be the set of existing event clusters, where each event is represented with its centroid, named entities, and one of its time statistics $e_i = \left(\vec{c_{e_i}}, r_{e_i}, t_{e_i}\right)$. Let the article be represented by its content embedding, named entities, and time attribute $a = (\vec{c_a}, r_a, t_a)$. We then check if the following conditions are met for each event:

$$\begin{aligned} \delta_c &= \frac{\langle \vec{c_{e_i}}, \vec{c_a} \rangle}{\|\vec{c_{e_i}}\|_2 \|\vec{c_a}\|_2} \geq \alpha, \\ \delta_r &= |r_{e_i} \cap r_a| \geq \beta, \\ \delta_t &= |t_{e_i} - t_a| \leq \tau, \end{aligned} \tag{1}$$

where α, β and τ are the thresholds corresponding to how similar the article's content must be to the event, the required amount of overlapping entities, and the time window in which an article has to be to be assigned to the event, respectively. Thus, $\delta_c, \delta_r, \delta_t$ correspond to the content similarity, entity overlap, and time window conditions, respectively.

If an event meets the conditions described in Equation 1, the article is assigned to it. If multiple events are appropriate, the article is assigned to the event that has the greatest δ_c value. If none are appropriate, a new empty event cluster is created, the article is assigned to it, and the event representations are updated.

To compare the impact of the conditions, we implement multiple versions of the algorithm that use a different combination

[1]The model is available at https://huggingface.co/sentence-transformers/paraphrase-xlm-r-multilingual-v1.

[2]The code of the model is available at https://github.com/ErikNovak/named-entity-recognition.

of δ_c, δ_r, and δ_t conditions. Table 1 shows all of the algorithm versions compared in the experiment.

Table 1: The list of algorithm versions. Each algorithm uses a different combination of conditions.

Algorithm	condition combination
CONTENT	δ_c
CONTENT + NE	δ_c *and* δ_r
CONTENT + TS	δ_c *and* δ_t
CONTENT + NE + TS	δ_c *and* δ_r *and* δ_t

4 EXPERIMENTS

We now present the experiment setting. We introduce the data set and how it is prepared for the experiment. Next, we present the evaluation metrics. Finally, the baseline algorithm is described.

4.1 Data Set

To compare the algorithm performances we use the news article data sets acquired via Event Registry and prepared by [3] for the purposes of news stream clustering. These data sets are in three different languages (English, German, and Spanish), and consist of articles containing the following attributes:

- *Title.* The title of the article.
- *Text.* The body of the article.
- *Lang.* The language of the article.
- *Date.* The datetime when the article was published.
- *Event ID.* The ID of the event the article is associated with. It is used to measure the performance of the algorithms.

For the experiment, we merge the three data sets together to create a single cross-lingual news article data set. We extract their content embeddings and named entities, and sort them in chronological order, i.e. from oldest to newest. Table 2 shows the data set statistics.

Table 2: Data set statistics. For each language data set we denote the number of documents in the data set (# docs), the average length of the documents (avg. length), the number of event clusters (# clusters) and the average number of documents in the clusters (avg. size).

Language	# docs	avg. length	# clusters	avg. size
English	8,726	537	238	37
German	2,101	450	122	17
Spanish	2,177	401	149	15
Together	13,004	500	427	30

4.2 Evaluation Metrics

For the evaluation we use the same metrics as [3]. Let tp be the number of correctly clustered-together article pairs, let fp be the number of incorrectly clustered-together article pairs, and let fn be the number of incorrectly not-clustered-together article pairs. Then we report precision as $P = \frac{\text{tp}}{\text{tp+fp}}$, recall as $R = \frac{\text{tp}}{\text{tp+fn}}$, and the balanced F-score as $F_1 = 2 \cdot \frac{P \cdot R}{P+R}$. While precision describes how homogenous are clusters the, recall tells us the amount of articles that should be together but are actually found in different clusters.

4.3 Baseline Algorithm

The baseline algorithm used in the experiment is presented in [3]. It performs cross-lingual news stream clustering by first generating monolingual event clusters using TF-IDF subvectors of words, word lemmas and named entities of the articles. Afterwards, it merges monolingual into cross-lingual clusters using cross-lingual word embeddings to represent the articles. The algorithm compares two approaches when performing cross-lingual clustering:

- *Global parameter.* Using a global parameter for measuring distances between all language articles for cross-lingual clustering decisions.
- *Pivot parameter.* Using a pivot parameter, where the distances between every other language are only compared to English, and cross-lingual clustering decisions are made only based on this distance.

Since the baseline algorithm was already evaluated using the cross-lingual data set we are using the the experiment, we only report their performances from the paper.

5 RESULTS

In this section we present the experiment results. For all experiments we fix the values $\beta = 1$ and $\tau = 3$ days, and evaluate the algorithms using different values of α. In addition, all experiments use the event's minimum time statistic when validating the time condition δ_t.

Baseline Comparison. Table 3 shows the experiment results of the best performing algorithm on the evaluation data set. We report the best performing CONTENT + NE + TS algorithm which uses the content similarity threshold $\alpha = 0.3$.

Table 3: The algorithm performances. The best reported algorithm uses all three asssignment conditions.

Algorithm	F_1	P	R
Baseline (global)	72.7	89.8	61.0
Baseline (pivot)	84.0	83.0	85.0
CONTENT + NE + TS	72.2	79.7	66.0

While the proposed algorithm does not perform better than any of the baselines with respect to the F_1 score, our algorithm still shows promising results. Its performance is comparable to the baseline using the global parameter and also outperforms the baseline (global) recall by 5%, showing it is better at grouping articles.

Condition Analysis. We have analyzed the impact the conditions have on the algorithm's performance. For each algorithm version we run the experiments using different values of $\alpha \in \{0.3, 0.4, 0.5, 0.6, 0.7\}$, and measure the balanced F-score, precision, and recall, as well as the number of clusters it generated. Table 4 shows the condition analysis results. By analysing the results we come to two conclusions:

Increasing α increases precision, decreases recall, and generates a larger number of clusters. When α is bigger, the content condition δ_c requires the articles to be more similar to the event. This condition is met when the article's content embedding is close to the event's centroid. Since this has to hold for all articles in the event, then the articles that have high similarity are clustered together, increasing the algorithm's precision.

Table 4: The condition analysis results. The bold values represent the best performances on the data set.

Algorithm	α	# clusters	F_1	P	R
CONTENT	0.3	46	29.6	19.7	59.8
	0.4	234	51.6	46.2	58.4
	0.5	849	57.7	67.7	50.3
	0.6	1762	45.3	73.1	32.8
	0.7	3185	26.0	81.9	15.5
CONTENT + NE	0.3	279	43.7	33.3	63.8
	0.4	648	52.9	55.8	50.3
	0.5	1168	56.5	67.4	48.6
	0.6	1939	45.1	73.6	32.5
	0.7	3254	25.9	82.3	15.4
CONTENT + TS	0.3	344	58.8	63.2	55.0
	0.4	806	64.1	76.5	55.2
	0.5	1346	58.8	83.4	45.4
	0.6	2068	47.1	81.7	33.1
	0.7	3356	25.2	**84.8**	14.7
CONTENT + NE + TS	0.3	925	**72.2**	79.7	**66.0**
	0.4	1221	**72.2**	80.5	65.5
	0.5	1554	54.0	81.9	40.2
	0.6	2174	46.7	80.7	32.9
	0.7	3403	25.0	**84.8**	14.7

However, if the α is to large then the condition is too strong, thus similar articles can be split into multiple clusters, consequently decreasing recall and increasing the number of clusters the algorithm generates.

Algorithms with more conditions can achieve better performance. The algorithm's performance is increasing with added conditions. While the worst performance is achieved when only the content condition δ_c is used (CONTENT algorithm), the best is reached when all three conditions are used (CONTENT + NE + TS algorithm). The most significant contribution is provided by the time condition δ_t which drastically improves the F_1 score.

6 CONCLUSION

We propose a news stream clustering algorithm that directly generates cross-lingual event clusters. It uses multilingual language models to generate cross-lingual article representations which are used to compare with and generate cross-lingual event clusters. The algorithm was evaluated on a news article data set and compared to a strong baseline. The experiment results look promising, but there is still room for improvement.

In the future, we intend to modify the assignment condition and learn the condition parameters instead of manually setting them. Modifying the language models to accept longer inputs could better capture the articles semantic meaning. In addition, events from different domains are reported with different rates. Learning these rates and including them in the algorithm could improve its performance.

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SloBERTa: Slovene monolingual large pretrained masked language model

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ABSTRACT

Large pretrained language models, based on the transformer architecture, show excellent results in solving many natural language processing tasks. The research is mostly focused on English language; however, many monolingual models for other languages have recently been trained. We trained first such monolingual model for Slovene, based on the RoBERTa model. We evaluated the newly trained SloBERTa model on several classification tasks. The results show an improvement over existing multilingual and monolingual models and present current state-of-the-art for Slovene.

KEYWORDS

natural language processing, BERT, RoBERTa, transformers, language model

1 INTRODUCTION

Solving natural language processing (NLP) tasks with neural networks requires presentation of text in a numerical vector format, called word embeddings. Embeddings assign each word its own vector in a vector space so that similar words have similar vectors, and certain relationships between word meanings are expressed in the vector space as distances and directions. Typical static word embedding models are word2vec [19], GloVe [24], and fastText [1]. ELMo [25] embeddings are an example of dynamic, contextual word embeddings. Unlike static word embeddings, where a word gets a fixed vector, contextual embeddings ascribe a different word vector for each occurrence of a word, based on its context.

State-of-the-art text representations are currently based on the transformer architecture [35]. GPT-2 [27] and BERT [5] models are among the first and most influential transformer models. Due to their ability to be successfully adapted to a wide range of tasks, such models are, somewhat impetuously, called foundation models [2, 17]. While GPT-2 uses the transformer's decoder stack to model the next word based on previous words, BERT uses the encoder stack to encode word representations of a masked word, based on the surrounding context before and after the word. Previous embedding models (e.g., ELMo and fastText) were used to extract word representations which were then used to train a model on a specific task. In contrast to that, transformer models are typically fine-tuned for each individual downstream task, without extracting word vectors.

Successful transformer models typically contain more than 100 million parameters. To train, they require considerable computational resources and large training corpora. Luckily, many of these models are publicly released. Their fine-tuning is much less computationally demanding and is accessible to users with modest computational resources. In this work, we present the training of a Slovene transformer-based masked language model, named SloBERTa, based on a variant of BERT architecture. SloBERTa is the first such publicly released model, trained exclusively on the Slovene language corpora.

2 RELATED WORK

Following the success of the BERT model [5], many transformer-based language models have been released, e.g., RoBERTa [14], GPT-3 [3], and T5 [28]. The complexity of these models has been constantly increasing. The size of newer generations of the models has made training computationally prohibitive for all research organizations and is only available to large corporations. Training also requires huge amounts of training data, which do not exist for most languages. Thus, most of these large models have been trained only for a few very well-resourced languages, chiefly English, or in a massively multilingual fashion.

The BERT model was pre-trained on two tasks simultaneously, a masked token prediction and next sentence prediction. For the masked token prediction, 15% of tokens in the training corpus were randomly masked before training. The training dataset was augmented by duplicating the training corpus a few times, with each copy having different randomly selected tokens masked. The next sentence prediction task attempts to predict if two given sentences appear in a natural order.

The RoBERTa [14] model uses the same architecture as BERT, but drops the next sentence prediction task, as it was shown that it does not contribute to the model performance. The masked token prediction task was changed so that the tokens are randomly masked on the fly, i.e. a different subset of tokens is masked in each training epoch.

Both BERT and RoBERTa were released in different sizes. Base models use 12 hidden transformer layers of size 768. Large models use 24 hidden transformer layers of size 1024. Smaller-sized BERT models exist using knowledge distillation from pre-trained larger models [11].

A few massively multilingual models were trained on 100 or more languages simultaneously. Notable released variants are multilingual BERT (mBERT) [5] and XLM-RoBERTa (XLM-R) [4]. While multilingual BERT models perform well for the trained languages, they lag behind the monolingual models [36, 33]. Examples of recently released monolingual BERT models for various languages are Finnish [36], Swedish [16], Estonian [30], Latvian [37], etc.

The Slovene language is supported by the aforementioned massively multilingual models and by the trilingual CroSloEngual BERT model [33], which has been trained on three languages,

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Croatian, Slovene, and English. No monolingual transformer model for Slovene has been previously released.

3 SLOBERTA

The presented SloBERTa model is closely related to the French Camembert model [18], which uses the same architecture and training approach as the RoBERTa base model [14], but uses a different tokenization model. In this section, we describe the training datasets, the architecture, and the training procedure of SloBERTa.

3.1 Datasets

Training a successful transformer language model requires a large dataset. We combined five large Slovene corpora in our training dataset. Gigafida 2.0 [13] is a general language corpus, composed of fiction and non-fiction books, newspapers, school textbooks, texts from the internet, etc. The Janes corpus [9] is composed of several subcorpora. Each subcorpus contains texts from a certain social medium or a group of similar media, including Twitter, blog posts, forum conversations, comments under articles on news sites, etc. We used all Janes subcorpora, except Janes-tweet, since the contents of that subcorpus are encoded and need to be individually downloaded from Twitter, which is a lengthy process, as Twitter limits the access speed. KAS (Corpus of Academic Slovene) [8] consists of PhD, MSc, MA, Bsc, and BA theses written in Slovene between 2000 and 2018. SiParl [23] contains minutes of Slovene national assembly between 1990 and 2018. SlWaC [15] is a web corpus collected from the .si top-level web domain. All corpora used are listed in Table 1 along with their sizes.

Table 1: Corpora used in training of SloBERTa with their sizes in billion of tokens and words. Janes* corpus does not include Janes-tweet subcorpus.

Corpus	Genre	Tokens	Words
Gigafida 2.0	general language	1.33	1.11
Janes*	social media	0.10	0.08
KAS	academic	1.70	1.33
siParl 2.0	parliamentary	0.24	0.20
slWaC 2.1	web crawl	0.90	0.75
Total		4.27	3.47
Total after deduplication		4.20	3.41

3.2 Data preprocessing

We deduplicated the corpora, using the Onion tool [26]. We split the deduplicated corpora into three sets, training (99%), validation (0.5%), and test (0.5%). Independently of the three splits, we prepared a smaller dataset, one 15th of the size of the whole dataset, by randomly sampling the sentences. We used this smaller dataset to train a sentencepiece model[1], which is used to tokenize and encode the text into subword byte-pair-encodings (BPE). The sentencepiece model trained for SloBERTa has a vocabulary containing 32,000 subword tokens.

3.3 Architecture and training

SloBERTa has 12 transformer layers, which is equivalent in size to BERT-base and RoBERTa-base models. The size of each transformer layer is 768. We trained the model for 200,000 steps (about 98 epochs) on the Slovene corpora, described in Section 3.1. The model supports the maximum input sequence length of 512 subword tokens.

SloBERTa was trained as a masked language model, using fairseq toolkit [22]. 15% of the input tokens were randomly masked, and the task was to predict the masked tokens. We used the whole-word masking, meaning that if a word was split into more subtokens and one of them was masked, all the other subtokens pertaining to that word were masked as well. Tokens were masked dynamically, i.e. in each epoch, a different subset of tokens were randomly selected to be masked.

[1]https://github.com/google/sentencepiece

4 EVALUATION

We evaluated SloBERTa on five tasks: named-entity recognition (NER), part-of-speech tagging (POS), dependency parsing (DP), sentiment analysis (SA), and word analogy (WA). We used the labeled ssj500k corpus [12, 6] for fine-tuning SloBERTa on each of the NER, POS and DP tasks. For NER, we limited the scope to three types of named entities (person, location, and organization). We report the results as a macro-average F_1 score of these three classes. For POS-tagging, we used UPOS tags, the results are reported as a micro-average F_1 score. For DP, we report the results as a labeled attachement score (LAS). The SA classifier was fine-tuned on a dataset composed of Slovenian tweets [20, 21], labeled as either "positive", "negative", or "neutral". We report the results as a macro-average F_1 score.

Traditional WA task measures the distance between word vectors in a given analogy (e.g., man : king $\approx$ woman : queen). For contextual embeddings such as BERT, the task has to be modified to make sense. First, word embeddings from transformers are generally not used on their own, rather the model is fine-tuned. Four words from an analogy also do not provide enough context for use with transformers. In our modification, we input the four words of an analogy in a boilerplate sentence "If the word [word1] corresponds to the word [word2], then the word [word3] corresponds to the word [word4]." We then masked [word2] and attempted to predict it using masked token prediction. We used Slovene part of the multilingual culture-independent word analogy dataset [32]. We report the results as an average precision@5 (the proportion of the correct [word2] analogy words among the 5 most probable predictions).

We compared the performance of SloBERTa with three other transformer models supporting Slovene, CroSloEngual BERT (CSE-BERT) [33], multilingual BERT (mBERT) [5], and XLM-RoBERTa (XLM-R) [4]. Where sensible, we also included the results achieved with training a classifier model using Slovene ELMo [31] and fastText embeddings.

We fine-tuned the transformer models on each task by adding a classification head on top of the model. The exception is the DP task, where we used the modified dep2label-bert tool [29, 10]. For ELMo and fastText, we extracted embeddings from the training datasets and used them to train token-level and sentence-level classifiers for each task, except for the DP. The classifiers are composed of a few LSTM layer neural networks. For the DP task, we used the modified SuPar tool, based on the deep biaffine attention [7]. The details of the evaluation process are presented in [34].

The results are shown in Table 2. The results of ELMo and fastText, while comparable between each other, are not fully comparable with the results of transformer models as the classifier training approach is different.

Table 2: Results of Slovene transformer models.

Model	NER	POS	DP	SA	WA
fastText	0.478	0.527	/	0.435	/
ELMo	0.849	0.966	**0.914**	0.510	/
mBERT	0.885	0.984	0.681	0.576	0.061
XLM-R	0.912	0.988	0.793	0.604	0.146
CSE-BERT	0.928	0.990	0.854	0.610	0.195
SloBERTa	**0.933**	**0.991**	0.844	**0.623**	**0.405**

On the NER, POS, SA, and WA tasks, SloBERTa outperforms all other models/embeddings. For the POS-tagging, the differences between the models are small, except for fastText, which performs much worse. ELMo, surprisingly, outperforms all transformer models on the DP task. However, it performs worse on the other tasks. SloBERTa performs worse than CSE-BERT on the DP task, but beats other multilingual models.

The success of ELMo on the DP task can be partially explained by the different tools used for training the classifiers. Further work needs to be done to fully evaluate the difference and success of ELMo embeddings on this task.

The performance on the SA task is limited by the low inter-annotator agreement [20]. The reported average of F_1 scores for positive and negative class is 0.542 for inter-annotator agreement and 0.726 for self-agreement. Using the same measure (average of F_1 for positive and F_1 for negative class), SloBERTa scores 0.667, and mBERT scores 0.593.

On the WA task, most models perform poorly. This is expected because very little context was provided on the input, and the transformer models need a context to perform well. SloBERTa significantly outperforms other models, not only because it was trained only on Slovene data, but largely because its tokenizer is adapted to only Slovene language and does not need to cover other languages.

5 CONCLUSIONS

We present SloBERTa, the first monolingual transformer-based masked language model trained on Slovene texts. We show that SloBERTa large pretrained masked language model outperforms existing comparable multilingual models supporting Slovene on four tasks, NER, POS-tagging, sentiment analysis, and word analogy. The performance on the DP task is competitive, but lags behind some of the existing models.

In further work we intend to compare improvement of BERT-like monolingual models over multilingual models for other languages.

The pre-trained SloBERTa model is publicly available via CLARIN.SI[2] and Huggingface[3] repositories. We make the code, used for preprocessing the corpora and training the SloBERTa, publicly available[4].

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[2]http://hdl.handle.net/11356/1397
[3]https://huggingface.co/EMBEDDIA/sloberta
[4]https://github.com/clarinsi/Slovene-BERT-Tool

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Understanding the Impact of Geographical Bias on News Sentiment: A Case Study on London and Rio Olympics

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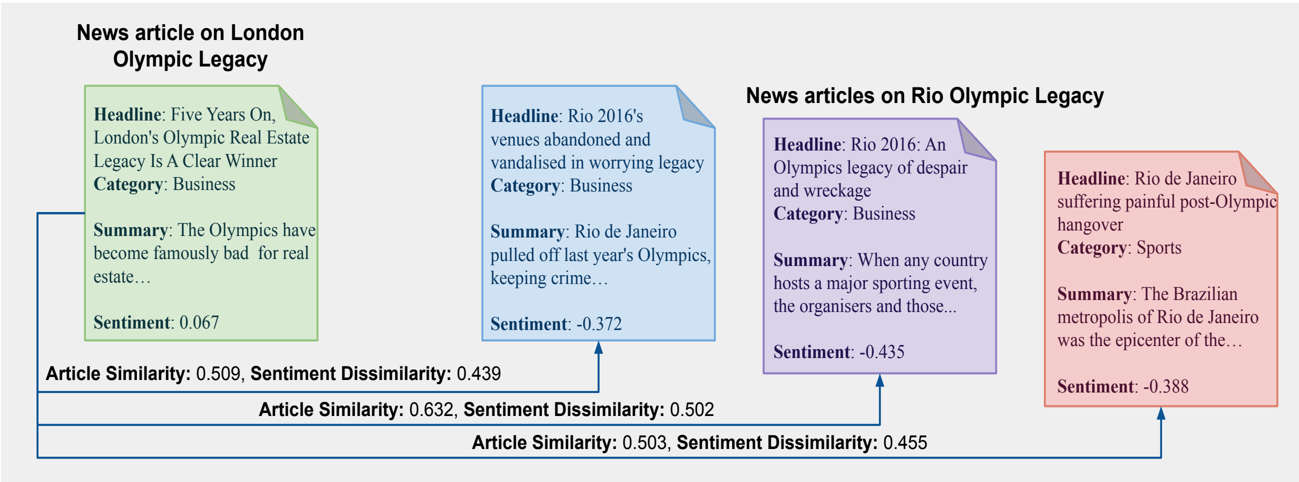

Figure 1: An example to illustrate the impact of geographical location on the sentiment of similar news articles.

ABSTRACT

There are various types of news bias, most of which play an important role in manipulating public perceptions of any event. Researchers frequently question the role of geographical location in attributing such biases. To that end, we intend to investigate the impact of geographical bias on news sentiments in related articles. As our case study, we use news articles collected from the Event Registry over two years about the Olympic legacy in London and Rio. Our experimental analysis reveals that geographical boundaries do have an impact on news sentiment.

KEYWORDS

Bias, News Bias, Geographical Bias, Olympics, Semantic Similarity, Sentiment Analysis, Dataset

1 INTRODUCTION

Claims of bias in news coverage raise questions about the role of geography in shaping public perceptions of similar events. Based on the geographical location, multiple factors, such as political affiliation, editorial independence, etc., can influence the way news articles are generated. Although it is well known that biased news can have more influence on people's thinking and decision-making processes [7, 9], it is nearly impossible to produce an article without any bias. Biased news articles have the potential to induce a variety of political and social implications, both direct and indirect. For instance, any political controversy presented from a specific perspective may alter the voting pattern [4, 1, 6].

There are different forms of news bias, and geographical bias is one of them. It exists if the sentiment polarity of similar articles published in different geographical location is contradictory or varies significantly. Sentiment analysis methods, which are commonly used to determine news bias [3, 14], can be used to examine the shift in sentiment polarity in similar news articles. Now, an intriguing question arises: Is geographical bias a factor affecting news sentiment? This study seeks to answer the above question by identifying and comparing sentiments of similar news articles. In doing so, we demonstrate how geographical location impacts the sentiments of similar articles. We also investigate this impact in relation to several news categories such as politics, business, sports, and so on.

The Olympic Games are a symbol of the greatest sports events in the world. Every edition leaves a number of legacies for the Olympic Movement, as well as unforgettable memories for each host city, whether positive or negative. In this regard, we select news articles about the Olympic legacy in London and Rio as a case study for our analysis.

We use Event Registry[1] [10] to collect English news articles, along with their sentiment and categories, published between January 2017 and December 2020. We use the popular Sentence-BERT (SBERT) [12] embedding to represent the articles and then compute the cosine similarity between them to identify similar article pairs.

Our data and code can be found in the GitHub repository at *https://github.com/Swati17293/geographical-bias.*

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[1] https://eventregistry.org

1.1 Contributions

The paper's contributions are as follows:

- We propose a task of analyzing the impact of geographical bias on the sentiment of news articles with data on the Olympic legacies of Rio and London as a case study.
- We present a dataset of English news articles customized to the above-mentioned task.
- We present experimental results to demonstrate the aforementioned impact of geographical bias.

2 RELATED WORK

The Majority of the sentiment analysis methods for news bias analysis depend on the sentiment words that are explicitly stated. SentiWordNet[2], which is a publicly available lexical resource used by the researchers for opinion mining to identify the sentiment inducing words that classify them as positive, negative, or neutral.

Melo et al. [5] collected and analyzed articles from Brazil's news media and social media to understand the country's response to the COVID-19 pandemic. They proposed using an enhanced topic model and sentiment analysis method to tackle this task. They identified and applied the main themes under consideration in order to comprehend how their sentiments changed over time. They discovered that certain elements in both media reflected negative attitudes toward political issues.

Quijote et al. [11] used SentiWordNet along with the Inverse Reinforcement Model to analyze the bias present in the news article and to determine whether the outlets are biased or not. The lexicons were first scored for the experiments using SentiWordNet and then fed to the Inverse Reinforcement model as input. To determine the news bias, the model measured the deviation and controversy scores of the articles. The findings lead to the inference that articles from major news outlets in the Philippines are not biased, excluding those from the Manila Times.

Bharathi and Geetha [3] classified the articles published by the UK, US, and India median as positive, negative, or neutral using the content sentiment algorithm [2]. The sentiment scores of the opinion words and their polarities were used as input to the algorithm.

Existing research investigates news bias using sentiment analysis methods, but, unlike our work, it does not provide a suitable automated method for analyzing the impact of geographical bias on news sentiment.

3 DATA DESCRIPTION

3.1 Raw Data Source

We use **Event Registry** [10] as our raw data source which monitors, gathers, and delivers news articles from all around the world. It also annotates articles with numerous metadata such as a unique identifier for article identification, categories to which it may belong, geographical location, sentiment, and so on. Its large-scale coverage can therefore be used effectively to assess the impact of geographical bias on news sentiment.

3.2 Dataset

To generate our dataset, we use a similar data collection process as described in [13]. Using the Event Registry API, we collect all English-language news articles about the Olympic legacy in London and Rio published between January 2017 and December 2020. We consider an article to be about the Olympic Legacy in London/Rio if the headline and/or summary of the article contains the keywords '*London*'/'*Rio*', '*Olympic*', and '*Legacy*'.

For each article, we then extract the summary, category, and sentiment. The article summaries vary in length from 290 to 6,553 words. Sentiment scores ranges from -1 to 1. We select seven major news categories, namely business, politics, technology, environment, health, sports, and arts-and-entertainment, and remove the rest of the categories. After excluding the duplicate articles we end up with 8,690 and 5,120 articles about the Olympic legacy in London and Rio respectively.

4 MATERIALS AND METHODS

4.1 Methodology

The primary task is to compute the average difference in sentiment scores between similar news articles about the Olympic legacies in Rio and London. The stated task can be subdivided and mathematically formulated as follows:

1. Generate two distinct sets of news articles A_1 and A_2, one about the London Olympic legacy and the other about the Rio Olympic legacy. For each $a_i \in A_1$ find a list of $a'_j \in A_2$, where a_i is the i^{th} article in set $A_1 = \{(a_1, s_1), (a_2, s_2)...(a_n, s_n)\}$ and a'_j is the j^{th} article in set $A_2 = \{(a'_1, s'_1), (a'_2, s'_2)...(a'_m, s'_m)\}$ which is the closest match (c.f. Section 4.1.1) to a_i. Here, $n = |A_1|$ and $m = |A_2|$.
2. For each list, calculate D_{ij} to represents the difference between the sentiment scores s_i and s'_j of the articles a_i and a'_j.
3. Calculate the average difference D of sentiment scores.
4. Calculate the percentage of similar article pairs with reversed polarity and those with unchanged polarity.

The secondary task is to assess the primary task with respect to news categories, i.e. to calculate the average difference D of sentiment scores for similar articles in each category.

In the following subsections, we discuss the tasks mentioned above in greater detail.

4.1.1 Article Similarity. We embed the articles in sets A_1 and A_2 to construct sets $F_1 = \{f_1, f_2...f_m\}$ and $F_2 = \{f'_1, f'_2...f'_n\}$. While alternative embedding approaches can be utilized, in this study we select the popular Sentence-BERT (SBERT) [12] embedding to extract 768-dimensional feature vectors to represent the individual articles in F_1 and F_2.

For each article a_i in A_1, we compute the similarity score[3] between a_i and every article a_j in A_2 using the cosine similarity metric $Sim^{cos}(a_i, a'_j)$ (Eq 1). We consider articles a_i and a'_j to be similar only if their similarity score is greater than 0.5.

$$Sim^{cos}(a_i, a'_j) = \frac{f_i \cdot f'_j}{||f_i||\ ||f'_j||} \tag{1}$$

where f_i and f'_j represents the embedded feature vectors of article a_i and a'_j.

The similarity score ranges from -1 to 1, where -1 indicates that the articles are completely unrelated and 1 indicates that they are identical, and in-between scores indicate partial similarity or dissimilarity.

4.1.2 Average Sentiment Dissimilarity. For every pair of similar articles a_i and a'_j, we calculate the difference D_{ij} between their sentiment scores s_i and s'_j. To calculate the average sentiment

[2] http://sentiwordnet.isti.cnr.it/

[3] https://en.wikipedia.org/wiki/Cosine_similarity

Table 1: Category-wise confusion matrix to show the percentage of similar article pairs with respect to their sentiment polarity.

	Sports		Business		Politics		Environment		Health		Technology		Arts & Entertainment	
	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg	Pos	Neg
Pos	77	10	62	28	42	18	55	18	29	12	87	4	59	16
Neg	11	2	7	4	23	16	14	12	12	46	1	0	7	18

Table 2: Confusion matrix to show the percentage of similar article pairs with respect to their sentiment polarity.

	Positive	Negative
Positive	69	15
Negative	11	4

Table 3: Distribution of average sentiment difference across news categories for similar article pairs with identical category.

News category	Average Sentiment Difference
Sports	0.19
Business	0.20
Politics	0.18
Health	0.16
Environment	0.22
Technology	0.14
Arts and Entertainment	0.19

dissimilarity score D, we add all D_{ij} and divide it by the total number of similar article pairs.

5 RESULTS AND ANALYSIS

In our experiments, we compare 44,492,800 possible article pairs for similarity and discover 375,008 similar pairs. The comparison in terms of sentiment similarity reveals that if two articles from different geographical regions are similar, in our case Rio and London, the average difference in their sentiment scores is 0.171. In addition, as defined in Table 2, we calculate the percentage of similar article pairs based on their sentiment polarity. It's worth noting that the polarity of the article is completely reversed 27% of the time, indicating the impact of geographic region on sentiments.

It is because the success of mega-events such as the Olympics in a particular host city is heavily influenced by its residents' trust and support for the government [8]. It can be viewed positively as a national event with social and economic benefits, or negatively as a source of money waste. While the Olympics have left an economic and social legacy in London, a series of structural investment demands in Rio raise the question of whether or not the Olympics was worthwhile for the entire country.

5.1 Impact of news categories

The impact of news categories on the sentiments of similar articles with identical categories from different geographical regions is shown in Table 3. It demonstrates that certain news categories have a greater impact than others. Figure 2 depicts this distinction more clearly.

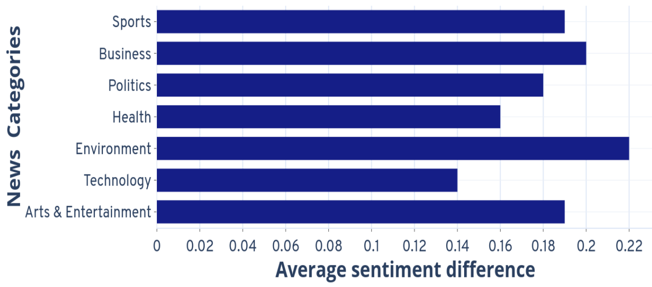

Figure 2: Distribution of average sentiment differences across categories for similar articles in the same category.

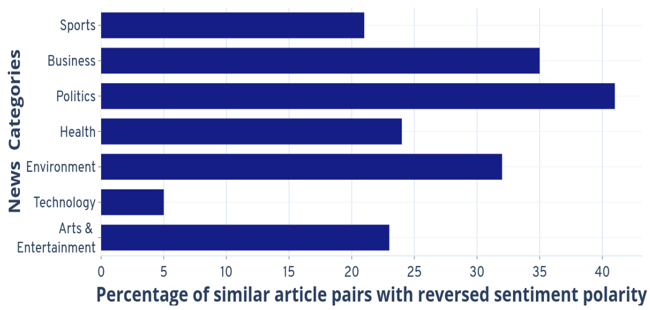

Figure 3: An illustration of the effect of category on sentiment polarity.

The categorical distribution of the percentage of similar article pairs in terms of sentiment polarity is shown in Table 1. *'Politics'* has the highest percentage of articles with reversed polarity, while *'technology'* has the lowest. Categories such as *'business'* and *'entertainment'*, though not as clearly as *'politics'*, exhibit the same bias.

This disparity arises from the fact that, in contrast to other categories, politics is most influenced by geographical boundaries, whereas science and technology are typically location independent. Since politics has such a large influence on shaping beliefs and public perceptions, it is frequently twisted to fit a particular narrative of a story. It is inherently linked to geographical borders, and it can be extremely polarizing depending on the geographical region.

6 CONCLUSIONS AND FUTURE WORK

In this work, we use news articles about the Olympic Legacy in London and Rio as a case study to understand how geographical boundaries interplay with news sentiments.

We begin by presenting a dataset of news articles collected over two years using the Event Registry API. We compute the cosine similarity scores of all possible embedded article pairs, one from each set of Olympic legacy articles (London and Rio). We use the popular Sentence-BERT for article embedding and then compute the sentiment difference between similar article pairs. From 44,492,800 possible article pairs we end up with 375,008 similar pairs.

In our analysis, we discovered that the sentiment reflected in similar articles from different geographical regions differed significantly. We also investigate this difference in relation to different news categories such as politics, business, sports, and so on. We find a significant difference in news sentiment across geographical boundaries when it comes to political news, while in the case of news in technology, the difference is much smaller. We find that articles in categories such as politics and business can be heavily influenced by geographical location, articles in categories such as science and technology are typically location independent.

In the future, we plan to identify the most frequently mentioned topics in the Olympic legacy corpus to see how they affect the news sentiment of articles about different geographical locations. Since our study is limited to English news articles, we intend to learn more about the role of cultures and languages in this bias analysis. We also intend to broaden our investigation to discover the adjectives used to describe the negative and positive legacies of Rio and London. Such an analysis would aid in understanding the expectations from cities such as Rio (the first in South America to host the Olympics) in comparison to London.

7 ACKNOWLEDGMENTS

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An evaluation of BERT and Doc2Vec model on the IPTC Subject Codes prediction dataset

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ABSTRACT

Large pretrained language models like BERT have shown excellent generalization properties and have advanced the state of the art on various NLP tasks. In this paper we evaluate Finnish BERT (FinBERT) model on the IPTC Subject Codes prediction task. We compare it to a simpler Doc2Vec model used as a baseline. Due to hierarchical nature of IPTC Subject Codes, we also evaluate the effect of encoding the hierarchy in the network layer topology. Contrary to our expectations, a simpler baseline Doc2Vec model clearly outperforms the more complex FinBERT model and our attempts to encode hierarchy in a prediction network do not yield systematic improvement.

KEYWORDS

news categorization, text representation, BERT, Doc2Vec, IPTC Subject Codes

1 INTRODUCTION

The field of Natural Language Processing (NLP) has greatly benefited from the advances in deep learning. New techniques and architectures are developed at a fast pace. The Transformer architecture [12] is the foundation for most new NLP models and it is especially successful with models for text representation, such as BERT model [1] which dominates the text classification. The gains in performance promised by the large BERT models comes at the price of significant data resources and computational capabilities required in the model pretraining phase. The practitioners take one of the models pretrained in the language of the data and finetune it for the specific classification problem. Multilingual BERT-like models have also shown remarkable potential for cross-lingual transfer ([7], [8], [6]). A majority of the research with BERT-like models is focused on English, while less-resourced languages tend to be neglected.

The IPTC Subject Codes originate in the journalistic setting. The news articles are tagged with the IPTC topics to enable search and classification of the news content, as well as to facilitate content storage and digital asset management of news content at media houses. It provides a consistent and language agnostic coding of topics across different news providers and across time. Solving the automatic classification of the news content to the standardized set of topics would enable faster news production and higher quality of the metadata for news content.

In this paper, we use recently published STT News[10] dataset in Finnish to evaluate the performance of the monolingual FinBERT model [13] on the IPTC Subject Codes prediction task, together with the Doc2Vec[3] model as a baseline. We attempt to encode the hierarchical nature of the prediction task in the prediction network topology by mimicking the structure of the labels. Finally, impact of using a different tokenizers with the same model is evaluated.

The paper is structured as follows. In Section 2, we describe the dataset and the labels relevant for the prediction task. Section 3 describes the methods used to model the prediction task and all variations of experiments. In Section 4, we provide results of our experiments and, finally, in Section 5 we conclude this paper and suggest ideas for further work.

2 DATASET

The STT corpus [10] contains 2.8 million news articles from the Finnish News Agency (STT) published between 1992 and 2018. The articles come with a rich metadata information including the news article topics encoded as IPTC Subject Codes[1]. The IPTC Subject Codes are a deprecated version of IPTC taxonomy of news topics focused on text. The IPTC Subject Codes standard describes around 1400 topics structured in three hierarchical levels. The first level consists of the most general topics. Topics on the second level are subtopics of the ones at the first level and, likewise, topics on the third level are subtopics of the ones on second level. All topics on the third level are leaf topics - there are no more subdivisions, but there are also some topics on the second level that are leaf topics and do not extend to the third level. A set of IPTC topics at STT is an extended version of IPTC Subject Codes as some codes used at STT are not part of the IPTC standard.

Not all articles in the STT corpus contain the IPTC Subject Codes, as can be seen in Figure 1, showing the ratio of articles containing this information through time. IPTC Subject Codes were introduced in STT in May 2011 and around 10-15% of articles do not contain this information.

If an article contains a specific sub-topic, it also contains its upper-level topics. For example, if an article contains the third level topic "poetry", it also contains the second level topic "literature" that generalizes the "poetry", as well as the first level topic "arts, culture and entertainment". In this way, article metadata contains full path through the topic hierarchy.

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[1] https://iptc.org/standards/subject-codes/

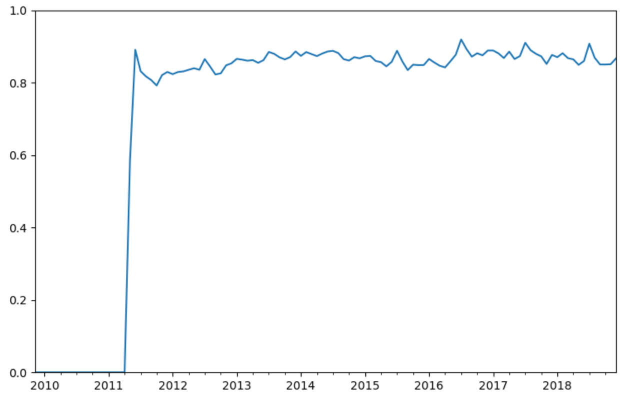

Figure 1: The Ratio of news articles in STT corpus containing IPTC Subject Codes.

Most articles are assigned only a small number of leaf-level topics (and its higher-level topics), but they can contain up to 7, 19 and 30 topics from the first, second and third level, respectively.

We split the dataset to train, validation and test set such that all articles published after 31-12-2017 belong to the test set and discard articles without IPTC Subject Codes from it. The rest of the articles were randomly split such that 5% of articles containing IPTC Subject Codes represent the validation set and all other articles belong to the train set.

After this step, there are around 30 thousand articles in the validation set, around 100 thousand in test set and 2.7 million in training set - of which some 560 thousand contain IPTC Subject Codes annotation.

The train set contains 17 different topics on the first level, 400 on the second level, and 972 on the third (the most specific) level. In our experiments, we evaluate models only on topics found in the training set.

3 METHODOLOGY

For our experiments, we used a network design consisting of two stacked neural networks (extractor and predictor). The extractor processes the text and produces the text representation in the format of a numeric vector. The predictor (the second part) is a multi-label prediction network that maps the extracted text representation vector to IPTC Subject Codes. For the extractor part, we evaluate the Doc2Vec and BERT model and for the predictor our models use one or three layer neural network.

3.1 Doc2Vec

Before the contextual token embeddings became popular, this model was regularly used to represent a text paragraph with a fixed vector. It was introduced in [3] with two variants of the algorithm - PV-DM (Paragraph Vector-Distributed Memory) and PV-CBOW (Paragraph Vector-Continuous Bag-of-Words). In the PV-DM variant of the algorithm, a training context is defined as a sliding window over the text. The model is a shallow neural network trained to predict the central word of this context window given the embeddings of the rest of the context words together with the embedding of the whole document. During training, the network learns both the word embeddings and the embedding for the document. The simpler PV-CBOW variant does not employ a context window, the neural network is trained to predict a randomly sampled word from the document. Our experiments use the PV-DM variant of the algorithm available in the Gensim[2] library with most of the hyperparameters set to their default values. We set the context window width to 5 and train the network for 10 epochs on the news content from the training data. The model produces a 256 dimensional output vector. Once the model is trained, we do not finetune it further during training of the prediction task.

Tokenization of the data was done using the SentencePiece[2] tokenizer. It was trained to produce a vocabulary of 40,000 tokens by using randomly selected 1 million sentences sampled from the articles in the training set. Additionally, we ran experiments using the same WordPiece[14] tokenizer that is used with the FinBERT model.

3.2 BERT

BERT is an deep neural-network architecture of bidirectional text encoders introduced in [1]. The base model consists of 12 Transformer [12] layers. It is trained using the masked language modeling (MLM) and next sentence prediction (NSP) objectives on a large text corpora. Maximum length of the input sequence for the model is 512 tokens and each token is represented with 768 dimensions. Model inference produces a context dependent representations of the input tokens. The whole input sequence can be represented with a single vector by using the context dependent representation of the *[CLS]* token. In [1], this representation is used as an aggregate sequence representation for classification tasks. Another way to represent the whole sequence, as used in [9], is to take the average representation of all output tokens (AVG). In this paper, we use FinBERT, a BERT model introduced in [13] that was pretrained on Finnish corpora.[3] We should note that this model contains the STT corpus as part of its training data.

Input to the model is restricted to 512 tokens[4] and longer news articles are trimmed such that only the first 512 tokens are used. In the dataset, there are less than 5% and 7% of documents in the training and test data that are longer than 512 tokens. We experiment with the CLS and the AVG representations and in both cases the article representation is a 768 dimensional vector. The FinBERT model is finetuned during training of the IPTC Subject Codes prediction task.

3.3 Prediction network

For the predictor part, we experiment with two different architectures. The first is a single layer of the neural network that maps the input vector to the predictions and can be seen in the Figure 2. The IPTC Subject Codes on all levels are concatenated together, thus producing a 1389 outputs in the final layer.

The second architecture utilizes the tree hierarchy of the IPTC Subject Codes. We assumed that a flat output (the previous approach) requires the network to predict each label independently, irrespective of the level of the target label. By introducing separate layers for each target level, we expect that the model will implicitly learn the hierarchy among labels. We designed this network in three layers and the architecture is shown in Figure 3. The first layer of the network predicts labels from the third IPTC hierarchical level (the most fine-grained topics), the second layer

[2]https://radimrehurek.com/gensim/
[3]We also test the FinEst BERT[11] but since the better performance was achieved with the FinBERT[13], we do not include FinEst BERT it in the results.
[4]The tokenizer used with the model is a predefined WordPiece tokenizer that came with the FinBERT model.

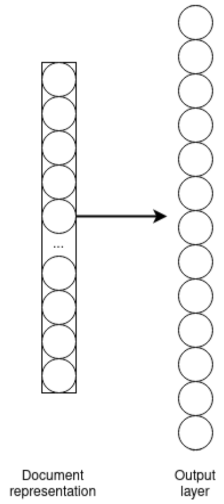

Figure 2: Predictor network architecture, flat variant. The image does not show a normalization layer before the output layer.

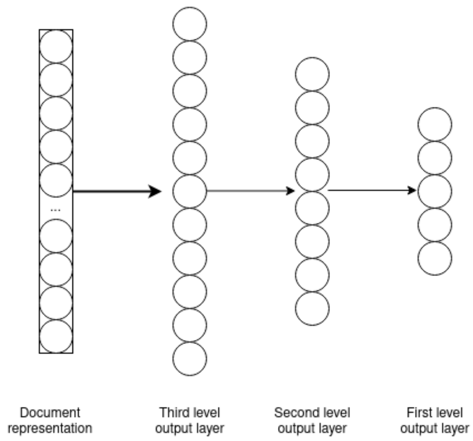

Figure 3: Predictor network architecture, tree variant. The image does not show a normalization layer before each output layer.

predicts topics from the second level and the third layer predicts only the toplevel IPTC Subject Codes.

3.4 Training

Each model was trained using the batch size of 128 articles and AdamW[4] optimizer with the learning rate of 1e-3. We compute the metrics on the validation set every 100 iterations. Once the loss on the validation data starts increasing, we stop the training and evaluate the best performing checkpoint on the test data. The loss function used in all experiments is the sum of binary cross-entropy losses calculated at each topic level. The news articles that do not have an annotation for certain topic level do not contribute to the loss of that level.

4 EXPERIMENTS AND RESULTS

All experiments were repeated three times and we report the median of those three runs in Table 1. The extraction network was evaluated with four configurations. The FinBERT model is using a WordPiece (WP) tokenizer and either the CLS token or the average (AVG) of all output tokens as a text representation. The Doc2Vec model is using either the WordPiece (WP) tokenizer or the SentencePiece (SP) tokenizer.

4.1 Evaluation metrics

We approach the article categorization problem through the information retrieval paradigm. Namely, we try to return the set of the most probable IPTC Subject Codes assigned to each article in the STT corpus. We use two performance metrics, the mean average precision (mAP) and recall at 10 (R@10). The mean average precision returns the expectation of the area under the precision-recall curve for a random query. The recall at 10 computes the ratio of correct topics found in the 10 tags with the highest predicted probability. To measure the generalization of our prediction models, we compute these metrics separately for each level of the IPTC Subject Codes.

4.2 Results and discussion

In all experiments, the Doc2Vec model performed significantly better than the FinBERT model, regardless of the specific extractor or predictor setup. This is surprising in the light of other successful applications of BERT models. Nevertheless, as there are less than 5% of articles in the training set and less than 7% of articles in the test set that have more than 512 tokens (the limitation of BERT but not Doc2Vec) we cannot assign the poor performance of BERT to this limitation.

Some other relevant findings are as follows. While for some tasks[9] the BERT average token representation performs better than the representation based on the CLS token, in our experiments the CLS and the AVG representations perform comparably. The three-layer network mimicking the shape of the tree-like IPTC Subject Codes hierarchy did not yield any systematic improvement over the single, flat layer of the neural network. Difference in tokenizers for Doc2Vec experiments shows small, but consistent improvement when using the SentencePiece tokenizer.

5 CONCLUSIONS AND FURTHER WORK

In this work, we have compared a monolingual FinBERT and Doc2Vec model on the IPTC Subject Codes prediction task in Finnish language. We evaluated several variations of experiments and achieved consistently better results with a Doc2Vec model. In contrast to the Doc2Vec, the BERT model has a limitation in the form of maximum number of input tokens. We believe the results cannot be explained by this as the data used does not contain a significant amount of documents exceeding this limit. We plan to explore this topic further in hope of understanding and addressing this problem. Recent work in BERT finetuning strategies[5] identifies a problem of vanishing gradients due to excessive learning rates and implementation details of the optimizer.

Our attempt at encoding the hierarchical nature of the prediction task did not yield systematic improvement and we believe it is worthwhile to explore other strategies and improve on this area, like encoding the hierarchy of the predictions in the loss function itself.

For Doc2Vec experiments, consistently better results were achieved using the SentencePiece[2] tokenizer over the WordPiece[14] tokenizer used in FinBERT model. Both of those tokenizers retain the whole information of the input as there are no destructive operations on the text. We plan further experiments

Table 1: Results for different experimental configurations.

Extractor	Predictor	mAP (lvl 1)	mAP (lvl 2)	mAP (lvl 3)	R@10 (lvl 1)	R@10 (lvl 2)	R@10 (lvl 3)
FinBERT (CLS)	Flat	0.5432	0.2047	0.1031	0.9058	0.3687	0.2242
FinBERT (CLS)	Tree	0.5434	0.1949	0.1043	0.9058	0.3602	0.2417
FinBERT (AVG)	Flat	0.5401	0.2026	0.1006	0.9045	0.3692	0.2391
FinBERT (AVG)	Tree	0.5410	0.2088	0.1089	0.9078	0.3724	0.2367
Doc2Vec (WP)	Flat	0.8091	0.5204	0.2990	0.9721	0.7008	0.4750
Doc2Vec (WP)	Tree	0.8127	0.5202	0.2972	0.9743	0.7099	0.4714
Doc2Vec (SP)	Flat	0.8298	0.5550	0.3149	0.9803	0.7277	**0.4951**
Doc2Vec (SP)	Tree	**0.8315**	**0.5643**	**0.3282**	**0.9832**	**0.7358**	0.4896

to confirm and quantify these findings and understand what enables such improvement of downstream prediction task at the tokenizer level.

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Classification of Cross-cultural News Events

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ABSTRACT

We present a methodology to support the analysis of culture from text such as news events and demonstrate its usefulness on categorising news events from different categories (society, business, health, recreation, science, shopping, sports, arts, computers, games and home) across different geographical locations (different places in 117 countries). We group countries based on the culture that they follow and then filter the news events based on their content category. The news events are automatically labelled with the help of Hofstede's cultural dimensions. We present combinations of events across different categories and check the performances of different classification methods. We also presents experimental comparison of different number of features in order to find a suitable set to represent the culture.

KEYWORDS

cultural barrier, news events, text classification

1 INTRODUCTION

Culture is defined as a collective programming of the mind which distinguishes the members of one group or category of people from another [9]. It has a huge impact on the lives of people and in result it influences events that involve cross-cultural stakeholders. News spreading is one of the most effective mechanisms for spreading information across the borders. The news to be spread wider cross multiple barriers such as linguistic, economic, geographical, political, time zone, and cultural barriers. Due to rapidly growing number of events with significant international impact, cross-cultural analytics gain increased importance for professionals and researchers in many disciplines, including digital humanities, media studies, and journalism. The most recent examples of such events include COVID-19 and Brexit [1]. There are few determinants that have significant influence on the process of information selection, analysis and propagation. These include cultural values and differences, economic conditions and association between countries. For instance, if two countries are culturally more similar, there are more chances that there will be a heavier news flow between them [10], [3]. In this paper, we focus on classification of news events across different cultures. We select some of the most read daily newspapers and collect information using Event Registry about the news they have published. Event Registry is a system which analyzes news articles, identifies groups of articles that describe the same event and represent them as a single event [7]. The description of the meta data of an event is shown in the Table 1. The main scientific contributions of this paper are the following:

(1) A novel perspective of aligning news events across different cultures through categorising countries and news events.
(2) A cross-cultural automatically annotated dataset in several different domains (Business, Science, Sports, Health etc.).
(3) Experimental comparison of several classification models adopting different set of features (character ngrams, GLOVE embeddings and word ngrams).

Table 1: The description of the meta data of an event.

Attributes	Description
title	title of the event
summary	summary of the event
source	event reported by a news source
categories	list of DMOZ categories
location	location of the event

2 RELATED WORK

In this section, we review the related literature about the influence of culture, its representation and classification in different fields.

Countries that share a common culture are expected to have heavier news flows between them when reporting on similar events [10]. There are many quantitative studies that found demographic, psychological, socio-cultural, source, system, and content-related aspects [2].

Cross-cultural research and understanding the cultural influences in different fields have competitive advantages. The goal of researching the impact of culture might be to draw conclusions in which way the cultural factors influence a specific corporate action. There are many type of cultures such as societal, organizational, and business culture etc [8].

The hidden nature of cultural behavior causes some difficulties in measurement and defining these. To cope with difficulties, researchers have developed measurements that measure culture on a general scale to compare differences among cultures and management styles. These results can be used to find similarities within a region and differences to other regions. There are many models that have tried to explain cultural differences between societies. Hofstede's national culture dimensions (HNCD) have been widely used and cited in different disciplines [6, 5]. Hofstede's dimensions are the result of a factor analysis at the level of country means of comprehensive survey instrument, aimed at identifying systematic differences in national cultural. Their purpose is to measure culture in countries, societies, sub-groups, and organizations; they are not meant to be regarded as psychological traits.

There is a plethora of research studies that were conducted to understand the cultural influences such as cross-culture privacy and

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attitude prediction, and cultural influences on today's business. [4] explores how culture affects the technological, organizational, and environmental determinants of machine learning adoption by conducting a comparative case study between Germany and US. Rather than looking at the influence of cultural differences within one domain, we intend to understand association between news events belonging to different domains (society, business, health, recreation, science, shopping, sports, arts, computers, games and home) and different cultures (117 countries from all the continents). We conduct this research to find an appropriate representation and classification of culture across different domains.

3 DATA DESCRIPTION

3.1 Dataset Statistics

We choose the top 10 daily read newspapers in the world in 2020 [1] and collect the events reported by these newspapers using Event Registry [7] over the time period of 2016-2020. Approximately 8000 events belongs to each newspaper with exception of "Zaman" that has only 900 events. Figure 1 shows the number of events reported by the selected newspapers on a yearly basis. This dataset can be found on the Zenodo repository (version 1.0.0) [2]

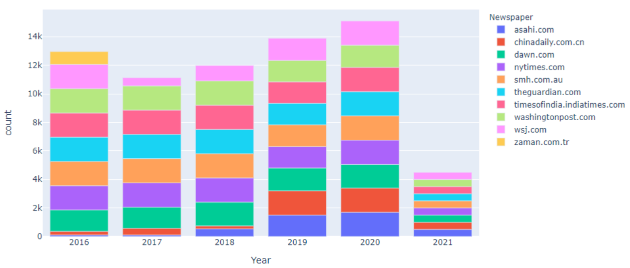

Figure 1: Each color in a bar represents the total number of events per year by a daily newspaper and a complete bar shows the total number of events per year by all the newspapers.

The attributes of an event with description are displayed in Table 1. Few attributes are self-explanatory such as title, summary, date, and source. DMOZ-categories are used to represent topics of the content. The DMOZ project is a hierarchical collection of web page links organized by subject matters [3]. Event Registry use top 3 levels of DMoz taxonomy which amount to about 50,000 categories [4].

4 MATERIAL AND METHODS

4.1 Problem Definition

There are two main parts of the problem that we are addressing. The first part is to label the examples by assigning a culture C to a news event E using its location L. The second part is a multi-class classification task where we predict the culture C of a news event E using its summary description S and its content category G as provided by the Event Registry. This task can be formulated as:

$$C = f(S, G)$$

C donates the culture of the news event, f is the learning function, S donates summary of a news event and G donates category of a news event (see Table 1).

4.2 Methodology

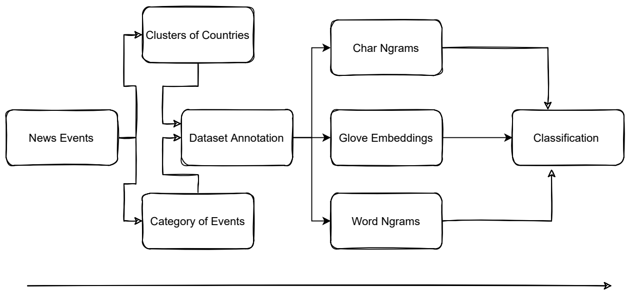

Figure 2: Classification of cross-cultural news events.

4.2.1 Data labeling. Each news event has information about the type of categories to which it belongs and the location where it happened (see Table 1). Each event has many categories and each category has a weight reflecting its relevance for the event. We only keep the most relevant categories and group the news events based on their categories. For each group of events, we estimate the cultural characteristic of each event through the country of the place where the event occurred. We cluster the countries based on their culture. We utilize the Hofstede's national culture dimensions (HNCD) to represent the culture of a country. We take average of cultural dimensions and call it average cultural score. Based on this score, we find optimal number of clusters using popular clustering algorithm k-means (see Figure 4). Finally, we label each news event with one of the six cultural clusters.

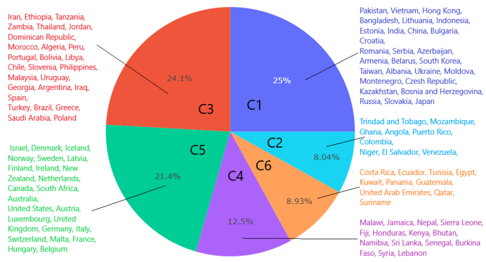

Figure 3: The pie chart depicts the percentage of the news events that occurred in six different clusters (each cluster consists of a list of countries with similar culture).

4.2.2 Data representation. Each news event in Event Registry has associated categories with it along with a weight (see Table 1), we take the top categories based on their weight. In case of multiple categories with equal weight, we sort them alphabetically and keep the first one. We represent each news event by a short summary S and a set of content categories G.

[1] https://www.trendrr.net/
[2] https://zenodo.org/record/5225053
[3] https://dmoz-odp.org/
[4] https://eventregistry.org/documentation?tab=terminology

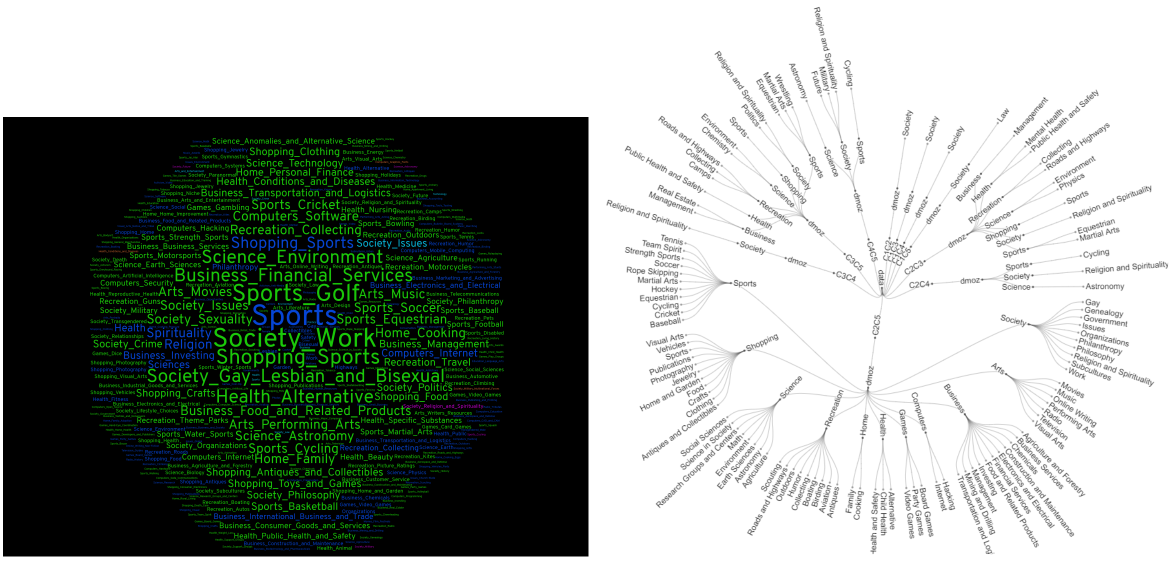

Figure 4: In word cloud, the color of each word shows cluster to whom it belongs (see Figure 3). Radial dendrograms illustrate the shared categories of news events between the pair of six clusters.

4.2.3 Data Modeling. For multi-class classification task, we use simple classification models (SVM, Decision Tree, KNN, Naive Bayes, Logistic Regression) as well as neural network. For simple classification models, we input character and word ngrams varying the number of ngrams and compare the results. We also use pre-trained Glove embeddings.

5 EXPERIMENTAL EVALUATION

5.1 Evaluation Metric

For multi-class classification task, we use following most commonly used evaluation measures: accuracy, precision, recall, and F1 score.

6 RESULTS AND ANALYSIS

6.1 Annotation Results

The results of annotation are six clusters where almost 50% news events belong to the two clusters (shown with red and blue colors) and remaining 50% belong to the other four clusters 3. Looking in each group, we find that clusters do not lies in a specific geographic area or a continent. Rather all the countries in a cluster belong to the different continents. Similarly, these clusters do not have all the countries that are economically rich or poor.

There are more categories in green and red colors in the word cloud (see Figure 4) which represent to the cluster with that colors. Radial dendrograms in Figure 4 present the shared categories between the clusters. In the figure, root of the tree is data and then there are ten pair of clusters that share the same categories. The objective of this whole process was to keep news events according to the category to whom they belongs. Moreover, we can only observe the cultural differences when we have same type of news events from different places.

6.2 Classification Results

Fro the experimental results we can see that the best performance is achieved by Logistic Regression, kNN and Decision Tree. The performance of SVM varies depending on the number of selected features: the highest F1-score is achieved with the top 10K or 20K word ngrams using 1 to 3 word ngrams (see Figure 5). Looking at the character ngrams, the highest F1-score is achieved when we select the top 15K characters for all the tested algorithms except Naive Bayes which declines in performance with the growing set of features. Based on these settings, we achieve the highest accuracy (0.85) using Logistic Regression. Using Glove embeddings, we experiment with and without using the category of event. The highest F1-score with and without the category is 0.80 and 0.79 respectively.

7 CONCLUSIONS AND FUTURE WORK

For researchers and professionals, it is very important to analyse the cross-cultural differences in different disciplines. As the international impact is increasing and international events are becoming popular, the need to develop some automatic methods is significantly increasing and leaving a blank space. We conducted experiments on news events related to different fields to have a broader look on data and machine learning methods. Further research would be helpful in examining the impact of specific socio-cultural factors on news events. In this research work, we estimate the culture of a specific place by its country, use basic features and simple classification models. To continue this work further, we would like to improve feature set such as by including part of speech tagging (POS) as well as other state of the art embeddings.

ACKNOWLEDGMENTS

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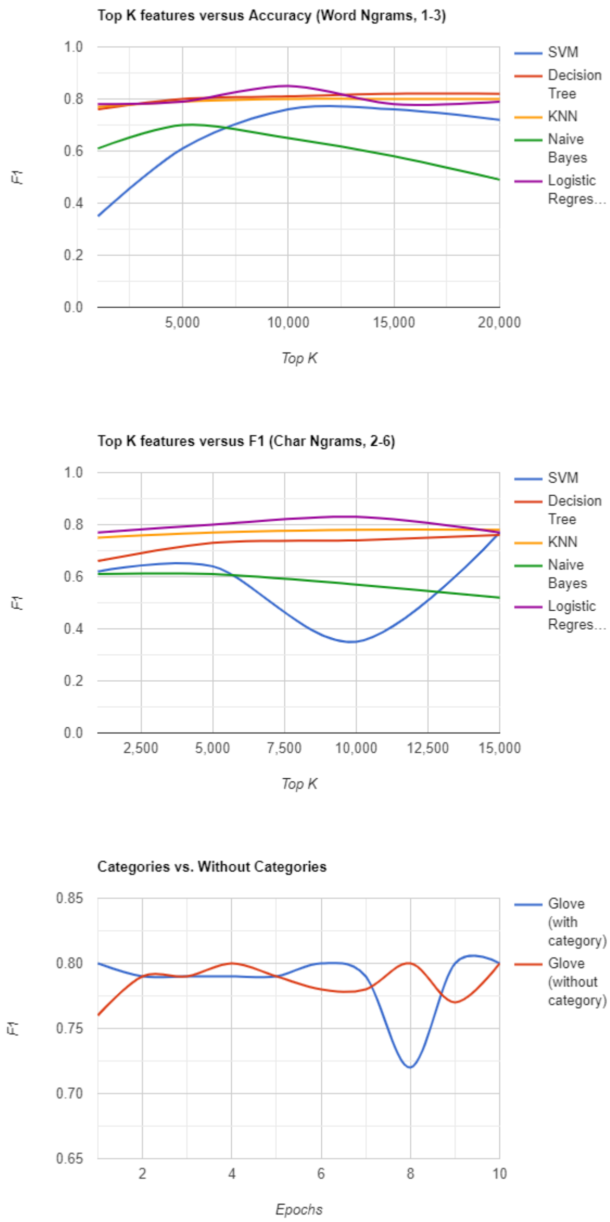

Figure 5: First two line charts illustrate the variations in F1 score by simple classification models after varying the number of features. The first line chart depicts the results of word ngrams whereas the second one shows the results for character ngrams. The last line graph presents comparison between Glove embeddings (with and without category feature).

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Zotero to Elexifinder: Collection, curation, and migration of bibliographical data

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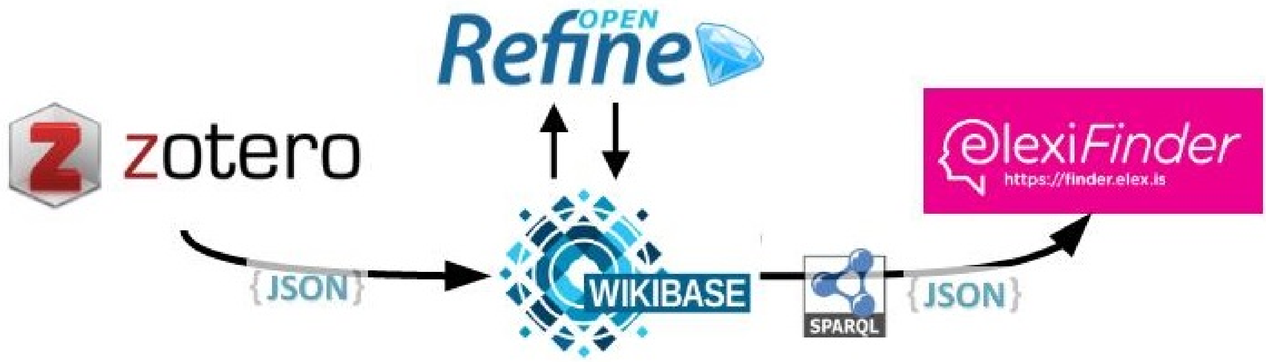

Figure 1: Zotero to Elexifinder workflow model

ABSTRACT

In this paper, we present ongoing work concerning a workflow and software tool pipeline for collecting and curating bibliographical data of the domain of Lexicography and Dictionary Research, and data export in a custom JSON format as required by the Elexifinder application, a discovery portal for lexicographic literature. We present the employed software tools, which are all freely available and open source. A Wikibase instance has been chosen as central data repository. We also present requirements for bibliographical data to be suitable for import into Elexifinder; these include disambiguation of entities like natural persons and natural languages, and a processing of article full texts. Beyond the domain of Lexicography, the described workflow is applicable in general to single-domain small scale digital bibliographies.

KEYWORDS

bibliographical data, author disambiguation, e-science corpora

1 INTRODUCTION

In 2019, version 1 of Elexifinder,[1] a discovery portal for lexicographic literature, was launched in the framework of the ELEXIS project [2].[2] At the same time, at University of Hildesheim, a domain ontology and bibliographical data collection for Lexicography and Dictionary Research was planned [6, 5]. Both endeavours already had compiled significant datasets. At a dedicated workshop connected to the 2019 eLex conference in Sintra (Portugal), it was decided to combine the efforts, and the workflow explained in this paper was designed, in order to merge existing datasets, decide criteria for data curation, and make the results available to the lexicographic community. Two years later, at the 2021 Euralex conference, Elexifinder version 2 was introduced [3]. Main shortcomings of Elexifinder version 1 have been sorted out, namely the missing author disambiguation, and the coverage of the domain's literature has been significantly increased, also regarding publication languages other than English. Moreover, a vocabulary of lexicographic terms has been developed, which is now used for content-describing indexation of article full texts.

Lexicography and Dictionary Research is a relatively small discipline, having thematic intersections with Corpus Linguistics, Terminology, Natural Language Processing, and Philology. In metalexicographic literature, all aspects of the lexicographic process, dictionary structure and functions, dictionary use, and other relevant issues are discussed. The lexicographic community communication is mainly taking place through a reduced number of conference series and journals, being complemented by handbooks and other edited volumes. The need for a dedicated digital bibliography arises from the following observations:

- The vast majority of publications do not have Digital Object Identifiers (DOI), and thus are not indexed in cross-domain digital collections of publication metadata. This applies to nearly all older publications, but also to many newer contributions published in the last two decades.
- When searching for metalexicographical publications in cross-domain digital collections, search results are mixed up with publications from other domains, which may disturb a straightforward information retrieval.
- Author disambiguation in domain-independent digital collections that can be considered the big players in the field (such as Google Scholar) is not at all accurate, so that very

[1] Accessible at https://finder.elex.is.
[2] See https://elex.is.

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often name variants are not resolved to a single person entity, and different persons with the same name are not disambiguated.
- If articles are indexed with content-describing terms in cross-domain digital collections, the vast majority of those terms will be out of the scope of the domain we are looking at.
- Publication metadata found at big (i.e. automatically compiled) repositories is often incomplete or noisy, so that using those, e.g. for citations, requires manual intervention in order to achieve a publishable quality.

Therefore, it seems useful to provide the lexicographic community with a platform that makes publications and their metadata accessible in a way that the described shortcomings will be overcome. Single-domain endeavours of this kind, which all involve manual curation, are *DBLP*[3] for Computer Science, *IxTheo*[4] for Theology, or *EconBiz*[5] for Economics. Inspired by features found in these, we propose a workflow that involves the use of free software accessible to anybody, which makes it reproducible and cost-reducing.

2 LEXBIB ZOTERO GROUP

Zotero,[6] developed and maintained by the Corporation for Digital Scholarship[7], a non-profit organisation, is the most widely used open source citation management software application. Zotero offers functionality for web-scraping publication metadata, importing metadata from different structured formats, and an online platform for collaborative curation of metadata, along with the possibility to attach full text PDF (and TXT versions) to metadata records. The Zotero scraper functionality allows to download publication metadata and attached PDF files from all those sites the Zotero community has provided a "translator"[8] for, including the web platforms of major publishing houses, Open Journal Systems, etc. From the Zotero platform, users are able to obtain metadata records as single items or as batches for import into their own citation managers, or as export records in a range of citation styles or in structured formats such as bibtex. Members of a Zotero group can view and download full text attachments. Moreover, Zotero items can be annotated with custom tags, and additional information (such as excerpts or comments) can be attached to them. Around Zotero, an active community is developing plug-ins that add new functionalities to Zotero.[9]

In the first planning period of the LexBib project, funded by the University of Hildesheim, conference publications of the Euralex and the eLex conference series, and publications from a range of journals and edited volumes have been added to LexBib Zotero group.[10] Items collected for Elexifinder version 1, available as tabular data, have then been merged to the Zotero group. For this purpose, tabular csv data has been transformed to RIS format[11] and imported to Zotero. Additionally, metadata records from OBELEX-meta and EURALEX-Dykstra bibliographies have been added.[12] Duplicate management has been done in batches (whole journal issues or conference iterations), or one by one using Zotero's built-in duplicate detection functionality. Main criterion for the inclusion of metadata records has been the availability of the corresponding full texts. This means a clear preference for Open Access publications; but also other publications have been included, wherever a suitable license agreement allowed access to the text.[13]

Zotero data can be accessed by API,[14] or exported locally using pre-set or custom export scripts. We use an adapted version of the Zotero JSON-CSL exporter, which produces a list of JSON objects containing all metadata fields and their values as literal strings, as well as the location of all local file attachment copies. For statements that cannot be expressed using standard Zotero fields[15], we have used Zotero tags as workaround, following a simple syntax of predicate and object. For example, for asserting that an article is a review article, the tag ":type Review", and so on. Tags in Zotero can be easily copied from one item to others by manual drag-and-drop operations, set via API, and also be included in display styles, so that in the Zotero item listings, for example, review article titles can be preceded by a coloured symbol. With this workaround we can assert semantic triples inside Zotero. That is, for instance, that for representing the statement that a certain item is contained in another item (e.g. a book chapter item in an item of type book), we use a tag beginning with ":container", followed by an identifier for the containing item; for a conference paper presented at a certain event, we use a tag beginning with ":event", followed by an identifier for that event. For both of these, corresponding Zotero fields do exist ("contained in", "presented at"), but these are filled by the web scraping and importer translators with literal string values as needed for citations, and not with unambiguous identifiers.

For Elexifinder, a special metadatum is included in all publication metadata sets: The location of the first author. This allows the generation of location maps and search filters according to locations in the Elexifinder portal. For these locations, we insert English Wikipedia page titles in the Zotero "extra" field.[16]

3 LEXBIB WIKIBASE

3.1 Wikibase as LOD infrastructure solution

The decisive shift from a metadata set as in Zotero, which consists of certain fields and their literal values, towards unambiguous Linked Data lies in the reconciliation of those literal values against existing or new unambiguous identifiers. For example, and this already refers to the hardest nut to crack in this context, an author may have several name variants appearing across the publication metadata collection, and there may be other persons sharing the same name, or any of the name variants. But one author or editor (i.e., a "creator") should only have one identifier (such as ORCID). Since we do not know Wikidata and/or ORCID identifiers of all creators in our database, we need to create our own (and map them later). Other Zotero fields that should be

[3]Accessible at https://dblp.org/.
[4]Accessible at https://ixtheo.de/.
[5]Accessible at https://www.econbiz.de/.
[6]See https://zotero.org.
[7]See https://digitalscholar.org/.
[8]See https://www.zotero.org/support/translators.
[9]For example, very recently the Cita plug-in has been developed, which allows to add citation metadata to Zotero records, see https://meta.m.wikimedia.org/wiki/Wikicite/grant/WikiCite_addon_for_Zotero_with_citation_graph_support.
[10]Last version accessible at https://www.zotero.org/groups/lexbib/library.
[11]See https://en.wikipedia.org/wiki/RIS_(file_format).
[12]See references in [3].
[13]Article full text are stored and exclusively used for project-related text mining tasks; they cannot be downloaded from Zotero. We instead provide download links which lead to the download offered by the corresponding publisher, subject to applicable restrictions.
[14]See https://www.zotero.org/support/dev/web_api/v3/start.
[15]See https://www.zotero.org/support/kb/item_types_and_fields.
[16]Wikipedia page titles are unambiguous (see e.g. https://en.wikipedia.org/wiki/Cambridge vs. https://en.wikipedia.org/wiki/Cambridge,_Massachusetts), and map to only one Wikidata entity. This strategy has turned out effective, since manual annotators are able to find the adequate Wikipedia page without hassle.

reconciled against unambiguous identifiers are those describing the containing item, the conference where the contribution was presented, the journal, the publisher, the publication place, and the publication language. For some of these, persistent identifiers are available in many cases (e.g. journals), or in all cases (languages). In general, we create our own identifiers, and map them to Wikidata; in some cases, immediately (languages, places, and, by ISSN, also journals), and in other cases, we leave that mapping to the (near) future, as it is the case for creators and publishers. Other Zotero fields contain identifiers (ISSN, ISBN, DOI), which after normalisation can be taken directly as external identifiers in a Linked Database.

After experimenting with different RDF database solutions, which allow to represent data in the described way, we have decided for Wikibase,[17] which is the software infrastructure underlying main Wikidata.[18] Since 2019, "Wikibase as a Service" is offered to the community.[19] Wikibase entities are items (each of which has its own identifier preceded by the letter Q), and properties (preceded by letter P), just as in Wikidata, but in a different namespace. Properties may point to other items, other properties, external identifiers, or values of a certain datatype, such as "monolingual text", "point in time", "string", "url", etc.[20]

Wikibase as central data repository solution has several advantages compared to other infrastructure solutions for Linked Open Data (LOD):

- Entity data is displayed on entity pages, where it can be viewed and edited. These pages always reflect the last update.
- A complete edit history is available, and changes can be undone.
- Every entity page is linked to a dedicated discussion page.
- User and user rights management allow a community-driven editing process.
- In addition to query interface and SPARQL endpoint known from other RDF database solutions, Wikibase data can be uploaded and downloaded using an API, and as entity data dump in several formats.

The backbone of LexBib Wikibase is an ontology of classes and properties,[21] which can be aligned to Wikidata or other external ontologies. We have started to define these alignments. This ensures interoperability with other resources, such as Wikidata, so that data can be transferred from LexBib to Wikidata or vice versa, or accessed in both at the same time, using federated SPARQL queries.

3.2 Zotero to Wikibase migration

As mentioned before, Zotero item data is exported from a local Zotero instance, using an adapted version of the Zotero JSON-CSL exporter.[22] The resulting list of JSON objects is then processed in the following way:

- Zotero tags that contain semantic triple shortcodes (explained above) are mapped to the corresponding LexBib wikibase properties, in this case with datatype "item", that is, to object properties.
- Creator name and publisher name literals are mapped to the properties corresponding to the creator role (author or editor), or to the publisher. This is done in a way that the name literals appear as qualifiers to a wikibase "novalue" statement, which is a placeholder for the creator or publisher item, that will be defined in the disambiguation process explained below.
- Zotero fields that contain external identifiers (ISSN, ISBN and DOI), are mapped to the corresponding properties of datatype "external identifier". Wikibase properties of that datatype allow to define a URL pattern, in order to make the identifier a valid hyperlink, which can be clicked on in Wikibase entity data pages.
- As mentioned, we use the Zotero "extra" field ("note" in bibtex) for annotation of the item with a Wikipedia page that corresponds to the first author's location. Wikidata API is queried for the corresponding Wikidata entity, an equivalent of which is created in LexBib Wikibase, in order to function as object to the property "first author location".
- The Zotero "language" field, in LexBib may contain a two-letter ISO-639-1, or a three-letter ISO-639-3 code. This is mapped to a property pointing to the language item corresponding to that code.
- The Zotero item URI is taken as external identifier in LexBib wikibase, with the Zotero storage location of PDF and TXT attachments as qualifiers to that statement. In addition, we annotate this statement with a qualifier asserting the presence of an abstract, and, if any, in what language.[23]
- The content of the remaining fields is mapped to Wikibase properties of the corresponding datatype ("URL", "string", or "point in time").

The resulting dataset is then imported into LexBib Wikibase. It is worth mentioning that uploading data to a Wikibase triple by triple using the mediawiki API of the Wikibase instance[24] takes about 0.5 seconds per triple, which is due to the need of updating Wikibase search indices and edit histories for every single uploaded triple.

3.3 Entity disambiguation using Open Refine

The around 5,000 creator names appearing in LexBib Zotero by spring 2021 have been mapped to around 4,000 unique person items. This has been done testing different clustering algorithms available in the Open Refine application,[25] by Christiane Klaes from the University of Hildesheim, in the framework of her MA thesis [1]. These are the creator items present in LexBib Wikibase experimental version 2.[26]

From that moment on, any new Zotero item that is exported to Wikibase, which will contain, as explained above, one or more creator statements of type "novalue", is reconciled against existing LexBib Wikibase creator items, using the given and last name literal qualifiers. For this purpose, a reconciliation service for LexBib Wikibase is set up[27], and then accessed by Open Refine, in order to match creator name literals to creator items.

[17] See http://wikiba.se; our instance is accessible at http://lexbib.elex.is.
[18] Accessible at http://www.wikidata.org.
[19] See https://www.wbstack.com. The service has been co-enabled by Adam Shoreland (https://addshore.com/), Rhizome (https://rhizome.org/), and WMDE (https://www.wikimedia.de/).
[20] See https://www.wikidata.org/wiki/Help:Data_type.
[21] For more information, see LexBib Wikibase main page at https://lexbib.elex.is.
[22] Available at https://github.com/elexis-eu/elexifinder/blob/master/Zotero/LexBib_JSON.js.
[23] The abstract language is assumed to be the same as the publicaton language, if not stated different as tag shortcode ":abstractLang".
[24] For LexBib Wikibase, see https://lexbib.elex.is/w/api.php.
[25] Available at https://openrefine.org/.
[26] Accessible at https://data.lexbib.org.
[27] This is done using https://github.com/wetneb/openrefine-wikibase.

If a literal can not be matched to any existing item, a new person item is created. The reconciliation also works with fuzzy matches, and all name variants attached to existing items are considered. Matches can also be manually chosen. Any additional name variant appearing in Zotero data is linked to the LexBib Wikibase person item as "alias" label, while the most frequent name variant is chosen as "preferred" label. This allows for the new name variants being available for subsequent reconciliation iterations.

LexBib persons have up to six name variants found in Zotero data. In some cases, we have chosen the preferred name variant manually, according to the author's own choice, or to conventions in the community regarding the naming of commonly known authors.[28]

3.4 Full text processing

LexBib full text PDFs are stored in the local Zotero storage folder, which is automatically synchronised with Zotero cloud. When processing Zotero JSON output, PDF files are sent to an installation of the GROBID application[29], which will propose a TEI representation of the PDF content. This allows for isolating the full text body from the other text components, such as title, running titles, abstract, author list, and references section. The extracted full text body is manually validated, and, in case of any mistake, it is corrected, using a plain TXT version of the PDF, which is by default produced by Zotero.

GROBID turns out to structure PDF content as TEI very efficiently if the article resembles a typical structure as found in journals and proceedings. Book chapters and review articles, which normally do not feature an abstract, in turn, are usually not parsed adequately. In those cases, we now use directly the plain TXT version for producing a cleaned version manually.

The article text is then lemmatised,[30] and lexicalisations of LexVoc lexicographic terms are looked up in the text.[31] LexVoc vocabulary[32] is a resource still under development; for the term discovery process, terms and lexicalisations (labels) are obtained from LexBib Wikibase by a SPARQL query, the result of which will reflect the state of LexVoc in that particular moment. The keyword processor returns counts of every term, so that relative frequencies can be calculated for every term, according to the occurrences of its labels and the amount of tokens in the article text body; this information can be uploaded to LexBib Wikibase bibliographical items, so that term indexation becomes part of their entity data.

4 WIKIBASE TO ELEXIFINDER

The described workflow is necessary for being able to export bibliographical data in a custom JSON format, as needed for Elexifinder, which is an application based on some of the elements of the Event Registry system architecture [4]. In particular, authors and content-describing terms (Elexifinder "categories") have to be represented as objects containing an unambiguous URI and a textual label; the containing item, the LexBib Zotero item URI, and the link for accessing full text download are represented as URL, publication date in ISO 8601 format, publication language in ISO 639-3 format, and the item title as simple string.

[28]See an example at http://lexbib.elex.is/entity/Q1583.
[29]See https://grobid.readthedocs.io.
[30]For the time being, we are only processing English text. For lemmatisation, we use spaCy (see https://spacy.io/).
[31]This is done using https://pypi.org/project/flashtext/.
[32]Described at http://lexbib.elex.is/wiki/LexVoc.

The full text body itself is also exported to Elexifinder, where it is used for displaying the first bits of it in search result displays, and for wikification, from which Elexifinder "concepts" are obtained, as long as the system is able to associate named entities occurring in the text with Wikipedia pages that describe them.

5 CONCLUSIONS AND OUTLOOK

The described workflow enables us to disambiguate entities found in bibliographical datasets. For the time being, we are applying this for feeding the Elexifinder app. Having chosen Wikibase as central data repository also allows for aligning LexBib data with Wikidata in a straightforward way. In some cases, we have imported statements from Wikidata, in order to enrich LexBib entities with additional information, but that can be done the other way round as well. In other words: Wherever we find (or create) a Wikidata entity to align with our own, we can export the statements asserted on LexBib Wikibase to the main Wikidata. We have done this using LexBib events (conferences) as test case, and plan to align other entity types with Wikidata in the near future, namely articles, persons, and organisations.

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Simple Discovery of COVID IS WAR Metaphors Using Word Embeddings

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ABSTRACT

In the past year, the discourse on the COVID-19 pandemic has produced a great number of metaphors stemming from the more basic conceptual metaphor ILLNESS IS WAR. In this paper, we present a semi-automatic method to detect linguistic manifestations of the latter in Slovene media. The method consists of assembling a seed vocabulary of war-related words from an existing Slovene metaphor corpus, extending the vocabulary using word embeddings, and refining the extended vocabulary using intersection filtering. Our method offers a quick compilation of corpus data for further analysis, however, we also address issues related to the method's precision and the need for manual filtering.

KEYWORDS

metaphors, covid, word embeddings, media discourse

1 INTRODUCTION

The COVID pandemic has been a ubiquitous topic in the discourse of the past year, featuring in medical, political, public and personal discourse. The emergence of a new virus of yet unknown origin, behaviour and effects has presented itself like a complex and obscure topic. To make sense of it, we have once more resorted to metaphorical language, much like we do when faced with other abstract, obscure concepts. According to Conceptual Metaphor Theory (CMT, [11, 12]), metaphors "are among our principal vehicles for understanding" and "play a central role in the construction of social and political reality" ([12, p. 151]). In CMT, linguistic metaphors such as *"food for thought"* and *"half-baked idea"* are considered manifestations of an established conceptual mapping between a more concrete domain and a more abstract domain, here for example IDEAS ARE FOOD. The domain of DISEASES, on the other hand, is often mapped to the domain of WAR, a more common frame of reference which has taken hold as a fairly conventional way to talk about illnesses and their treatments, as well as several other domains ([8]).

As was already observed in various studies ([19, 2, 5, 7]), the discourse on the current COVID pandemic has also repeatedly used the WAR domain in its metaphors. At the time of our experiment, however, no study has yet addressed the use of such metaphors in Slovene, where they were also adopted for communicating various implications, preventive measures, recommendations and laws to abide by. To investigate the use and pervasiveness of this metaphorical domain in Slovene media, we have conducted a quick analysis of a corpus of COVID-related news articles using an innovative methodological approach. We propose a top-down method to search for expected conceptual metaphors through semi-automatic means employing word embeddings. While most previous corpus-based approaches to identify metaphors either use a small set of candidate words or require manual inspections of large data samples, our approach reduces manual work on assembling linguistic data by combining existing annotated resources and text mining methods.

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2 PROPOSED APPROACH

Our method aims to discover linguistic expressions of the conceptual metaphor COVID IS WAR in the corpus by targeting a broader potentially metaphoric vocabulary. Previous related works have relied on either a limited vocabulary set (e.g. [7]) or a list of words laboriously compiled from various sources such as dictionaries, thesauri and other studies on metaphor [19], or have used sophisticated but complex NLP methods and specialized resources (e.g. [6]). In our experiment, we use a simple unsupervised approach using existing resources and language processing technologies.

The main novelty of our approach is using pre-trained word embeddings to extend the vocabulary, used also by e.g. [16] and [18] to extend terminology. As past research has shown [14], word embeddings used for training language models retain linguistic regularities, including syntactic and semantic relationships between words. This means that similar words have similar vectors, and the closer vector representations (word embeddings) are, the higher the chance they share a certain semantic space. We make use of this feature by trying to capture a semantic space that would resemble the conceptual domain of WAR, which represents the source domain of the metaphor.

2.1 Method

First, we start by collecting war-related lexical units from the KOMET corpus [1], the only corpus of metaphors in Slovene which was recently compiled and annotated similarly to the English corpus of metaphors, VUAMC [17]. KOMET contains approximately 200,000 words obtained from journalistic, fiction and online texts and was hand-annotated for metaphoricity on the basis of the MIPVU procedure ([17]). Additionally, the metaphoric expressions are tagged for one of 69 semantic frames, i.e. the source concepts that semantically motivate them. One of these semantic frames is `#met.battle`, which subsumes 105 metaphoric instances with 67 different lemmas, such as *predati, ostrostrelec, orožje, napasti* [surrender, sniper, weapon, attack]. These also form multi-word idioms such as *železna pest* [iron fist] and *boriti se z mlini na veter* [to tilt at windmills] which we exclude from our candidates list because the word embeddings we use only represent tokens, not whole phrases. Moreover, the lemmas within do not themselves necessarily represent the desired domain. We also filter out some words erroneously annotated with the frame such as *številen* [numerous]. This gives a starting vocabulary of

51 unique seed words. Then, to extend the vocabulary further, we employ Slovene word token embeddings ([13] pre-trained with fastText ([4]) on various large corpora of Slovene (GigaFida, Janes, KAS, slWaC etc.). For each seed word in the list of words extracted from the KOMET corpus, we use the Gensim library ([20]) to find the word's *N* nearest neighbours in the fastText embeddings' space (using the `most_similar` function).

To increase the robustness of the extended vocabulary, we try to automatically filter out lexis not related to war. To this end, we use the word embeddings intersection method ([18]). The method retains only the candidates that intersect between the sets, meaning they occur in the neighbourhood of at least *k* input seed words. For our main experiment, presented in this paper, we select the parameters *N*=50 and *k*=3. We thus obtain a maximum of 2550 (50 x 51) potential candidates. In the output, there are 2078 unique words, and, after lemmatization, 1539 unique lemmas. After the intersection filtering, the vocabulary extended by word embeddings consists of 184 word lemmas: 44 of them are already included in our initial seed set and 140 are new lemmas. We join the new, extended set with the initial seed set, which yields a total of 191 lemmas to search for.

3 CORPUS

The experiment is carried out on a corpus of Slovene COVID-19-related news articles, automatically crawled from the web by searching for the keyword "covid-19" in article titles (a subset of the Slovene corpus used in the Slav-NER 2021 shared task ([15]). The corpus consists of 233 texts spanning from February 2nd to December 11th, 2020 . To prepare it for analysis, we remove the header of each text (comprised of the article number, locale, date and URL), then parse the text into sentences and tokens using the NLTK library ([3]). We also lemmatize the corpus using the LemmaGen lemmatization module ([9]). The pre-processed corpus contains 7,273 sentences and 151,947 tokens.

3.1 Corpus search

In the next step, we extract all sentences from the corpus containing any of the war-related terms from our expanded vocabulary of 191 lemmas. The results yield 335 instances of potentially metaphorical expressions. Out of the 191 lemmas on the metaphorical candidate list, the COVID corpus contains 49, appearing in 268 sentences. Due to the unsupervised approach these are still only candidate words from the semantic domain of war. A manual analysis shows that in addition to war metaphors, our extracted sentences include the following four cases:

(1) Some of the seed words found in the corpus are used literally;
(2) Some of the seed words found in the corpus are a result of lemmatization errors
(3) Some of the seed words found in the corpus are used metaphorically, but refer to other target domains, such as POLITICS or NATURE (e. g. *boriti se proti podnebnim spremembam* ['fight against climate change'])
(4) Some of the seed words in our initial 191-candidate list are not actually related to the topic of WAR but are more closely related to another topic (e.g. *gol* ['goal'])

On this account we perform a manual analysis of the extracted sentences and categorize them as follows:

(1) falsely extracted instances due to a lemmatization error or literal use, or true metaphorical expressions but with other source or target domain, and
(2) true metaphorical expressions referring to disease as target domain

For example, in the following sentence, the word brigade [brigades] only refers to a name of a street, which we mark as literal usage.

- */…/ odvzem brisov pri pacientih s sumom na Covid-19: ob Cesti proletarskih **brigad** 21 /…/*
  */…/ taking swabs from patients with suspected Covid-19: at 21, Proletarian **Brigades** Road /…/*

In the following example, the word napad [attack] is used to refer to another domain – INTERNET, COMPUTING, which we mark as metaphor for another target domain.

- *Covid-19 je okrepil trend rasti kibernetskih **napadov** [Covid-19 reinforced the growing trend of cyber **attacks**]*

The following three example sentences contain expression that we mark as metaphor for the target domain of DISEASE.

- *Čeprav v **boju** z virusom to nikakor ni hitro.*
  *[Although this is by no means fast in the **fight** against the virus.]*

- *Kako bo jeseni, ko bodo **»udarili«** še drugi virusi?*
  *[What will happen in autumn, when other viruses also **"strike"**?]*

- *Prvi organski sistem v organizmu, ki ga virus **napade**, povzroči pljučnico, …*
  *[The first system in the organism that the virus **attacks** causes pneumonia …]*

Results of this analysis are presented in Table 1, whereby we report only lemmas that were metaphorically used for the DISEASE target domain at least once.

As can be derived from Table 1, our proposed method correctly identified 25 different lemmas with a total of 123 occurrences that are used metaphorically to frame the topic of the pandemic. Out of our 233 articles, 68 or 29,18% contained at least one militaristic metaphorical expression. The ostensibly most frequent expression used was *boj* [fight] with 46 metaphorical occurrences, followed by *boriti* [to fight] with 13 metaphorical occurrences and *soočati* [to confront] with 7 metaphorical occurrences. They account for 37.4%, 10.6% and 5.7% of all metaphorical expressions found by our method, respectively, and together, they represent more than 50% of them. This points to the interpretation that the news corpus contains mostly highly conventional and recurrent metaphors. A lot of the war-related vocabulary (potential candidates in our extended war-related lexis) is not used, meaning the corpus does not, at this moment, exhibit very original, novel metaphorical expressions. Using a larger and a more recently compiled corpus would perhaps reveal a more innovative use of COVID IS WAR metaphors. The vocabulary extension method using word embeddings has proven fruitful as it revealed some metaphorical expressions that were not in the initial 51-word list extracted from the KOMET corpus. The 9 newly discovered lemmas are: *soočiti, izbojevati, zmagati, obraniti, uiti, soočanje, spopadati, zoperstaviti, podleči* [to confront, to fight, to win, to defend, to escape, confrontation, to combat, to oppose, to succumb].

The analysis also revealed some additional lemmas that relate the epidemic to the war frame. In the sentences containing the lemmas we searched for, there were other words from the WAR

Table 1: Analysis of metaphoric lemmas from the extended vocabulary

Lemma	Corpus occurences	Literal uses, lemmatization errors or other source/target domain	DISEASE as target domain
Boj [fight]	57	11	46
Boriti [to fight]	16	3	13
Soočati [to confront]	17	10	7
Spopad [to combat]	6		6
Spopadanje [combatting]	6		6
Zoperstaviti [to oppose]	5		5
Bitka [battle]	5	1	4
Napad [attack]	41	37	4
Podleči [succumb]	5	1	4
Spopadati [to combat]	5	1	4
Bojen [combat [ADJ]]	17	15	2
Borba [battle]	3	1	2
Braniti [to defend]	4	2	2
Napasti [to attack]	6	4	2
Obramben [defense [ADJ]]	9	7	2
Soočanje [confronting]	2		2
Soočiti [to confront]	6	4	2
Žrtev [victim]	49	47	2
Borec [fighter]	3	2	1
Izbojevati [to fight]	1		1
Obraniti [to defend]	1		1
Štab [base, headquarters]	3	2	1
Udariti [to hit]	2		2
Uiti [to escape]	2	1	1
Zmagati [to win]	5	4	1
TOTAL	270	147	123

domain forming so called metaphor clusters ([10]). Thus, we managed to capture some metaphorical expressions that appeared in close vicinity (in the same sentence) of the found metaphorical expressions: *fronta, strategija, preboj, akcijski načrt, vojna mentaliteta, sovražnik* [front, strategy, breakthrough, action plan, war mentality, enemy]. For instance, our method found the sentence below which, in addition to the word *bitka* [battle] in our candidate list, contains a metaphorical use of the word *fronta* [front].

- ***Bitka** proti virusu na več **frontah***
  *[**Battle** against the virus on multiple **fronts**]*

4 ANALYSING DIFFERENT PARAMETER SETTINGS

Some of the expressions mentioned above would have been captured had we modified the parameters of vocabulary extension. Namely, we experimented with using more nearest neighbours (75, 100, 150 and 200). Our initial experiments were carried out on a N of 50 and intersection k of 3. However, by changing the parameters, the results of initial new lemmas could differ. In Figure 1, we analyse how the seed list changes with different parameters: N of 50 and 75 neighbours, each combined with the intersection count k of 2, 3 and 4. Note that these refer only to the list of potentially metaphoric lemmas, and not to the analysis of their use, which can only be analysed in context. We see that the initially selected parameters (50 neighbours and 3 recurrences) are an acceptable middle-ground between precision and size while still maintaining an unsupervised approach, however, had we wanted more examples, we could increase the parameter N or decrease the parameter k.

For the recall, we are not able to carry out a systematic evaluation. Nevertheless, based on metaphor clusters analysis mentioned above, we identified the set of additional words that belong to the military vocabulary: *fronta, strategija, preboj, akcijski, vojen, sovražnik* [front, strategy, breakthrough, action [ADJ], war [ADJ], enemy]. The words *vojen* [war[ADJ]] and *sovražnik* [enemy] would have been included if we lowered the intersection parameter to $k = 2$ at $N = 50$ neighbours or extended the vocabulary by $N = 75$ neighbours while keeping the intersection parameter $k = 3$. Other metaphorical expressions occurring in the corpus *(fronta, preboj, strategija, akcijski)* [front, strategy, breakthrough, action [ADJ]] are not found anywhere in the first 200 neighbours of any of the words, indicating perhaps that the number of neighbours might be further increased. However, we observe that increasing the number of neighbours leads to fuzzier results. The added vocabulary using 75, 100, 150, and 200 nearest neighbours of our initial seed words includes increasingly more words unrelated to the topic of war and some very common words, which would need additional filtering. We assume that the reason for this is that words commonly used metaphorically (conventional or dead metaphors) are "displaced" in the vector space of embeddings, moving away from the words in their original semantic domains and closer to words in other semantic domains – target domains. For example, we observed a lot of sports expressions in our extended vocabulary (e.g. "ball", "goal", "goalpost"). This shows how entrenched metaphors are in our language: in the vector space of word embeddings, the semantic domains are already "muddled". In the present example, this could be a due to the frequent linguistic manifestations of the conceptual metaphor COMPETITION IS WAR.

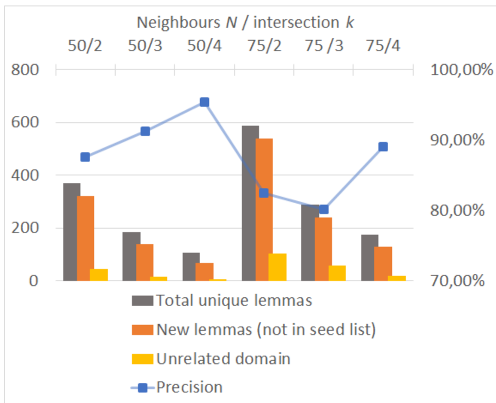

Figure 1: Analysis of vocabulary extension parameters N and k

5 CONCLUSION

We present an innovative approach using word embeddings as a tool for extending the vocabulary of potentially metaphoric expressions and identify them in corpora. Our approach shows promise in that it correctly identifies numerous such expressions and confirms that intersections of semantic spaces of metaphorical seed words can be used to refine the quest for words pertaining to the military domain. Nevertheless, some metaphoric expressions are missed by our method and the experiment still needs manual analysis. Further research and experiments would be needed for a larger expansion of vocabulary and a finer filtering approach as well as comparing different word embeddings, possibly those trained on more literal language.

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Topic modelling and sentiment analysis of COVID-19 related news on Croatian Internet portal

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ABSTRACT

The research aims to identify topics and sentiments related to the COVID-19 pandemic in Croatian online news media. For analysis, we used news related to the COVID-19 pandemic from the Croatian portal *Tportal.hr* published from 1st January 2020 to 19th February 2021. Topic modelling was conducted by using the LDA method, while dominant emotions and sentiments related to extracted topics were identified by National Research Council Canada (NRC) word-emotion lexicon created originally for English and translated into Croatian, among other languages. We believe that the results of this research will enable a better understanding of the crisis communication in the Croatian media related to the COVID-19 pandemic.

KEYWORDS

News media, sentiment, emotions, pandemic, lexicon approach, Latent Dirichlet Allocation

1 INTRODUCTION

There are three major approaches to sentiment and emotions analysis in text: lexicon based, machine learning based approach [12] and the most recent deep-learning approach. In this research, we used a hybrid approach by applying the method of Latent Dirichlet Allocation (LDA) for topic modelling [6] and lexicon approach by using NRC word-emotion lexicon [13] for detection of sentiments (positive or negative) and basic emotions, according to Pluchik's model of emotions [15], in extracted topics.

The main goal of this paper is to analyse sentiments and emotions in crises communication in the news related to the COVID-19 pandemic published on the Croatian online portal. Our goal was aggravated in this research because articles belong rather to objective than to subjective type of reporting. Another problem is the lack of lexical resources for sentiment and emotions in the Croatian language. Glavaš and co-workers [10] developed a Croatian sentiment lexicon called CroSentiLex, which consists of positive and negative lists of words ranked with PageRank scores. Nevertheless, there is no available lexicon for the analysis of emotions for the Croatian language. Our analysis uses the NRC word-emotion lexicon, initially developed for English and translated into 104 languages, including Croatian. Such an approach has disadvantages due to cultural differences, but developing emotion lexicons for low-resource languages as Croatian is very demanding. Sentiment analysis of COVID-19 related texts is conducted mainly for texts written in English, such as research by Shofiya and Abidi [17], where the SentiStrength tool was used to detect the polarity of tweets, and support vector machine (SVM) algorithm was employed for sentiment classification. In [14], tweets about COVID-19 in Brazil written in Brazilian Portuguese due to lack of language resources are analysed by translating original text from Portuguese to English and using available resources for English.

Regarding Croatian social media space, Twitter social network communication was analysed through sentiment analysis [2] and COVID-19 information spreading [3]. Crisis communication of Croatian online portals was already explored by topic modelling of COVID-19 related articles [7]. However, in that research, it is not included further sentiment and emotional analysis of topics. In [4], information monitoring and name entity

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recognition were conducted on news portal texts related to pandemics.

2 METHODS

2.1 Latent Dirichlet Allocation

LDA is a generative, probabilistic hierarchical Bayesian model that induces topics from a document collection [5,6]. The intuition behind topic modelling using LDA is that documents exhibit multiple topics. The topic is formally defined as a distribution over fixed vocabulary. Induction of topics is done in three steps:

- Each document in the collection is distributed over topics that are sampled using Dirichlet distribution.
- Each word in the document is connected with one single topic based on Dirichlet distribution.
- Each topic is defined as a multinomial distribution over words that are assigned to the sampled topics.

Topic modelling by LDA is conducted using *stm* package in R [16].

2.2 Number of topics estimation

Before performing the LDA topic modelling, it has to be estimated the number of topics. In this research we used four metrics from the R package *ldatuning*: Arun2010 [1], CaoJuan2009 [8], Deveaud2014 [9], and Griffiths2004 [11]. Measures Arun2010 and CaoJuan2009 have to be minimised, while measures Deveaud2014 and Griffiths2004 have to be maximised. However, as measures, Arun2010 and CaoJuan2009 generally decrease with the number of topics, and measures Deveaud2014 and Griffiths2004 increase with the number of topics, we will choose the number of topics as the value when observed measures start to stagnate.

2.3 Detection of sentiments and emotions

For the association of sentiments and emotions to extracted topics it was used NRC word-emotion lexicon [13], which consists of 14,182 words with scores of 0 or 1, according to the association to *positive* or *negative* sentiment or one of eight emotions of Pluchick's model (*anger*, *anticipation*, *disgust*, *fear*, *joy*, *sadness*, *surprise*, and *trust*) [15]. The lexicon was created manually by crowdsourcing on Mechanical Turk.

For every sentiment and emotion, we created a vector with a distribution of zeros and ones over the words of a controlled dictionary created from the collection. Association of topics to sentiments and emotions is calculated as the cosine similarity between vectors of topics and corresponding vector of sentiment or emotion.

3 EXPERIMENT

3.1 Data set and preprocessing

The data set used for research consists of articles from the Internet portal *Tportal.hr* related to the topics of COVID-19 pandemic crises and collected from 1st January 2020 to 19th February 2021. Each article included in the dataset is defined as a COVID-19 article only if it contains at least one keyword related to coronavirus thematic. We use COVID-19 thesaurus for article filtering, which contains about thirty of the most important words describing the SARS-CoV-2 virus epidemic together with their corresponding morphological variations. From the total of 31,177 articles, according to defined filtering, the dataset used in the experiment consists of 12,080 COVID-19 related articles. Articles on the portal are categorised into one of nine main categories: *Biznis* (*Business*), *Sport* (*Sport*), *Kultura* (*Culture*), *Tehno* (*Techno*), *Showtime*, *Lifestyle*, *Autozona* (*Autozone*), *Funbox*, and *Vijesti* (*News*) (see Table 1).

Documents of a collection are created using text from the article's subcategory, introduction, main text, and tags. The collection is preprocessed by ejection of English and Croatian stop words and numbers and performing a lemmatisation. It is created a term-document matrix using *tf-idf* weighting scheme. The collection is indexed by terms contained in at least four documents of the collection, and the final list of index terms contained 31,121 terms.

Table 1: Number of articles from dataset categorised into one of nine main categories

Category	Number COVID-19 articles
Business	2,767
Sport	2,008
Culture	894
Techno	101
Showtime	1,352
Lifestyle	1,442
Autozone	124
Funbox	58
News	3,334

3.2 Results

As a first step, the number of topics had to be estimated. Since articles on the portal are categorised into nine main categories, we examined a number of topics from 5 to 15. We chose nine topics since the metrics started to stagnate for a higher number of topics (see Figure 1).

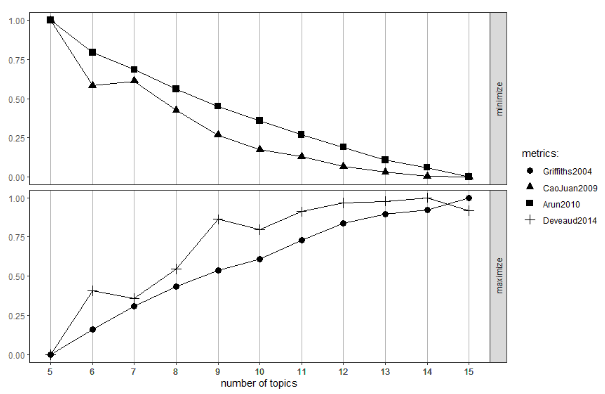

Figure 1: Metrics for estimation of the best fitting number of topics for 5 to 15 topics

Table 2: Top 10 words with the largest probabilities over topics and top 10 words with a *negative* sentiment with the largest probabilities over topics, both sorted in descending order of their probabilities. Topics are sorted by their representation in documents in descending order.

Topic's theme	Top 10 words
Topic 1 – *Sport*	*words by theme:* koronavirus (coronavirus), liga (league), klub (club), nogometni (football), igrač (player), godina (year), utakmica (match), sezona (season), hrvatski (Croatian), nogomet (football)
	words by negative sentiment: igrač (player), velik (big), problem (problem), epidemija (epidemic), odgoditi (to delay), prekinuti (to interrupt), čekati (to wait), borba (fight), napraviti (to make), posljedica (consequence)
Topic 2 – *Vaccination and epidemic measures*	*words by theme:* cijepljenje (vaccination), cjepivo (vaccine), zemlja (country), europski (European), koronavirus (coronavirus), doza (dose), predsjednik (president), vlada (government), mjera (measure), čovjek (man)
	words by negative sentiment: vlada (government), velik (big), epidemija (epidemic), red (order), borba (fight), sud (court), granica (border), problem (problem), potreban (required), upozoriti (to warn)
Topic 3 – *Earthquake and government measures*	*words by theme:* mjera (measure), hrvatska (Croatia), vlada (government), rad (labor), pomoć (help), potpora (support), odluka (decision), potres (earthquake), zaštita (protection), Zagreb
	words by negative sentiment: potres (earthquake), velik (major), pogoditi (to hit), potreban (required), posao (job), šteta (demage), prijava (report), republika (republic), poziv (call), posljedica (consequence)
Topic 4 – *Lifestyle*	*words by theme:* modni (fashion), godina (year), pandemija (pandemic), nov (new), koronavirus (coronavirus), poznat (famous), moda (fashion), obitelj (family), brend (brand), model (model)
	words by negative sentiment: velik (big), nositi (to wear), izolacija (isolation), veza (relationship), majka (mother), dug (debt), djevojka (wench), znak (sign), mali (small), pun (full)
Topic 5 – *Generally stories*	*words by theme:* čovjek (man), vrijeme (time), znati (know), virus (virus), velik (big), život (life), dan (day), dijete (child), koronavirus (coronavirus), dobro (good)
	words by negative sentiment: velik (big), virus (virus), problem (problem), posao (job), napraviti (to make), bolest (disease), mali (small), potreban (required), teško (hard), nositi (to wear)
Topic 6 – *Business 1*	*words by theme:* posto (percentage), godina (year), pad (drop), velik (big), pandemija (pandemic), tržište (market), rast (growth), kuna, gospodarstvo (economy), banka (bank)
	words by negative sentiment: pad (drop), velik (big), kriza (crisis), vlada (government), prihod (income), smanjiti (decrease), mali (small), trošak (expenditure), posljedica (consequence), epidemija (epidemic)
Topic 7 – *Daily reports*	*words by theme:* osoba (person), koronavirus (coronavirus), covid, slučaj (case), mjera (measure), broj (number), županija (county), nov (new), sat (hour), bolnica (hospital)
	words by negative sentiment: bolest (disease), virus (virus), zaraziti (to infect), zaraza (infection), epidemija (epidemic), umrijeti (to die), velik (big), infekcija (infection), zarazan (contagious), simptom (symptom)
Topic 8 – *Culture*	*words by theme:* godina (year), film (film), nov (new), festival (festival), program (program), hrvatski (Croatian), Zagreb, kultura (culture), kazalište (theater), knjiga (book)
	words by negative sentiment: velik (big), mali (small), predstavljati (to present), nastup (appearance), otkazati (to cancel), odgoditi (to delay), smrt (death), rat (war), strana (side), kritika (critique)
Topic 9 – *Business 2*	*words by theme:* nov (new), proizvod (product), automobil (car), velik (big), godina (year), hrvatska (Croatia), proizvodnja (production), tvrtka (company), trgovina (market), kupac (buyer)
	words by negative sentiment: velik (big), nafta (oil), epidemija (epidemic), lanac (chain), smanjiti (decrease), kriza (crisis), mali (small), zaraza (infection), problem (problem), utjecaj (influence)

Topics were labelled based on words with the largest probabilities in topics vectors (keywords) shown in Table 2. Some of the topics are directly connected to main categories on the portal: the first topic is labelled as *Sport*, the fourth topic as *Lifestyle*, and the eighth topic as *Culture*, while the sixth and the ninth topics are connected to the business world and are labelled as *Business 1* and *Business 2*. *Business 1* is associated with the capital market, while *Business 2* is associated with production. Topic 2 is associated with *Vaccination and epidemic measures*, while Topic 3 is associated with *Earthquake and government measures*. Topic 5 seems rather *General on stories* in a pandemic world, while Topics 7 contains *daily reports* on the pandemic state.

We found that all topics are mainly associated with *negative* sentiments. In Table 2 are listed words associated with *negative* sentiment with the largest probabilities across topics, while words associated with *positive* sentiment have coincided with the words from topics theme. This list gives some insight into what "bears" *negative* sentiment in the topics.

Figure 2 shows the association of topics to sentiments and emotions. The ratio of *positive* and *negative* sentiments is the best for categories of *Sport* and *Culture*. These categories and *Lifestyle* are only categories associated with *joy* as one of the dominant emotions. *Surprise* and *anticipation* are dominant emotions across all topics. Categories *Vaccination and epidemic measures*, *Earthquake and government support*, *Generally stories* and *Business 1* are associated with the emotion of *sadness*, while categories *Vaccination and epidemic measures* and *Daily reports* are associated with *fear*.

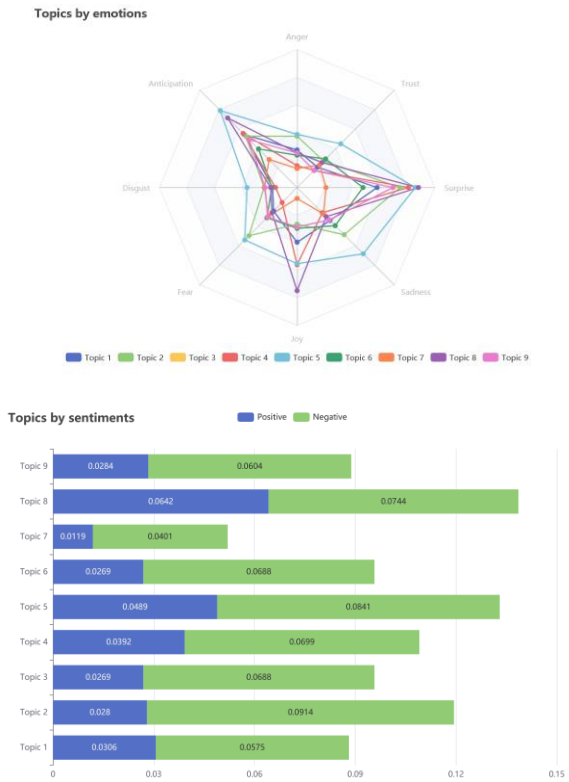

Figure 2: Association of topics to sentiments and emotions

4 CONCLUSIONS AND FURTHER WORK

The main goal of this paper was to analyse sentiments and emotions in crises communication in the news related to the COVID-19 pandemic. For that purpose, we have created our collection of documents from articles on the Internet news portal connected to pandemic crises and analysed it utilising the LDA method for extraction of prevalent topics in the collection and NRC word-emotion lexicon for detection of sentiments and emotions associated with extracted topics.

Application of LDA resulted in relatively intuitive topics. Some of them can be associated with the main categories of the observed portal, and the other are related to the actual situation in a pandemic world in Croatia: *vaccination*, *earthquake* (there were two great earthquakes in Croatia in 2020), *stories*, *daily reports*. It is shown that all extracted topics are associated dominantly with *negative* sentiment, while prevalent emotions are *anticipation*, *surprise*, *sadness* and *fear*.

By this research, we have gained insight into how COVID-19 pandemic crises was communicated to the public. To gain insight into how the public experienced the crises, we could use the same methodology applied to comments of articles or on social networks. This could be a direction for a further work. Also, it would be interesting to investigate how topics and sentiments/emotions are changing and evaluating over time.

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Tackling Class Imbalance in Radiomics: the COVID-19 Use Case

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ABSTRACT

Since the start of the COVID-19 pandemic, much research has been published highlighting how artificial intelligence models can be used to diagnose a COVID-19 infection based on medical images. Given the scarcity of published images, heterogeneous sources, formats, and labels, generative models can be a promising solution for data augmentation. We propose performing data augmentation on the embeddings space, saving computation power and storage. Moreover, we compare different class imbalance mitigation strategies and machine learning models. We find CTGAN data augmentation shows promising results. The best overall performance was obtained with a GBM model trained with focal loss.

CCS CONCEPTS

• Information systems → Data mining; **• Computing methodologies → Computer vision problems**; **• Applied computing**;

KEYWORDS

COVID-19, CT Scans, Imbalanced Dataset, Data Augmentation, Computer-Aided Diagnosis, Radiomics, Artificial Intelligence, Machine Learning

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1 INTRODUCTION

In December 2019, an outbreak of the coronavirus SARS-CoV-2 infection (a.k.a COVID-19) began in Wuhan, China. The disease rapidly spread across the world, and on January 30th 2020, the World Health Organization (WHO) declared a global health emergency. The most common COVID-19 symptoms are dry cough, sore throat, fever, loss of taste or smell, diarrhea, myalgia, and dyspnea[5]. In addition, older people, or people with previous medical problems (e.g., diabetes, obesity, or hypertension), are more likely to develop a severe form of the disease[12, 42], which can derive into multiple organ failure, acute respiratory distress syndrome, fulminant pneumonia, heart failure, arrhythmias, or renal failure, among others[37, 40].

Expert radiologists have observed that the impact of the COVID-19 infection on the respiratory system can be discriminated from other viral pneumonia in computed tomography (CT) scans[7, 39]. Most frequent radiological signs include irregular ground-glass opacities and consolidations, observed mostly in the peripheral and basal sites[31]. While such opacities were observed up to a maximum of seven days before the symptoms onset[25], they progress rapidly and remain a long time after the symptoms onset[35, 38]. While such opacities can be observed on chest radiography, they have low sensitivity, which can lead to misleading diagnoses in early COVID-19 stages, and thus a CT scan is preferred[38].

Scientific studies have shown Artificial Intelligence (AI) is a promising technology transforming healthcare and medical practice helping on some clinicians' tasks (e.g., decision support, or providing disease diagnosis)[45]. In particular, the field of radiomics studies how to mine medical imaging data to create models that support or execute such tasks. Given that distinct patterns can be observed on chest radiographies and CT scans, clinicians and researchers sought to use AI for COVID-19 diagnostics[31].

There are multiple challenges associated with radiomics, and in particular, with the COVID-19 diagnosis use case. Despite the limitations that can exist regarding privacy concerns[26, 44], many datasets have been made publicly available. From those datasets, many are limited to a few cases[35]; were collected from different sources and image protocols, and thus cannot be merged (e.g., the gray-levels across images can have different meanings[7]); or were labeled at different granularity levels (e.g., patient-level, or slice-level)[2]. Therefore, models developed from these datasets cannot always be ported to a specific environment. Finally, limitations can exist regarding data collection, further limiting available data to develop working models to diagnose the disease.

The main contributions of this research are (i) a comparative study between four data-augmentation strategies used to deal with class imbalance, (ii) across eight frequently cited machine learning algorithms, based on a real-world dataset of chest CT scans annotated with their COVID-19 diagnosis. We developed the machine learning models with images provided by the Medical Physics

*Both authors contributed equally to this research.

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Research Group at the University of Ljubljana and made them available as part of the RIS competition[1].

We report the models' discrimination power in terms of the area under the receiver operating characteristic curve (AUC ROC). The AUC ROC is a widely adopted classification metric that quantifies the sensitivity and specificity of the model while is invariant to *a priori* class probabilities.

This paper is organized as follows. Section 2 outlines related scientific works, Section 3 provides an overview of the use case, and Section 4 details the methodology. Finally, section 5 presents and discusses the results obtained, while Section 6 concludes and describes future work.

2 RELATED WORK

The field of radiomics is concerned with extracting high-dimensional data from medical images, which can be mined to provide diagnoses and prognoses, assuming the image features reflect an underlying pathophysiology[16, 27, 28]. While the research on the field is experiencing exponential growth, multiple authors have warned about common issues affecting the quality and reproducibility of radiomics research and proposed several criteria that should be met to mitigate them (e.g., RQS, CLAIM, or TRIPOD)[10, 27, 32]. It has also been observed that the translation into clinical use has been slow[13].

Since the start of the COVID-19 pandemic, much research has been published highlighting how AI models could be used to issue COVID-19 diagnoses based on medical images. While much research was invested into transfer learning leveraging pre-trained deep learning models, or the use of deep learning models as feature extractors[24], some authors also experimented with handcrafted features[7]. Most common machine learning approaches involved the use of deep learning (end-to-end models, or pre-trained models for feature extraction)[14, 23, 34, 36, 43], Support Vector Machine (SVM)[4, 7, 14, 22, 23, 34, 36, 38, 43], k-Nearest Neighbors (kNN)[14, 22, 23, 38, 43], Random Forest (RF)[22, 23, 36], CART[22, 23, 36], Näive Bayes[22, 23], and Gradient Boosted Machines (GBM)[6, 22].

Two commonly faced challenges regarding COVID-19 diagnoses based on medical images are images scarcity and class imbalance. Given the heterogeneity of the datasets, it is not always possible to merge them[2, 7, 35]. Thus, some researchers successfully experimented using generative adversarial networks (GANs) to generate new images that comply with the existing patterns in the dataset[1, 34]. GANs provide means to learn deep representations from labeled data and generate new data samples based on a competition involving two models: a *generator*, learns to generate new images only from its interaction with the *discriminator*; and the *discriminator*, who has access to the real and synthetic data instances, and tries to tell the difference between them[3, 11]. While this method was first applied on images[17], new approaches were developed to adapt it for tabular data[41].

The fact that the classification categories are not approximately equally represented in a dataset can affect how the machine learning algorithms learn and their performance on unseen data, where the distribution can be different from the one observed in training data[8]. Due to these reasons, care must be taken to select metrics not sensitive to such imbalance. Among common strategies to deal with class imbalance, we find oversampling data methods, which aim to increase the number of data instances of the minority class to balance the dataset. Oversampling methods can add data instances from existing ones by replicating them (e.g., using a näive random sampler that draws new samples by randomly sampling with replacement from the available train samples), or by creating synthetic data instances (e.g., through SMOTE[9], ADASYN[19], or GANs). In addition to data oversampling, the *Focal Loss*[29] can be used on specific algorithms. The *Focal Loss* reshapes the cross-entropy loss to down-weight well-classified examples while focusing on the misclassified ones, achieving better discrimination. Finally, while the techniques mentioned above are useful for classification, we can reframe the problem as an anomaly detection problem, attempting to detect which data instances correspond to the minority class (anomaly).

Through the research we reviewed, we found a paper describing the use of SMOTE[14], and two papers using GANs[1, 34] for data augmentation at the image level. We found no paper performing a more extensive assessment of the class imbalance influence nor compared class imbalance strategies towards the COVID-19 detection models' outcomes. We propose utilizing data augmentation techniques, generating new embeddings instead of full images. Such an approach provides similar information in the embedding space as would be obtained from synthetic images while enabling widely used techniques for tabular data oversampling. Furthermore, in GANs, new data instances are cheaper to compute and store than would be if creating new images.

3 USE CASE

The research reported in this paper is done with images provided by the Medical Physics Research Group at the University of Ljubljana and made available as part of the RIS competition. The dataset was built from computed tomography (CT) scans obtained from three datasets reported in[18, 25, 33], that correspond to 289 healthy persons and 66 COVID-19 patients. Healthy persons are determined with a CT score between zero and five, while COVID-19 patients are considered those with a CT score equal to or higher than ten[15]. Each CT scan was segmented into twenty slices, resulting in 7.100 images with an axial view of the lungs, and annotated into two classes: COVID-19 and non-COVID-19. The visual inspection of CT scans aims to determine if the person was infected with the COVID-19 disease. Automating this task reduces manual work and speeds up the diagnosis.

4 METHODOLOGY

We propose using artificial intelligence for an automated COVID-19 diagnosis based on images obtained from CT scan segmentation, posing it as a binary classification problem. The discrimination capability of the models is measured with the AUC ROC metric with a cut threshold of 0.5.

We use the ResNet-18 model[20] for feature extraction, retrieving the vector produced by the Average Pooling layer. Since the vector consists of 512 features, we perform feature selection computing the features' mutual information and selecting the *top K* to avoid

[1]http://tiziano.fmf.uni-lj.si/

overfitting. To obtain K, we follow the equation $K = \sqrt{N}$ suggested by[21], where N is the number of data instances in the train set.

To evaluate the models' performance across different data augmentation strategies, we apply a stratified ten-fold cross-validation. Data augmentation is performed by introducing additional minority class data samples on the train folds. We consider five imbalance mitigation strategies: NONE (without data augmentation), RANDOM (näive random sampler), SMOTE, ADASYN, and CTGAN (GAN that enables the conditional generation of data instances based on a class label)[41]. No augmentation is performed on the test fold to ensure measurements are comparable. The performance of the data augmentation strategies is measured across eight machine learning algorithms: SVM, kNN, RF, CART, Gaussian Näive Bayes, Multilayer Perceptron (MLP), GBM, and Isolation Forest (IF)[30]. Finally, we compare the performance of the data augmentation scenarios computing the average AUC ROC across the test folds and assess if the difference is statistically significant by using the Wilcoxon signed-rank test, using a p-value of 0.05.

5 RESULTS AND ANALYSIS

When comparing the results across different imbalance mitigation strategies (see Table 1), we observed that data augmentation leads to inferior results in most cases. While this outcome was expected for IF (the minority class is no longer an outlier after data augmentation), we found that only the CART, MLP, and GBM algorithms achieved better performance with CTGAN data augmentation compared to the original dataset. Moreover, six algorithms achieved the best results when augmented with CTGAN compared to other data imbalance strategies (except NONE). We confirmed the AUC ROC differences between imbalanced datasets strategies were statistically significant, with a few exceptions: *SMOTE vs. ADASYN* for CART, MLP, and GBM; *NONE vs. RANDOM* for CART; *NONE vs. SMOTE* for Näive Bayes; *RANDOM vs. SMOTE* for SVM and RF; and *RANDOM and SMOTE vs. CTGAN* for SVM and IF. From the results obtained, we consider the CTGAN success can be attributed to the fact the generative model can learn over time to generate high-quality data instances based on the discriminator's feedback loop, while Näive random sampling reuses existing instances (providing little new information to the dataset), and the SMOTE and ADASYN algorithms generate new samples based on heuristics without learning capabilities.

We observed that GBM models trained with a Focal Loss achieved the best results in all datasets. Even when no data augmentation is performed and the RF achieves the best result, the difference is not statistically significant compared to the GBM model. The overall best performance was obtained with a GBM model trained over a dataset with CTGAN data augmentation. While the reasons behind the performance drop for the kNN, Näive Bayes, RF, and SVM models remain unclear, further investigation is required to clarify them. Nevertheless, we consider the CTGAN data augmentation on the embeddings space approach is promising.

6 CONCLUSION

This research presents a novel approach towards data augmentation in radiomics by generating new data instances in the embedding space rather than generating new images. We demonstrate that this approach leads to the best forecast outcomes with a GBM model trained with a Focal Loss on a dataset enriched with new CTGAN generated instances. Moreover, we compare this approach to other imbalanced data strategies, finding that Näive random oversampling, SMOTE, and ADASYN degrade the resulting models' performance compared to the original dataset. Future work will focus on further understanding the cases where the CTGAN data augmentation leads to poor results and provide an integral explainability model for machine learning classifiers that consume image embeddings.

ACKNOWLEDGMENTS

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Class Imbalance Mitigation Strategies	CART	IF	kNN	MLP	Naive Bayes	RF	SVM	GBM
NONE	0,6429	0,6802	0,8504	0,7879	0,6653	**0,8601**	0,8066	*0,8555*
RANDOM	0,6402	0,5215	0,7846	*0,7993*	0,6464	0,6691	0,6888	**0,8150**
SMOTE	0,6147	0,5607	0,6813	*0,7663*	0,6590	0,6660	0,6817	**0,7826**
ADASYN	0,6020	0,5863	0,6660	*0,7655*	0,6282	0,6435	0,6652	**0,7787**
CTGAN	0,7401	0,5340	0,8118	*0,8419*	0,6395	0,7090	0,6896	**0,8871**

Table 1: Average AUC ROC values obtained across the ten cross-validation folds. Best results are bolded, second-best results are highlighted in italics.

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Observing Water-Related Events for Evidence-Based Decision-Making

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ABSTRACT

With the awareness of a changing climate impacting our sustainability, and in line with the European Green Deal initiative or the Sustainable Development Goal 6 addressing water, the industry, society and local governments are requiring reliable and comprehensive technology that can provide them an overview to water events to anticipate problems and the tools to analyse best practices appropriate to solve them. This paper presents the NAIADES Water Observatory (NOW), a digital solution offering a series of analysis and visualisations of water-related topics, helping users to extract important insights in relation to the water sector. Taking advantage of heterogeneous data sources, from the media and social media landscape, to published research and global/local indicators. Through collaboration with local water resource management institutions, the NWO was configured to local priorities and ingests local datasets to better fit the needs of decision-makers.

CCS CONCEPTS

• Real-time systems • Data management systems • Life and medical science

KEYWORDS

Water Resource Management, Smart Water, Observatory, Water Digital Twin, Elasticsearch, Streamstory

1 Introduction

The water sector is facing rapid development towards the smart digitalisation of resources, much motivated and supported by the UN's global initiative for the Sustainable Development Goal 6. In that context, the efforts to address the specific challenges related to water management data and priorities multiply globally. There are several "digital twin" systems dedicated to water, each of which focuses on the different aspects of the digitalisation of signals to support water management companies, as well as water "observatories". These are usually meant as Geographical Information Systems that showcase the different aspects of water resources through time.

Within the scope of the European Commission-funded project NAIADES [1] focusing on the automation of the water resource management and environmental monitoring, we propose a slightly different approach that integrates heterogeneous data sources to try and solve common research questions, as well as to support water management companies in their current problems. This solution is named NAIADES Water Observatory (NWO), available at naiades.ijs.si, putting together: (i) real-time information from multilingual world news on water topics; (ii) data visualisation of water-related indicators through time, sourced from the datasets associated with the Sustainable Development Goal 6 (water) and other UN data (see Figure 1); and (iii) scientific knowledge from published biomedical research on water-related topics (e.g., water contamination).

Due to the rapidly growing awareness of the sustainability challenges that we are facing in Europe and worldwide in the context of water resource management, there has been much work done to develop systems that are able to collect information about the available water and even simulate and forecast that in the near future. But these are usually geolocation-based systems ingesting water-related data to enable real-time monitoring of resources and usage [x] [y] [z], and thus much different than the water observatory that we are proposing in this paper. The typical example is GoAigua system [4], a digital twin technology allowing, e.g., the city of Valencia to optimize its water management at the network level, improving efficiency in daily operations, plan real-time scenarios, and make some prediction on its future behaviour [5].

Figure 1: **Visualisation of water-related indicators within Spain to complement the global indicators view ingesting data from, e.g., U.N. and the World Bank.**

2 A data-driven solution for water events

The proposed Water Observatory enables extraction of insightful water-related information, configured to use case priorities and needs from the data integration of

heterogeneous sources. This includes information from social media when the weather is favourable for floods and the historical information from news and published research on these weather-related events and how to make better decisions to solve them.
This is complemented by data ingested from global and local indicators (i.e., datasets at regional level), showcasing the observation of water-related datasets linked to SDG 6 at global and country levels that can help us observe changes and trends. The NAIADES Water Observatory enables the user to explore the information provided by published science and the success stories that can be used in decision-making and water education at the local level (i.e., showcasing the resources and problematics of the region).
In this approach, the water data sensing is done over dynamic open data sources that serve as digital sensors (news, social media, indicators, publications, weather forecasts). This data is then integrated and visualised, each in its tab, addressing specific topics of interest. The observatory is thus composed of all that heterogeneous data coming in at different frequencies. The interactions between those data sources to solve common problems make it a Water Digital Twin. The envisioned examples include the analysis of best practices in water events in, e.g. Braila, identified in the news and explored over the published research, or the alerts triggered by weather conditions and observed over social media on a water event. The questions we are trying to solve with this innovative technology are, e.g., if we can predict water shortages in a certain region given the historical data; or if we can identify early signals of water-related problems from social media (see Figure 2).

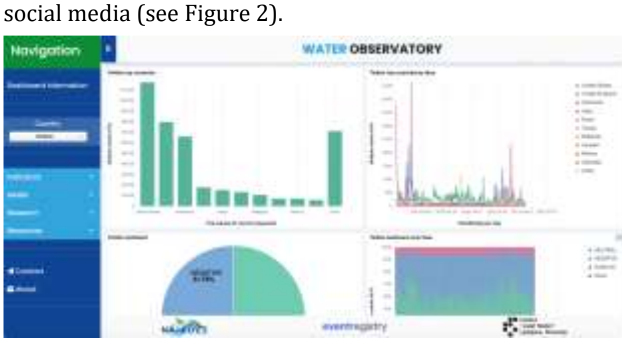

Figure 2: **Analysis of the sentiment in water-related posts in Twitter and the relation to consumer satisfaction and water-related events**

All of the views of this observatory, each of which represents digital solutions on their own, are configured to the local priorities of the NAIADES users as a Proof of Concept, showing that each can address specific conditions.

- Indicators: adding to the global UN indicators, we are ingesting curated open datasets that have regional information about water topics of interest to the stakeholder
- Media: each location has its own news and social media streams configured to priorities and aspects of the news that stakeholders define as topics of interest (e.g. floods)
- Research: similarly to the media sources, the research topics allow for some customisation to fit the needs of the local user better
- Resources: the natural resources information provided for exploration is geolocated to the regions of interest to the user of the platform

It is relatively easy to include new use cases and corresponding workspaces after the discussions on user priorities that will allow us to configure the information presented and making it meaningful.

3 Addressing the challenges of tomorrow

With the range of views provided at the observatory, the problems addressed can be of complex nature and cover a range of concerns and workflows. The different ICT capabilities available across the water sector require intuitive and meaningful technologies to ensure the usefulness of the contribution to the Community. The target users of the NWO seem to belong to three main scenarios with different workflows that can be supported by the developed technology:

1. Water resource management: using the provided information in the resolution of problems related to weather events to understand how their actions are perceived by the consumers and to explore successful scenarios in similar cases
2. Local governments: to help evidence-based decision-making using open data, better synchronise to SDG6 and other guidelines and evaluate commitments in time
3. General public: for water education with a local context, in aspects that matter to the local population, based on parts of the Water Observatory that can be open to public

The priorities in the European Union are rapidly changing towards sustainability and environmental efficiency, transversally to most domains of action. The European Commission's Green Deal [3] aiming for a climate-neutral Europe by 2050 and boosting the economy through green technology provides a new framework to understand and position water resource management in the context of the challenges of tomorrow. The NAIADES Water Observatory will not only contribute to the improvement of European sustainability in water-related matters but will also assign the local actors on the water resource management an active role in that. The NAIADES Water Observatory provides the user of the NAIADES platform, as earlier extensively discussed, with the global and local insight that can be transformed into business intelligence, and help companies to steer their strategies towards customer satisfaction. We will be describing selected views of this observatory through the verticals (or views) News – Indicators – Biomedical, first at the level of the specific dashboards that constitute the tabs in the online instance, and then by the extended exploratory instances, including public instances and APIs, for each of the three verticals.

Figure 3: **The global view of the pilot 1 over usage and data sources.**

These dashboards come together to provide the user with a global perspective in real-time, where five different tiers of usability are made available (see Figure 3). The tiers allow for the extended usability of the Water Observatory, Transversally to the data sources available.

4 System description and architecture

The NWO offers user exploratory dashboards for the further investigation over news, to get deeper into the indicators ingested, and to explore the biomedical research on water contamination in detail. Moreover, each of the three dashboards have versions built to be exposed by, e.g., iframe through a publicly available channel that can be used for integration in high management KPI-monitoring dashboards. Furthermore, we also offer a part of the information in these through APIs easily integrable with our own systems.

The *Indicators* view provides the user with interactive data exploration tools that allow for the KPI-monitoring over several water-related topics that include the SDG 6, the World Bank Open Data, the UN data, etc. In this module we also ingest regional data sources that include local indicators, addressing the user's priorities. Considering their well-established data types, the data integration is possible and, whenever limitations appear due to lack or poor quality of the data, the dataset is pre-processed to allow for data completion (whenever possible), or at least the improvement of data quality.

The *Media* view provides the user with the real-time news monitoring over water-related topics (such as Water Scarcity and Water Contamination), and the analysis of water-related tweets based on data visualisation modules. Based on the news engine *Eventregistry* [7] this view provides the system with a continuous stream of news articles, sourced from RSS-enabled sites across the world. From the data management module the real-time news data is accessed by the news dashboard that can be configured by the NAIADES user to tune the topics of interest in the configuration web app. To further explore a water-related topic, the NWO provides a dashboard for the analysis of social media posts in Twitter (see Figure 2), collected in a real-time frequency, where sentiment is analysed, related concepts are extracted and it is possible to access the raw tweets or apply several filters.

Finally, the biomedical module allows for the exhaustive exploration of water contamination information from scientific research articles published worldwide and available through the MEDLINE biomedical open dataset [9] and the Microsoft Academic Graph [8]. The MEDLINE dataset is collected from the official FTP source made available by the North American National Library of Medicine (NLM) over an XML dump and uploaded to the elasticSearch data management system through a python script, the Microsoft Academic Graph dataset is collected from an Azure container with the data biweekly updated by the Microsoft Research team. The data management is based on the elasticsearch technology [2, useful for both the interactive data visualisations and the Indicators Explorer view. The latter allows the NAIADES user to explore the raw data through template visualisations, use a Lucene-based query that can leverage the loaded metadata, and easily build visualisation modules that can define a new dashboard of data visualisation modules. The dataset is then called over and HTTP API by the SearchPoint technology [6] to load the dataset and respective metadata. thus allowing for powerful Lucene-based queries and further interaction over a movable pointer. This will lead to the refinement of the search of information that can then be extended over the Biomedical Explorer, which feeds over the same dataset through Kibana, but also allows for the analysis of raw data, or the easy construction of data visualisation modules from templates, and for an interactive data visualisation dashboard. All the mentioned dashboards can be made publicly available through, e.g., iframe to be integrated in high-management KPI monitors.

Figure 4: **System architecture of the NAIADES Water Observatory showcasing the relation between used technologies and NOW views**

5. Conclusions and further work

In this paper we discussed the technological development and research opportunities motivated by the emerging need to support decision-makers with evidence from open data that can retract best practices and answer questions from the collected data, bringing the digitalisation of the water sector to a new level.

The potential to ingest complementary local data and configure global sources to parameters addressing local priorities provides a local dimension that is being explored close to the priorities of the NAIADES data providers within water resource management institutions. It will also be exploring the insights driven by the appropriate aspects of chosen datasets, e.g., between news data and focused interactions through Twitter for weather-related events when the weather is likely to be favourable to their cause (see Figure 5). There are many systems that can collect business intelligence data, but we believe that the "digital twin"-type of insight is in the interaction between these data streams.

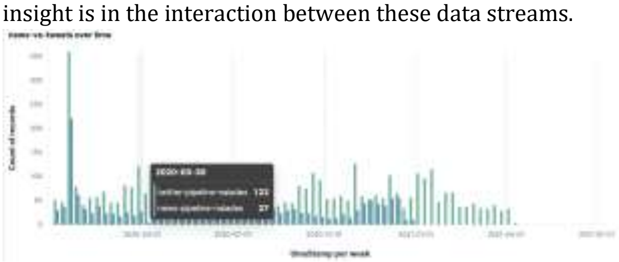

Figure 5: **Preliminary data analysis of the relation between news and tweets on water-related events and their relations with other topics (e.g., weather).**

Further development to the NAIADES Water Observatory, will be providing the users with tools to explore the impact of natural resources as, e.g., the weather, as well as predictions on the levels of the available bodies of water, based on ingested weather data from the ECMWF (on humidity, temperature and rainfall) and other open data sources. This will help the users to have some insight on the impact of the climate crisis in regions that directly relate to their water resources. We will use a sophisticated engine - Streamstory [6][10] - to explore the states of that weather-related data and short/medium term predictions on aspects of that data (see Figure 6).

Figure 6: **The multi time-series analysis of the weather parameters, using Markov chains in complex data visualisation through the Streamstory technology** [9]**.**

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Anomaly Detection on Live Water Pressure Data Stream

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ABSTRACT

We present the application of several anomaly detection algorithms to water pressure data streams. We evaluate their quality on unlabelled data sets using agreement rates. The applied algorithms are the Generative Adversarial Network (GAN), DBSCAN, Welford's algorithm and Facebook Prophet. We found that GAN performed best.

Keywords

water management, machine learning, anomaly detection

1. INTRODUCTION

In last decades, Internet of Things (IoT) has penetrated and shaped several fields such as energy management, traffic, health care and others. The water sector is, however, still implementing IoT solutions that will improve the water management with features such as real-time consumption prediction, leakage detection, water quality estimation and others.

In the presented work, we focus on the anomaly detection on the live water pressure data stream from the town of Braila (Romania). The overall goal of the research is to detect leakage points in the city's water distribution network. To detect the presence of a leakage in the system we apply an anomaly detection algorithm to the water pressure data stream. We considered several such algorithms, which were applied and evaluated on four data streams obtained from four pressure sensors. Our goal was to find the algorithm which returns the best results. Since the data is not labeled (regular or anomalous), the estimation of accuracy was done with a method considering relative agreement among selected algorithms [1]. The anomaly detection algorithms that were tested were GAN (generative adversarial networks) [6], DBSCAN [10], Welford's algorithm [9] and anomaly detection with Facebook Prophet [11]. It is important to note that first three algorithms consider the data stream as an actual live stream. This means that they consume one sample at a time (or a feature vector containing multiple past values, enrichment values and contextual data) and declare it regular or anomalous as the algorithms were intended to do in production. In contrast, the Facebook Prophet consumes the whole data stream as a batch and labels all the samples together. This makes it unusable in production (in this setting), however it is included in the experiment since it can help to estimate the accuracy of other algorithms.

Anomaly detection on time series is a well researched field. The algorithms in this paper were already considered in the related work in different settings and for different time series.

Anomaly detection can be used by estimating the expected regular interval in the upcoming measurement. This can be achieved in an incremental fashion with a simple short-term prediction model, for example with Kalman filter [7], or with a more advanced approach, based on time-series modeling [11]. The latter can be used in several settings, for example in detecting air temperature anomalies in the sewer systems [12].

DBSCAN [10] is a data clustering algorithm that can be applied in frequently changing data sets. Its incremental version [5] can be used in a streaming setting. The potential of the algorithm for anomaly detection has been demonstrated in several use cases, for example in detecting air temperature anomalies [3].

The paper that demonstrated the use of Generative Adversarial Networks for anomaly detection on data stream is fairly recent [6]. The authors have shown that this approach can outperform several other baselines on data sets obtained from NASA, Yahoo, Amazon etc. They introduced different measures of evaluating the reconstruction accuracy, which we tried to improve upon in our paper.

In this work, we use the already established anomaly detection approaches and compare their performance on an unlabeled water pressure data stream from a water distribution network. A more detailed description of the algorithms is given in the Methodology section. We argue that the relative agreement approach [1] improves the anomaly detection performance, which we demonstrate by manual evaluation of the results.

2. DATA AND DATA PREPROCESSING

We demonstrate our anomaly detection methodology on four data sets. Each of the data sets represents the pressure values of one of the sensors, which are located at different points in Braila's water distribution network. The sensors are labeled as '5770', '5771', '5772' and '5773'. The data sets contain between 10 and 11 thousand instances, which are spaced in 15 minute intervals, so about 100 days-worth of data. The data was first pre-processed to remove any duplicated points and 'holes' in the data which were formed as a consequence of sensor down-time. When working with data streams, this process should be done automatically to avoid any incorrect analysis when feeding the data into the anomaly detection algorithms. Each of the four data sets was split into a training and evaluation part. The training sets consisted of the first 2000 data points and the evaluation sets contained all the rest. This is done so that the algorithms which require training can be trained on one part of the data and evaluated on the other (GAN, DBSCAN).

3. METHODOLOGY

3.1 Evaluation of algorithms

Evaluation of the performance of algorithms on unlabelled data always represents a challenge. Since we are working with such data an actual calculation of accuracy scores would require manual labelling of the data instances. To avoid this time-consuming process, we use a method for estimating error rates (ratio of wrong classifications to the total number of instances) from the agreement rates of multiple algorithms. Agreement rate of two classifiers f_i and f_j is defined in the following way:

$$a_{\{i,j\}} = \frac{1}{S} \sum_{s=1}^{S} \mathbb{I}\{f_i(X_s) = f_j(X_s)\}$$

where $X_1, ..., X_S$ are unlabeled samples. The calculated agreement rates are then inserted into the following equations:

$$a\{i,j\} = 1 - e_{\{i\}} - e_{\{j\}} + 2e_{\{i,j\}}$$

Here we assume that the functions make independent errors we can substitute $e\{i,j\}$ with $e_{\{i\}}e_{\{j\}}$. With such a system of equations we can then calculate error rates using some root-finding algorithm. Such an approach has been previously used for the evaluation of classifiers on an unlabelled dataset [1]. Therefore we consider the anomaly detection algorithm as a binary classifier and use the aforementioned method for the comparison of different algorithms. Additionally, two important assumptions were made. Firstly, we assumed that the anomaly detection algorithms were independent and secondly, that each of those algorithms performs better than a random classifier.

Since the estimated performance of one algorithm depends on the output of the others it was important that the algorithms yield a similar percentage of anomalies. In other words, the algorithms are tuned to have similar predicted positive condition rate ($PPCR = \frac{FP+TP}{FP+TP+FN+TN}$). For most data streams this means that 1%-3% of the samples are labelled as anomalous.

3.2 GAN

The Generative Adversarial Network (GAN)[6] is an unsupervised machine learning approach to anomaly detection. An encoder-decoder structure of the neural network is used to first encode the input data point and then decode the encoded one. The model learns to reconstruct the input data point as closely as possible. The idea is that the reconstruction should be better if the input data is 'normal' and worse if it is abnormal/anomalous. We use an input vector, which is composed of 10 consecutive values of the uni-variate data stream. We then compare the input vector to the reconstructed one using the mean squared error (MSE) metric. We classify the data point as 'normal' if the value of the MSE is below the defined threshold. [6] calculated the thresholds using sliding windows on reconstruction errors (4 standard deviations from the mean of the window). We used a slightly different approach using the moving average multiplied by a constant as the threshold. This proved to be easier to implement on our live data stream use-case.

3.3 DBSCAN

DBSCAN [4] is a well-known data clustering algorithm. It groups together points, which are close together based on Euclidean distance. The group with the largest number of points in our case are considered 'normal', and the lower-density groups are outliers which are then labeled as an anomaly. The ϵ parameter which measures how close the points should be for them to still be considered of the same group, can be adjusted based on the data set, and the desired sensitivity of the algorithm. For DBSCAN we also use an input vector composed of consecutive pressure values. In this case, we discovered that a vector of 5-6 values works best.

3.4 Welford's algorithm

Welford's algorithm gets its name from the Welford's method for online estimation of mean and variance. A very simple anomaly detection approach [9] can then be constructed by defining the upper and lower limits (UL and LL) of "normal" data as a function of mean and variance:

$$UL = mean + X * variance$$

$$LL = mean - X * variance$$

X is fixed and determines the threshold band. Any instance which falls out of that band is labeled as an anomaly. Instances can then be input into the algorithm one by one to be labeled and after each the mean and the variance (consequently UL and LL also) are updated.

For this experiment the actual Welford's method was not used since the mean and variance were computed from the last 1500 samples so that they would better adapt to the new samples. Note that the first 1500 samples therefore could not be labeled; however, this was not a problem since most of the other approaches required 2000 samples for fitting the models and the evaluation was therefore done on the remaining stream. However, the upper and lower limits of the interval were still computed as shown above with the value of $X = 2.2$.

3.5 Facebook Prophet

Facebook Prophet is an algorithm for time series forecasting that works especially well on data streams with multiple seasonalities [8]. Prophet also works well with missing data which makes it a good candidate for the problem at hand. After fitting the model it can make predictions for a chosen set of timestamps presented to it. Furthermore besides the prediction it also outputs upper and lower limits of the confidence interval for every sample. Ashrapov [2] demonstrates the implementation of an anomaly detection algorithm which uses this property to classify the samples inside the confidence interval as regular and the rest as anomalies. The model is fitted on the entire data set and then makes predictions on the same data set, providing both the anomaly detection and the confidence interval.

4. RESULTS

The results of the algorithms for data stream from sensor 5770 are presented in Figures 1, 2, 3 and 4. The charts show the raw values obtained from the pressure sensors, indicating the points which are labeled as anomalies with red points. Since the data sets are unlabelled it is hard to assess the accuracy of each algorithm based on anomaly visualizations alone, but we do notice some similarities and some differences. All of the algorithms are good at identifying obvious outliers (points which fall far out of the 'normal' range). The difference between the algorithms can be noticed when classifying points closer to the normal range. For example Welford's algorithm tends to label points as anomalies at the peaks of daily pressure fluctuation, which might not be ideal since we know that this behaviour can be considered normal. More sophisticated algorithms such as GAN and Prophet were also able to identify more "subtle" anomalies.

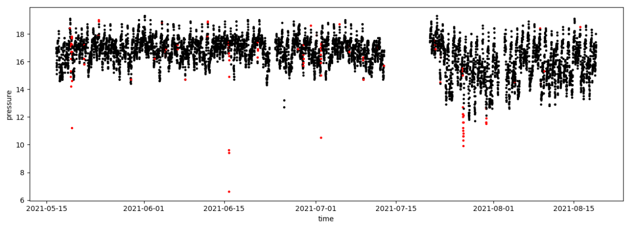

Figure 1: Anomalies found using GAN on data stream from sensor 5770.

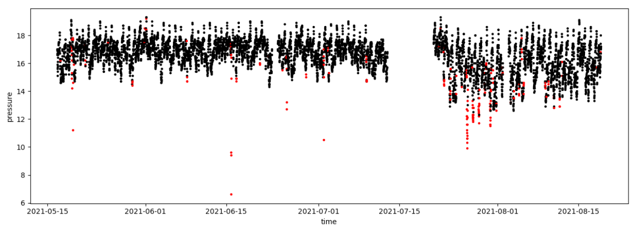

Figure 2: Anomalies found using DBSCAN on datastream from sensor 5770

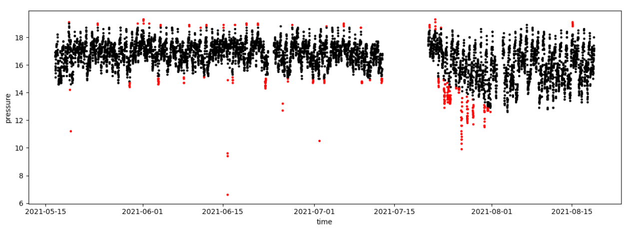

Figure 3: Anomalies found using Welford's algorithm on datastream from sensor 5770.

The recall of each algorithm can be increased or decreased by modifying parameters and thresholds. Since the data

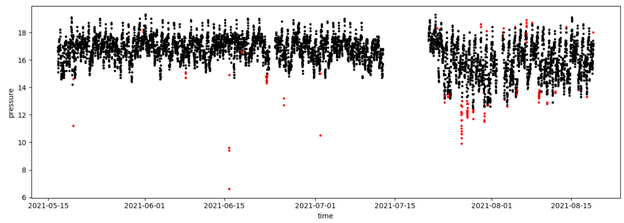

Figure 4: Anomalies found using Facebook Prophet on datastream from sensor 5770.

sets are unlabeled, it is hard to determine the optimal parameters. We decided to tune the algorithms to have similar recall of 1 - 3%, as we deemed that this would make the comparison of the algorithms the most fair. In Table 1 the shares of anomalies are presented for each separate data stream.

Algorithm	5770 anomaly share	5771 anomaly share	5772 anomaly share	5773 anomaly share
GAN	1.42%	0.99%	0.77%	1.13%
DBSCAN	2.63%	2.82%	2.73%	2.85%
Welford's algorithm	3.39%	3.41%	1.66%	3.16%
Facebook Prophet	1.66%	1.13%	0.46%	1.40%

Table 1: Shares of anomalies for all four data streams.

The error rates calculated from agreement rates are shown in Table 1 for each of the data streams. Since we assumed most of the samples in the data stream were normal these error rates are not very informative out of context. We can however, observe that Prophet performed best followed by GAN, DBSCAN and Welford, respectively. The results are consistent in all four scenarios. If we take into consideration that Prophet worked on the whole data set at once when the other three were limited to one sample at a time (as it is in production) we can declare that GAN performed best out of the algorithms that can detect anomalies on a live stream.

Algorithm	5770 Error rate	5771 Error rate	5772 Error rate	5773 Error rate
GAN	1.34%	1.38%	0.66%	1.09%
DBSCAN	1.59%	1.70%	1.78%	1.81%
Welford's algorithm	2.44%	2.41%	1.10%	2.31%
Facebook Prophet	1.14%	0.62%	0.39%	0.81%

Table 2: Error rates estimated from agreement rates for all four data streams.

We also considered a state-of-the-art method Isolation Forest, however it was too sensitive and therefore not usable in the error rate calculation.

5. CONCLUSIONS

We have tested five anomaly detection algorithms (Generative Adversarial Network, DBSCAN, Facebook Prophet, Welford's algorithm and Isolation Forest) on four separate data streams of water pressure data. Out of those five the Isolation Forest performed poorly since the share of anomalies found with this method was unreasonably high and was therefore not included in the final error estimates calculation.

Other approaches had similar shares of anomalies and were therefore used to calculate agreement rates and finally the estimated error rates of each anomaly detection algorithm. The results were consistent for all four data streams. Prophet performed best in every setting, however it looked at a data stream as a batch and it therefore could not be used for online anomaly detection. GAN performed second best followed by DBSCAN and Welford's algorithm which all work on a live data stream. Therefore we can conclude that the most fitting algorithm to be used for anomaly detection on the live water pressure data from water distribution network is GAN.

In future work, Facebook prophet could be adopted in such a way that it would also work on a live data stream since it has shown promising results in this experiment.

6. ACKNOWLEDGMENTS

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Entropy for Time Series Forecasting

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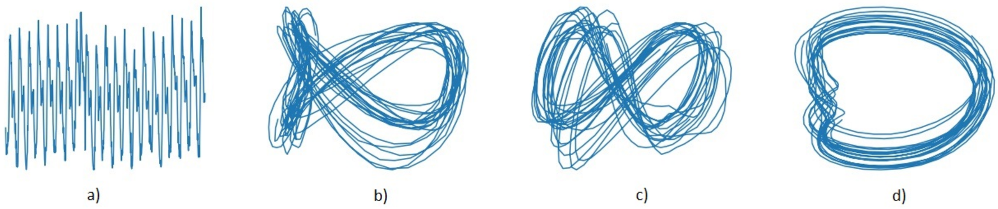

Figure 1: Sample of the time series and projections of the embedding - This plot gives us a geometrical representation of the theory involved in section 3 and shows the reconstructed state space of the given time series. This can be obtained by using Takens' embedding to reconstruct the time series y, given in figure a), as the markovian system Y_K with K time delays and then use Principal Component Analysis in order to perform the change of basis of the data. The obtained projections b), c) and d) attain the dynamics of the system, which gives us the possibility to predict the time series with higher efficiency.

ABSTRACT

In this paper, we present the exploitation of a method to extract information from microscopic samples of time series data in order to provide a representation of optimized stability to a chaotic system [1]. The main goal of this approach is to predict the dynamics of a time series and therefore develop optimized forecasting algorithms. First, we study how to increase the predictability of a system and second, we develop a Deep Learning Algorithm, namely an LSTM, that can recognize patterns in sequential data and accurately predict the future behaviour of a time series.

KEYWORDS

Recurrent Neural Networks, LSTM, Entropy, Markov Chain, Clustering, Time Series

1 INTRODUCTION

Given its intrinsic nature, mathematics concerns with the construction of formal statements and proofs relating the different concepts within it. Its methods are used in countless ways and effectively model the shape of our world. But how is it possible to shape the unknown? Motivated by this question and the upmost need for finding ways of optimizing water resources for future generations, there has been a great development on the study of dynamical systems based on, for example, (Shannon) entropy [9] and phase space reconstruction [4]. In this paper, we provide an approach to water resource management using Deep Learning and Chaos Theory, by studying the dynamics of a time series using the 2 main ideas cited before. This study was developed for the H2020 NAIADES Project [2] with data collected from the Municipality of Alicante (Spain). We will present this study for the Autobus Dataset, related to the Bus Station Areas in Alicante.

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2 STATIONARY AND CHAOTIC NATURE

2.1 Dickey-Fuller Test for Stationarity

In order to proceed with the theory involved in the method, it is necessary to understand the behaviour of the time series and its sensitivity to initial conditions. For studying time series' stationarity, one can use the Augmented Dickey-Fuller test, which is a type of statistical test called a unit root test, where generally the null hypothesis is that the time series can be represented by a unit root, which means that for $y = \{y_t\}_{t=1}^{T}$, the information at point y_{t-1} does not provide us the ability to predict y_t. In our case, we obtained that the p-value of the test was 0, so the null hypothesis was rejected and the time series has no unit root. Therefore, it is stationary and the time delays will provide important information for predicting the dynamics of the time series.

2.2 Lyapunov exponents for understanding chaotic nature

The Lyapunov Exponent is a quantifier for the sensitivity of the time series on initial conditions and therefore for its chaotic nature. The main idea is to select an array of nearest neighbors, i.e, points at minimum distance, and calculate its trajectories in time. By doing so, we can then obtain an average of this divergence exponent which gives us the Lyapunov Exponent. Since the system is bounded, the divergence is also bounded and will reach a plateau after a certain number of timesteps. In our case, the Lyapunov Exponent, given as the initial slope, is ≈ 518 and the initial growth is exponential, as can be seen in figure 5. Therefore, the time series is of a chaotic nature.

3 MAXIMUM PREDICTABILITY

Given the high variability of any chaotic system, it is hard to capture the whole set of variables that model the state space. This is characteristic of a non-Markovian system which is highly unpredictable. How do we surpass this issue?

Takens' Embedding Theorem [8] tells us that, under certain conditions, it is possible to use past data to reconstruct a Markovian system, thus giving us the possibility to model the initial time series with higher efficiency. We start by considering a set of ODEs $x = (\dot{x}_1, \dot{x}_2, \ldots, \dot{x}_D)$ and the d-dimensional time series $y(t)$ of duration T which is a set of incomplete measurements of x given by a measure M, i.e., $y = M(x)$. Then, in order to calculate the number of K time delays to feed the LSTM with, the d-dimensional measurements are lifted into the state space $Y_K \in \mathbb{R}^{d \times K}$ consisting of the previously referred K time delays [3]. It is possible to quantify the chaotic measure of the system Y_K by calculating the entropy resulting from clustering. This can be done by partitioning the $d \times K$-dimensional space into N Voronoi cells using K-Means clustering. Having partitioned the state space Y_K, the reconstructed dynamics are encoded as a row-stochastic transition probability matrix $P = [P_{ij}]_{i,j}$ which relates increments on the state-space density p in the following way

$$p_i(t + \delta t) = \sum_j P_{ji} p_j(t). \tag{1}$$

The entropy rate of the initial time series $y(t)$ is then approximated by estimating the entropy rate (Figure 3) of the associated Markov chain on the different time delays K using Kolmogorov's definition

$$h_{p_N}(K) = -\sum_{i,j} \pi_i P_{ij} \log P_{ij}, \tag{2}$$

where π is the estimated stationary distribution of the Markov chain P. This approximation gives an estimate for the conditional entropies (Figure 6), i.e., for a discrete state with delay vectors $\vec{y}^K = \{\vec{y}_i, \ldots, \vec{y}_{i+K-1}\}$, the entropy of the Markov chain provides an estimate for the conditional entropy,

$$\begin{aligned} h_{p_N}(K) &\approx \langle -\log[p_N(y_{i+K}|y_i, \ldots, y_{i+K-1})] \rangle \\ &= H_{K+1}(N) - H_K(N) \\ &= h_K(N), \end{aligned} \tag{3}$$

where H_K is the Shannon Entropy of the sequence obtained by partitioning the $\vec{y}$ space into N partitions.

4 MODEL ARCHITECTURE

4.1 LSTM

Long Short Term Memory (LSTM) Networks are a special type of Recurrent Neural Networks (RNN) which rely on gated cells that control the flow of information by choosing what elements of the sequence are passed on to the next module. This idea was introduced in order to surpass the vanishing gradient problem in conventional RNNs [7]. At each time t, consider f_t as the forget gate, i_t as the input gate and o_t as the output gate, which are functions that depend on the output of the previous LSTM module, given by h_{t-1} and on the input of the current timestep, given by x_t. Then, the next figure shows a representation of how a single LSTM cell performs its computations. The computations

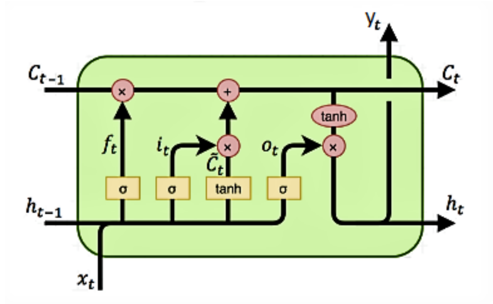

Figure 2: An LSTM performs the following ordered computations: The first step is to forget their irrelevant history. Then, LSTMs perform computation to decide on relevant parts of new information and based on the previous two steps, they selectively update the internal state. Finally, an output is generated.

shown in this figure can be mathematically represented as

$$\begin{aligned} f_t(x_t, h_{t-1}) &= \sigma(w_{f,x}^T x_t + w_{f,h} h_{t-1} + b_f) \\ i_t(x_t, h_{t-1}) &= \sigma(w_{i,x}^T x_t + w_{i,h} h_{t-1} + b_i) \\ o_t(x_t, h_{t-1}) &= \sigma(w_{o,x}^T x_t + w_{o,h} h_{t-1} + b_o), \end{aligned} \tag{4}$$

where $w_{f,x}, w_{i,x}, w_{o,x} \in \mathbb{R}^d$ are weight parameters and σ is an activation function.

4.2 Our approach

The core idea is to take a list of k training sets $Q_0, Q_1, \ldots, Q_{k-1}$ and testing sets $P_0, P_1, \ldots, P_{k-1}$ in order to generalize the model and do the best estimation for the time series. This is based on translating the testing sets' partitions along the time series, where the first partition $P_0 = \{p_0^0, \ldots, p_0^n\}$ is taken from the zeroth point of the time series data and the last partition $P_{k-1} = \{p_{k-1}^0, \ldots, p_{k-1}^n\}$ until the last point of the time series data and

$$|P_i| = \frac{|y|}{k}, \forall i \in \{0, \ldots, k-1\} \tag{5}$$

where $|y|$ stands for the cardinality of the time series y. This procedure yields k models which will use each of the training sets to make predictions on the respective test sets. Given the erratic nature of the data, which was taken in 15 and 30 minutes samples, a resampling to 30 minute delays had to be done on the 15 minutes delay data points and a masking was added to the time series in order to neglect NaN values that could be created from resampling. Therefore, a masking layer was added and the model is composed by 3 other layers $\mathcal{L}_{n_1}$, $\mathcal{L}_{n_2}$ and $\mathcal{L}_{n_3}$, where $n_1 = n_3 = 1$ (we have a univariate timeseries) and $n_2 = 64$, since it gave the best results in cross validation. A dropout regularization of 0.1 was added for better approximation of training and validation errors and the batch size was set to 128. The mean squared error for the predictions on the training set is ≈ 0.00115 and for the testing set is ≈ 0.00236. One can address the capacity of the model whose predictive results are shown in figure 4.

5 FORECASTING

5.1 Forecasting Methods

Consider a time series $T = \{t_1, \ldots, t_N\}$. The forecasting process can be done in 3 ways:

(1) iterated forecasting

(2) direct forecasting
(3) multi-neural network forecasting

Process number (1) is based on "many-to-one" forecast for which

$$t_{n+1} \approx \mathcal{F}(t_i, \ldots, t_{i+n-1}), i \in \{1, \ldots, N-n\}. \tag{6}$$

Then, a K-step forecast can be iteratively obtained by

$$\hat{t}_{N+j} := \mathcal{F}(\hat{t}_{N+j-n+1}, \ldots, \hat{t}_{N+j-2}, \hat{t}_{N+j-1}), j \in 1, \ldots, K. \tag{7}$$

Process number (2) can be characterized by training a "many-to-many" function $\mathcal{F}$ for which

$$(t_{i+n}, \ldots, t_{i+n+K-1}) \approx \mathcal{F}(t_i, \ldots, t_{i+n-1}), \tag{8}$$

where $i \in \{1, \ldots, N-n-K+1\}$. We can obtain a K-step forecast by

$$(\hat{t}_{N+1}, \ldots, \hat{t}_{N+K}) := \mathcal{F}(t_{N-n+1}, \ldots, t_N). \tag{9}$$

Finally, process (3) is defined by k "many-to-one" functions $\mathcal{F}_1, \ldots, \mathcal{F}_k$ which hold the following relationship

$$\begin{aligned} t_{i+n} &\approx \mathcal{F}_1(t_i, \ldots, t_{i+n-1}) \\ &\vdots \\ t_{i+n+K-1} &\approx \mathcal{F}_k(t_i, \ldots, t_{i+n-1}), \end{aligned} \tag{10}$$

where i ranges from 1 to $N-n-K+1$. Process (1) does not require k a propri while both process (2) and (3) are dependent on the choice of k.

5.2 Our Approach

We chose to do a Direct Forecasting for the next 7 days by taking the last test set partition P_{k-1} and did a prediction on this test set. Although forecasting seems pretty motivating, by choosing a partition that attains more characteristics of the time series, one can achieve even better results. The achieved forecast can be seen on Figure 8 and compared with a 7 days sample on Figure 7.

6 RESEARCH METHODS

6.1 Time Series Reconstruction

Consider the time series y with duration T as given in section 2. The idea is to add K time delays to y in order to obtain a $(t-K) \times Kd$ space $Y_K \in \mathbb{R}^{d \times K}$ and further partition Y_K using k-means Clustering into N Voronoi Cells.

6.2 Entropy Calculation

Consider the N Voronoi Cells given as the number of partitions of Y_K and consider the joint probability $p(c_{i_1}, \ldots, c_{i_l}), \{i_1, \ldots, i_l\} \in \{0, \ldots, N-1\}$. Then, the Shannon Entropy [6] is given by

$$H_l = -\sum p(c_{i_1}, \ldots, c_{i_l}) \log p(c_{i_1}, \ldots, c_{i_l}) \tag{11}$$

and the conditional probabilites are given by

$$p(c_{i_{l+1}} | c_{i_1}, \ldots, c_{i_l}), \tag{12}$$

where ci_{l+1} is the next Voronoi Cell after c_{i_l}. We can calculate the entropy rate growth by considering the conditional probabilities of the system given the previous l cells, when visiting the $(l+1)$-th cell, via

$$h_l = \langle -\log[p(c_{i_{l+1}} | c_{i_1}, \ldots, c_{i_l})] \rangle = H_{l+1} - H_l \tag{13}$$

Taking the supremum limit over all possible partitions P of Y_K, we obtain the Kolmogorov-Sinai invariant of the system,

$$h_{KS} = \sup_P \lim_{l \to \infty} h_l(P). \tag{14}$$

6.3 Data and Code Git Repository

The complete work can be found in:
https://github.com/johncoost/JoaoModelsForAlicante.

7 PLOT OF RESULTS

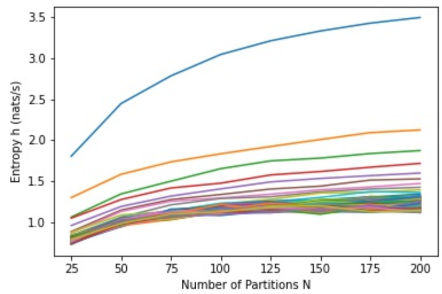

Figure 3: Entropy Rate h - The entropy rate h is given as the function of the number of partitions N for increasing number of delays K (given by the different colors in a descendent mode). It is possible to observe that the entropy rate is a non-decreasing function on the number of partitions N. The idea is to choose the value of N for which the entropy is maximum so that we have the maximum possible information about the system's dynamics.

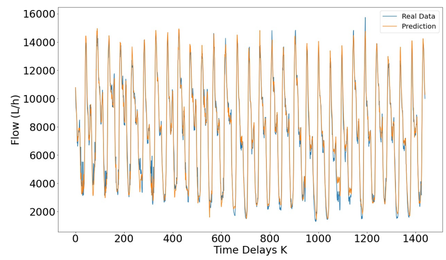

Figure 4: Prediction on the last test set - This shows a sample of the last test set and its prediction. We can observe the effectiveness of the LSTM in modelling the given time series by having a deep understanding of its inherent dynamics.

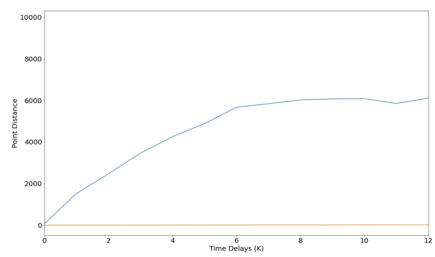

Figure 5: In this figure, we can understand the initial exponential growth on distance between points (given in blue), relative to a curve of slope 1 (given in orange).

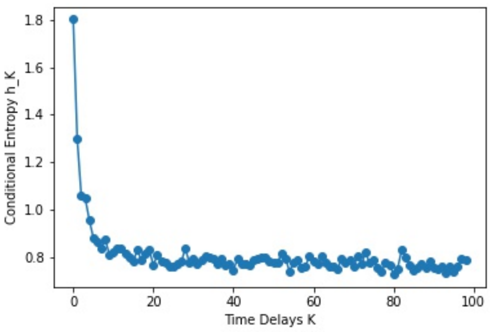

Figure 6: Conditional Entropies - In this plot we can see the entropy rate for number of partitions $N = 200$ which maximizes this entropy. This function reaches a plateau at ≈ 24 timesteps, which gives us an idea about which is the optimal K to choose. Given that we have 30 minutes timesteps, this plot shows that the optimized time delay is of 12h which corresponds to the day and night cycles

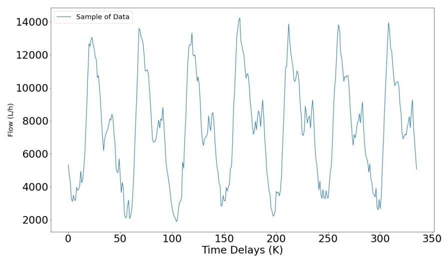

Figure 7: 7 Days Sample

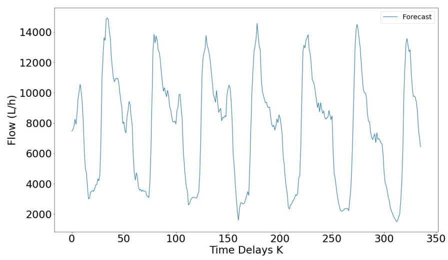

Figure 8: Prediction for 7 days ahead - Actual forecast using 336 timesteps that gives a 7 day future forecast sample using the LSTM model and direct forecasting. It is possible to observe that, as in figure 6, the values vary between ≈ 2000 to ≈ 14000 flow units and the essential dynamics of the time series were understood by the LSTM.

8 CONCLUSION

Having developed all the necessary machinery for constructing a coherent forecasting engine, we come to the conclusion that although the cardinality of the time series data was relatively small, the obtained results are promising and the model will certainly show satisfying results when applied in real time.

For the future, we want to continue developing the project by building other algorithms, such as Transformer neural network, that would provide even better results. Another idea is to use weather data and build a multivariate LSTM that optimally gives better results than the univariate one.

9 ACKNOWLEDGMENTS

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Modeling stochastic processes by simultaneous optimization of latent representation and target variable

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ABSTRACT

This paper proposes a novel method for modeling stochastic processes, which are known to be notoriously hard to predict accurately. State of the art methods quickly overfit and create big differences between train and test datasets. We present a method based on simultaneous optimization of latent representation and the target variable that is capable of dealing with stochastic processes and to some extent reduces the overfitting. We evaluate the method on equities and cryptocurrency datasets, specifically chosen for their chaotic and unpredictable nature. We show that with our method we significantly reduce overfitting and increase performance, compared to several commonly used machine learning algorithms: Random forest, General linear model and LSTM deep learning model.

1. INTRODUCTION

Time series prediction has always been an interesting challenge. Deep learning structures that are designed for time series are prone to overfitting. Especially if the underlying time series is stochastic by nature. Every young researcher's first attempt when dealing with time series, was trying to learn a time series model that will predict future prices; whether in equities, commodities, forex or cryptocurrencies. Unfortunately it is not that simple. One can easily build a near perfect model on the train dataset just to find it is completely useless on the test dataset.

We propose a novel method that is capable of effectively combatting the overfitting, especially this proves to be a difficult task when one is dealing with a problem directly applicable in practical situations. The main idea is to add noise from the same distribution as the training data and then at the same time optimize the target variable and the latent representation with the help of the autoencoder. The longer the training goes, the lower is the amplitude of noise and the less focus is on the optimization of the representation. We have evaluated the proposed method on an equities dataset and a cryptocurrency dataset, in both cases achieving extraordinary results on the test dataset. We have also shown the importance of noise distribution and how the de-noising fails if the distributions of the data and noise do not align.

The rest of the paper is organised as follows. Section 2 describes the data we were using. In section 3 we introduce the proposed method. In section 4 we present empirical results. In section 5 we conclude by pointing out the main results and defining guidance for the future work.

2. DATA

The proposed method works well for stochastic processes. Equities are supposed to follow some form of stochastic process [9], either the Black-Scholes one or some more complex process with unknown formulation. In order to evaluate our method, we have collected daily data of more than 5000 equities listed on NASDAQ from 2007 on. The data is freely available on the Yahoo Finance website [2]. We transformed the data using technical analysis [10] and for test set took every instance that happened after 2019. We calculated moving average using 10 days closing price then tried to predict the direction of the change of this trendline.

The equity data turned out to be a little bit timid, not chaotic enough to demonstrate the full ability of the proposed method. This is why we also collected minute data of cryptocurrencies Ethereum and Bitcoin and used the method on them as well. Data is available on the crypto exchange Kraken [1]. We used the same transformation as for the equities, but with a bit quicker trend. This time the target variable was change in the trendline in the next 6 hours. For the test set we took every instance that has time stamp after December 2020.

The reader should note that the end goal is not to accurately predict future equity price, since that is next to impossible. As soon there is a pattern, someone will profit from it and then the pattern will change. By predicting the future trend line, one can obtain a significant confidence interval and estimates of where the price could be, and then design for example a derivative strategy that searches for favourable risk versus rewards trades.

3. PROPOSED METHOD

We propose the method designed for prediction of stochastic processes. The method achieves significant results improving the metrics and loss functions on unseen data, where standard deep learning is prone to over-fit. The main advantage is reducing the gap between training data and testing data, sometimes to a degree where one sacrifices a little bit on the train side to actually have the model outperforming it on test data. This is very important in time series, where a prediction model is usually just one part of a bigger strategy and where the train over-fit is the biggest issue. For example, designing a trading strategy on over-fitted predictions, that kind of mistake can lead to huge capital losses.

The proposed method can be broken down into 3 important parts: normalization, noise addition and additional optimization of latent representation. Each part can be easily integrated into an already existing pipeline.

3.1 Empirical normalization

Normalization plays an important role in deep learning models. It was shown that normalization significantly speeds up the gradient descent, almost independently of where normalization takes place. It can be weight normalization [11] during the actual optimization, or it can be the batch normalization [8], or just normalization of the whole input data [7]. In the proposed method it is important that the 3 dimensional input data comes from the same distribution as the generated noise. Since it is fairly straightforward to sample data from a 3 dimensional normal distribution, we normalize input data using an empirical cumulative distribution function [12] and empirical copula [4] [5]. We align all central moments of the unknown distribution to the ones from centered and standardised normal distribution. The normalization takes place before the data is reshaped to 3 dimensional tensor.

3.2 Noise addition

Introduction of the noise is not new in unsupervised learning and it was shown that it has a positive effect [14]. Adding noise to input data and then forcing the model to learn how to ignore it has a lot of success in generative adversarial networks [3], where convergence can be very tricky to achieve. We transformed that idea and embedded it into supervised learning procedure. The noise addition is described in Algorithm 1.

In Algorithm 1 we will use the following abbreviations.

- $X = [bs, ts, np]$ stands for the input tensor with 3 dimensions; batch size, time steps and number of features used for predictions.
- α, β are parameters that control how fast noise will decrease during the training procedure. They should be between 0 and 1, where lower value correspond to a faster decrease in the amplitude of the added noise.
- mvn stands for function sampling from a two dimensional correlated Gaussian distribution, where Σ is the covariance. $matmul$ stands for matrix multiplication.

Algorithm 1 Noise definition

Inputs: X, α, β, $epoch$
$Y = [ts, ts, np]$ ▷ Array for holding Cholesky decompositions of time correlation matrices.
for $t \in \{1, \ldots, np\}$ **do**
  $\Sigma_t = cov(X[, , t])$
  $Y[, , t] = chol(\Sigma_t)$ ▷ In practice the closest positive definite matrix of Σ_t is computed before the Cholesky decomposition.
end for
$Z = [bs, ts, np]$ ▷ Array for holding noise samples.
for $i \in \{1, \ldots, ts\}$ **do**
  $\Sigma_i = cov(X[, i,])$
  $Z[, i,] = mvn(bs, \Sigma_i)$
end for
for $j \in \{1, \ldots, np\}$ **do**
  $Z[, , j] = matmul(Z[, , j], Y[, , j])$ ▷ Correcting initially independent noise samples with respect to time.
end for
for $w \in \{1, \ldots, ts\}$ **do**
  $Z[, w,] = Z[, w,] * ((\beta^{ts-w} \cdot \alpha^{epoch}) \cdot sd)$ ▷ Decrease the noise during the training procedure.
end for
$R = X + Z$
Return R.

3.3 Optimization of latent representation

The most common issue with deep learning optimization is falling into a local optimum and being unable to move past it [13]. We introduce autoencoder part into the optimization procedure in order to force the model to shift from going directly to local optimum to learning the latent representation first. We expect that this combined with the addition of noise, will force the model first to learn how to ignore the noise that we added and the noise that is already in the data by nature of the stochastic process [15]. We optimized the model using the Adam optimizer [6]. The loss function used in optimization is defined like:

$$L = L_Y + W_{ae} \cdot decay^{epoch} \cdot L_{ae},$$

where L_Y stands for the supervised loss function which will depend on the problem while L_{ae} stands for the loss between encoded output and input data. Decay weight is decreasing the longer the training goes on.

4. RESULTS

We have divided the results section into 2 parts: unsupervised and supervised. In the first we demonstrate why the noise distribution is important. For the unsupervised part, due to hardware constraints, we have only used the cryptocurrency dataset since we deemed it more demanding than the equity one. In the second, we demonstrate how the our method increases test metric on both datasets.

4.1 Unsupervised learning results

In order to test the efficiency of distributed noise versus just random noise, we created 3 models. The baseline model was a deep learning model with 3 stacked LSTM layers, encoded layer, then again 3 stacked LSTM for decoded output. We have used Adam as optimizer. As loss function we used mean-squared error. We have stopped the learning after there was no improvement for 25 epochs on the validation set. The validation set was randomly taken out of the train set. Parameters α and β were both set to 0.99 and sd was initially set to 1.25. The noise decreases with learning procedure. Interestingly keeping noise constant did not achieve any results.

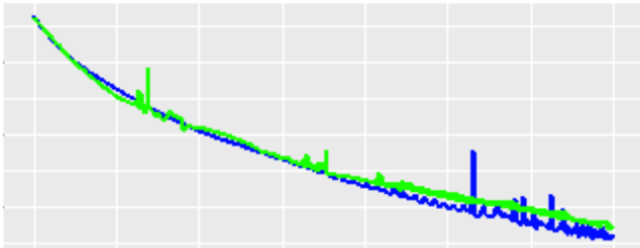

Figure 1: Test loss of autoencoder model with random noise (green) versus no noise (blue).

Initially we have tested baseline model versus de-noising model but with uncorrelated noise. In the Figure 1 is plotted the de-noising test loss function in green colour and the baseline test loss function in blue. Training was stopped relatively early compared to Figure 2 and it is also obvious that de-noising test loss is even worse than that of the classic autoencoder.

In the second example we switched from uncorrelated noise to the noise with same distribution as input data. As is apparent on Figure 2, where again we have de-noising test loss plotted with green and classic test loss with blue, the de-noising autoencoder achieved lower test loss than the classic one.

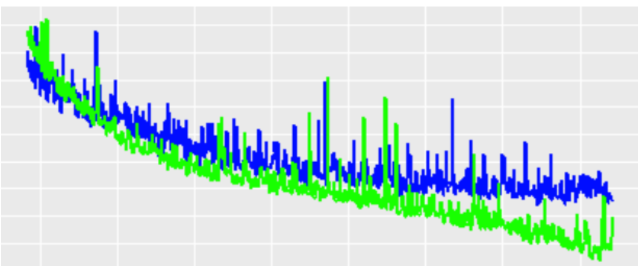

Figure 2: Test loss of autoencoder model with correlated noise (green) versus no noise (blue).

What we expected is that then the train and validation losses will be worse than with the classic autoencoder. Surprisingly, that was not the case. With the de-noising autoencoder using noise with the same distribution as the input data, both train and validation losses were better than with classic one. This result is definitely worth further investigation and experimentation.

4.2 Supervised learning results

In the previous section we have shown that the distribution of the noise matters. In this section we will show that noise combined with optimization of latent representation significantly improves metrics on unseen data. Similarly as before, α and β were both set to 0.99 and sd was initially set to 1.25. From our experience this setting achieves the best results, but further exploration needs to be done. W_{ae} was initially set to 5 and $decay$ to 0.95.

Since we now operate in a supervised environment, we can compare our models to the majority class. But to really demonstrate the effectiveness of the method, we chose to compare the following models:

- Majority class, which serves as a sanity check.
- Random Forest with 500 trees.
- Generalized linear model.
- Deep learning model with 3 stacked LSTM layers.
- Deep learning model with 3 stacked LSTM layers and optimization of latent representation.
- Deep learning model with 3 stacked LSTM layers and correlated noise addition.
- Finally, deep learning model with 3 stacked LSTM layers and correlated noise addition and optimization of latent representation.

All 4 of the deep learning models are identical, all are optimized with Adam and categorical cross entropy was used as a loss function for the supervised part and mean squared error for the autoencoder part. Initially we have only tested the models on equities data, but it turned out that the equities were not chaotic enough. By that we mean that especially with deep learning models the difference between train and test loss was not so big that it would be problematic. From previous work experience we know that overfit is a big issue in cryptocurrency dataset, so then we decided to test that dataset in a supervised setting as well. All models were trained three times on each dataset and the results in Table 1 and Table 2 are the averages of the 3 runs.

In Table 1 we show the results from the equity dataset. Our method managed to improve test accuracy (from 0.673 to 0.682) without decreasing train accuracy (0.681). Maintaining test accuracy and keeping it comparable to test one is important if one needs to build additional strategy upon predictions. Just noise addition slightly improved the results (from 0.673 to 0.675), while just the optimization of the latent distribution does not improve anything.

Table 1: Supervised results on equity dataset.

Method	Train Accuracy	Test Accuracy
Majority	0.513	0.537
Random Forest	0.649	0.655
GLM	0.664	0.655
LSTM	0.681	0.673
latent LSTM	0.633	0.673
noise LSTM	0.681	0.675
latent noise LSTM	0.681	0.682

In Table 2 we show results from the cryptocurrency dataset. Similar as on the equity dataset, our method behaves as intended on the cryptocurrency dataset as well. We can see reduced overfitting that is apparent in the normal LSTM model. With those results we can conclude that the proof of concept works, but for additional claims we will need more testing and deeper parameter analysis.

Table 2: Supervised results on cryptocurrency dataset.

Method	Train Accuracy	Test Accuracy
Majority	0.512	0.556
Random Forest	0.689	0.692
GLM	0.682	0.695
LSTM	0.754	0.696
latent LSTM	0.736	0.683
noise LSTM	0.697	0.695
latent noise LSTM	0.706	0.714

It is interesting to point out that with the proposed method the test loss on cryptocurrency dataset was 0.552, while train loss was 0.592. While 0.552 was the best loss any deep learning model achieved, that wide difference indicates that we could improve our model even further by fine tuning the parameters.

5. CONCLUSIONS AND FUTURE WORK

In this work we have introduced and demonstrated how the addition of noise and simultaneous optimization of latent representation and target variable reduce overfitting on time series data. In the unsupervised case we have shown that the distribution of the noise matters and the input data must align to achieve maximum effect from the noise addition.

In the future work we have to estimate the effect of the newly introduced parameters on method's convergence. At the same time we need to explore how the method behaves when embedded into larger models, transformers for example. We also need to evaluate the method in datasets that are by nature stochastic but do not come from the financial domain. Finally, we need to evaluate our method on a dataset that is not stochastic.

6. ACKNOWLEDGMENTS

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Causal relationships among global indicators

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ABSTRACT

It is important to know how changing one thing will affect another. This becomes even more important when the thing we are changing will affect a lot of people. Therefore, we need a way to visualize how all the things are connected. In this paper, we will demonstrate an approach that uses Granger causality to find causal relationships between global indicators. Our results show that global indicators are indeed highly interconnected however, they still need to be looked at within each country individually. We also comment how this approach can be used to help with policy making decisions.

KEYWORDS

Causality, Global indicators, Granger, Timeseries, SDGs

1 INTRODUCTION

The Sustainable Development Goals (SDGs) launched on January 1, 2016 include 17 goals, 169 targets and 232 unique indicators with the intent to help frame the policies of the United Nations' (UN) member states through 2030 [8]. Because the goals are highly interconnected, as the indicators are not independent, it is important to understand synergies, conflicts and causal relationships between them to support decisions. Without such understanding a policy to help one goal could hurt another. For example, a policy aiming to improve hunger could conflict with climate-mitigation. This paper will focus on finding such relationship with Granger causality.

Granger causality is a statistical concept of causality that is based on prediction and was traditionally only used in the financial domain however, over recent years there has been growing interest in the use of Granger causality to identify causal interactions in neural data [6].

Similar works such as [7] and [2] have already looked for causal relationships between specific SDGs. This paper confirms the previously done work and expands it by adding additional indicators and looking for causal relationship between all the indicators, not just the ones focused on SDGs.

In paper [2] the authors say that the analysis of all of the indicators country by country is without doubt impractical. Nevertheless, Table 2 shows that however impractical it may be, it is still required, as even neighboring countries have vastly different causal relationships.

2 DESCRIPTION OF DATA

2.1 United Nations Statistics Division (UNSD)

This is the official source published by the United Nations it provides information on the development and implementation of an indicator framework for the follow up and review of the 2030 Agenda for Sustainable Development [4].

2.2 The World Bank (WB)

As the data set provided by the UN itself often has missing values, which results in unhealthy timeseries and unreliable results, we decided to add the dataset "World Development Indicators" from The World Bank [5]. Although the data set might not be as official as the one provided by the UN, it does contain 1440 unique indicators for 266 different countries and groups, where each indicator contains a timeseries ranging from the year 1960 to the present time. This addition does not only make the dataset healthier, it also introduces new indicators that are not listed in the UN SDGs. Even so our new dataset still has some limitations. From Figure 1 we can see that on average a country or groups has no values for around 33% of its indicators. Therefore, from now on when talking about the indicators, we will restrict ourselves to just those ones that have at least 20 nonmissing values in their timeseries. This restriction will insure that we are always dealing with a healthy timeseries and it is justified as on average those indicators make up about 50% of all of the ones available as seen in Figure 2.

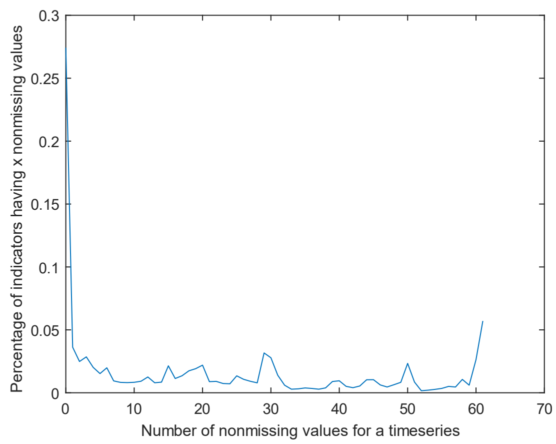

Figure 1: Percentage of indicators having x nonmissing values in its timeseries.

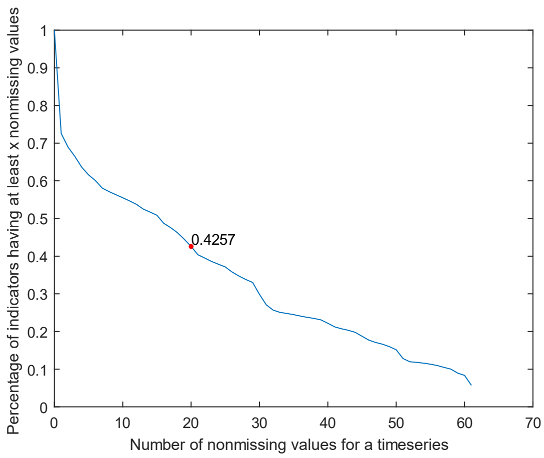

Figure 2: percentage of indicators having at least x nonmissing values in its timeseries.

To better imagine what kind of indicators we are dealing with, we can check Table 1 which shows the top 10 most common ones.

Indicator name	Frequency
Renewable electricity output (% of total electricity output)	265
Population, total	265
Population growth (annual %)	265
Nitrous oxide emissions in energy sector (thousand metric tons of CO2 equivalent)	265
Methane emissions in energy sector (thousand metric tons of CO2 equivalent)	265
Agricultural nitrous oxide emissions (thousand metric tons of CO2 equivalent)	265
Agricultural methane emissions (thousand metric tons of CO2 equivalent)	265
Urban population growth (annual %)	263
Urban population (% of total population)	263
Urban population	263

Table 1: Most common indicators and their frequency of 20 nonmissing values

3 METHODOLOGY

3.1 Granger causality

The causal relationships between indicators were determined by the Granger causality test. The Granger causality test is a statistical hypothesis test for determining whether one timeseries is useful in forecasting another. Informally we say that timeseries X Granger-causes timeseries Y if predictions of the value of Y based on its own past values and on the past values of X are better than predictions of Y based only on Y's own past values. Or in other words X Granger-causes Y if we can better explain the future values of Y with both the past values of X and Y and not just the past values of Y.

More formally, let x and y be stationary timeseries and let x(t) and y(t) be the univariate autoregression of x and y respectfully:

$$x(t) = b_0 + \sum_{i=1}^{p} b_i x(t-i) + E_2(t)$$

$$y(t) = a_0 + \sum_{i=1}^{p} a_i y(t-i) + E_1(t)$$

where p is the number of chosen lagged values included in the model, a_i and b_i are contributions of each lagged observation to the predicted values of $x(t)$ and $y(t)$ and $E_i(t)$ the difference between the predicted value and the actual value. To test the null hypothesis that x does not Granger-cause y, we augment $y(t)$ by including the lagged values of x to get:

$$y(t) = c_0 + \sum_{i=1}^{p} a_i y(t-i) + b_i x(t) + E_3(t).$$

We then say that x Granger-causes y if the coefficients b_i are jointly significantly different from zero. This can be tested by performing an F-test of the null hypothesis that $b_i = 0$ for all i.

3.2 Statistical significance and the p-value

In testing, a result has statistical significance if it is unlikely to occur assuming the null hypothesis. More precisely, a significance level α, is the probability of the test rejecting the null hypothesis, given that the null hypothesis was assumed to be true and the p-value is the probability of getting result at least as extreme, given that the null hypothesis is true. Then we say that the result is statistically significant when $p \leq \alpha$.

3.3 Limitations of the Granger causality test

As its name implies, Granger causality is not necessarily true causality. Having said this, it has been argued that given a probabilistic view of causation, Granger causality can be considered true causality in that sense, especially when Reichenbach's "screening off" notion of probabilistic causation is considered [1].

A problem may occur if both timeseries x and y are connected via a third timeseries z. In that case our test can reject the null hypothesis even if manipulation of one of the timeseries would not change the other. Other possible sources of problems can happen due to: (1) not frequent enough or too frequent sampling, (2) time series nonstationarity, (3) nonlinear causal relationship.

4 EXPERIMENTS

4.1 Setup

Due to time constraints and the limitations of my home system, we decided to limit ourselves to taking just a few countries and groups and calculating the causality relationships for them. The ones we decided on are: (1) United States, (2) China, (3) Uruguay, (4) Slovenia, (5) Austria, (6) Croatia, (7) Italy, (8) European Union and (9) OECD. Our plan was to choose

	AUS	CH	CRO	EU	ITA	OECD	SLO	UY	USA
AUS	100%	4.8%	5.1%	6.9%	6.7%	6.0%	5.9%	4.4%	7.1%
CH		100%	5.6	3.5%	4.3%	3.9%	4.2%	4.7%	4.3%
CRO			100%	4.6%	5%	3.3%	6.6%	3.8%	5.6%
EU				100%	11%	20%	5.7%	3.6%	10%
ITA					100%	6.7%	7.5%	3.8%	6.7%
OECD						100%	5%	3%	17%
SLO							100%	3.5%	5.6%
UY								100%	4.2%
USA									100%

Table 2: Percentage of same causal relationships.

a few of the major world powers and compare the differences and similarities between the causal relationships.

4.2 Modeling the dataset

Once the data was collected from the UNSD and WB website it first had to be put into a suitable form. We decided on a 3D matrix where the first component represented the country or group, the second component represented the time series and last one representing the indicator.

4.3 Parameters

As mentioned before, when searching for causal relationships in a certain country or group we limit ourselves only to those indicators who have at least 20 nonmissing values. Furthermore, we chose a significance level of 0.05 or 5% and tested for lagged values from 1 to 4.

4.4 Determining causality

Once the modeling was done and the parameters were set we first needed to make sure that the timeseries were stationary. To do that we ran the ADF-test and differenced the times series accordingly to make them stationary. Then we ran the Granger-causality test 4 times, once for each lagged value, for each of the 9 countries and groups listed in 4.1. The results for each lagged value were then saved in a 1440x1440 weighted adjacency matrix, where the (i,j) element was nonzero if and only if the i-th indicator Granger-caused the j-th indicator for all lagged values between 1 and 4 and had the weight of the average of the 4 p-values.

Once we had the weighed adjacency matrix we matched the available indicators with the 17 SDGs by comparing the most common buzzwords found in the description of the SDGs and the name of the indicators. An example of some of the buzzwords can be seen in Table 3.

5 RESULTS

With the weighted adjacency matrix in hand, it is sensible to ask ourselves whether there exist any causal relationships that hold true for each of the tested countries or groups. The answer is positive as seen in Figure 3. We can however see that the only causal relationships that survived were the ones that connected different population ages to each other. This result seems sensible as in general no two countries are exactly the same and are therefore going to have a unique set of causal relationships.

That being said one can easily imagine why each population age Granger-causes

the next one. For example, if we know the percentage of people aged 4, we can pretty accurately predict what the percentage of people aged 5 is going to be in the next year.

SDG	Buzzwords
Zero Hunger	nourishment, food, stun, anemia, agriculture
Clean Water and Sanitation	water, sanitation, drinking, drink, hygiene, freshwater
Affordable and Clean Energy	energy, electricity, fuel
Climate Action	disaster, disasters, climate, natural, risk, Sendai, environment, environmental, green, developed, pollution
Good Health and Well-Being	mortality, birth, infection, tuberculosis, malaria, hepatitis, disease, cancer, diabetes, treatment, Alcohol, death, birth, health, pollution, medicine

Table 3: Some of the most common buzzwords found in SDGs

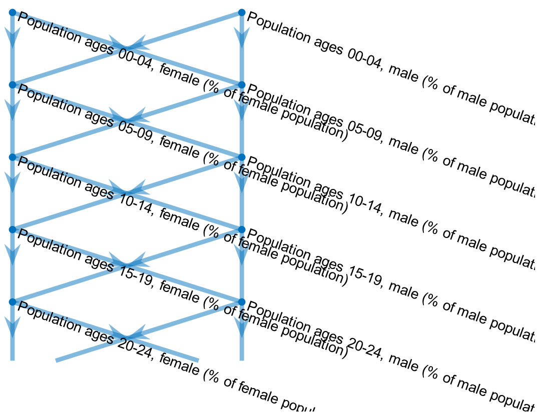

Figure 3 Only causal relationships that are true for each of the 9 countries and groups (continuous down).

On the other hand, one may assume that if we compare countries which are close to each other or are historically connected then the causal relationships should not differ by a lot.

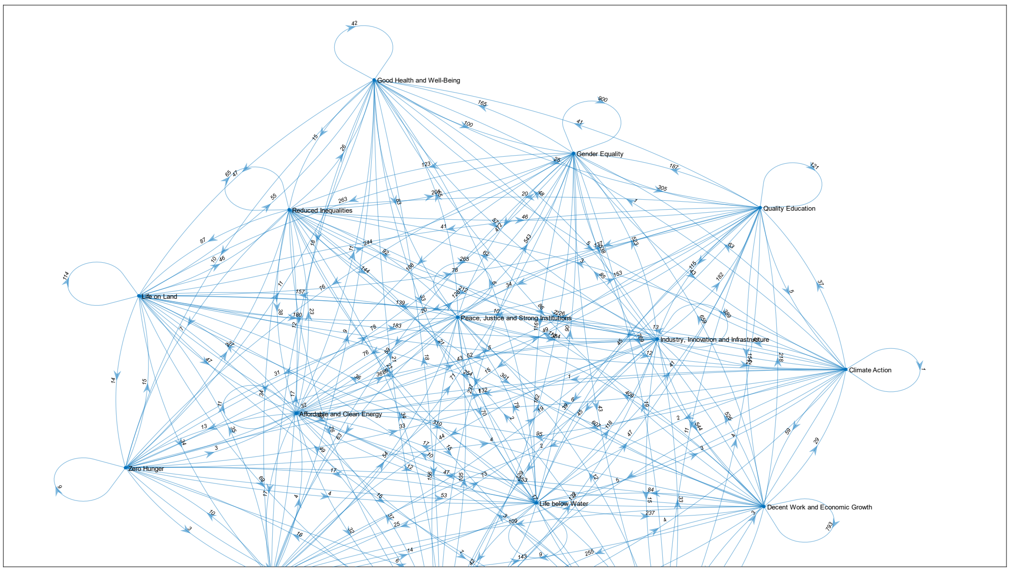

Figure 4: Interconnectedness of SDGs.

That however is not the case as can be seen in Table 2. This suggests, that when talking about causal relationships, one must look at each country or group individually.

Therefore, let’s focus just on Slovenia. Due to Slovenia having 10083 positive causal relationships we will limit ourselves to just those that interact with SDGs. Figure 4 shows that indeed SDGs are not independent and in fact are highly interconnected. The presence of self-loops also suggests that there exist causal relationships between indicators of an SDG itself. This result has two consequences:

- When thinking about policies aiming to improve one goal we need to be careful to not harm another
- Instead of outright improving one goal, we can instead focus the ones that are in causal relationship with the one we wish to improve

Let’s give an example. Suppose we would want to implement a policy to help to help lower the suicide mortality rate, but we are not how to do that directly. We can therefore instead check which indicators Granger-cause the one we are trying to improve. In our case the indicator “Unemployment, youth total (% of total labor force ages 15-24)” Granger-causes the suicide mortality rate. Therefore, if we improved the % of unemployed young people we would be able to also reduce the suicide mortality rate which was our initial goal.

6 CONCLUSION AND FUTURE WORK

In this paper we demonstrated an approach for calculating causality between depending global indicators and mentioned how this can help with implementing policies. We also showed that neighboring and similar countries in general don’t have the same causal relationships, which makes it hard to group them together. However, finding such a grouping, if it exists, could be done in the future. The approach shown in this paper could also be implemented to find causal relationship between certain google searches and natural events. For example, we could check if there is any correlation between the increase of users searching the words “water”, “rain”, or “cloud” and the likelihood of a flood happening.

7 ACKNOWLEDGMENTS

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Active Learning for Automated Visual Inspection of Manufactured Products

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ABSTRACT

Quality control is a key activity performed by manufacturing enterprises to ensure products meet quality standards and avoid potential damage to the brand's reputation. The decreased cost of sensors and connectivity enabled an increasing digitalization of manufacturing. In addition, artificial intelligence enables higher degrees of automation, reducing overall costs and time required for defect inspection. In this research, we compare three active learning approaches and five machine learning algorithms applied to visual defect inspection with real-world data provided by *Philips Consumer Lifestyle BV*. Our results show that active learning reduces the data labeling effort without detriment to the models' performance.

CCS CONCEPTS

• **Information systems → Data mining**; • **Computing methodologies → Computer vision problems**; • **Applied computing**;

KEYWORDS

Smart Manufacturing, Machine Learning, Automated Visual Inspection, Defect Detection

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1 INTRODUCTION

Quality control is one of the critical activities that must be performed by manufacturing enterprises [27, 28]. The main purpose of such activity is to detect product defects meeting quality standards, avoid rework, supply chain disruptions, and avoid potential damage to the brand's reputation [3, 27]. Along with the information regarding defective products, it provides insights into when and where such defects occur, which can be used to further dig into the root causes of such defects and mitigation actions to improve the quality of manufacturing products and processes.

The decreased cost of sensors and connectivity enabled an increasing digitalization of manufacturing [3], which along with the adoption of Artificial Intelligence (AI) [12], represents an opportunity towards enhancing the defect detection in industrial settings [5]. While the quality of the manual inspection has low scalability (requires time to train an inspector, the employees can work a limited amount of time and are subject to fatigue, and the inspection itself is slow), its quality can be affected by the operator-to-operator inconsistency, and it depends on the complexity of the task, the employees (e.g., their intelligence, experience, well-being), the environment (e.g., noise and temperature), the management support and communication [23]; none of these factors affect the outcome of automated quality inspection. Machine learning has been successfully applied to defect detection in a wide range of scenarios [1, 9, 11, 15, 21].

An annotated dataset must be acquired to implement machine learning models for defect detection successfully. The increasing number of sensors provides large amounts of data. As the manufacturing process quality increases, the data obtained from the sensors is expected to be highly imbalanced: most of the data instances will correspond to non-defective products, and a small proportion of them will correspond to different kinds of defects. Annotating all the data is prone to similar limitations as manual inspection described in the paragraph above. It is thus imperative to provide strategies to select a limited subset of them that are most informative to the defect detection models.

We frame the defect detection problem as a supervised learning problem. Given a large amount of unlabeled data, and based on the premise that only a tiny fraction of the data provides new information to the model and thus has the potential to enhance its performance, we adopt an active learning approach. Active learning is a subfield of machine learning that attempts to identify the most informative unlabeled data instances, for which labels are requested some *oracle* (e.g., a human expert) [24]. This research compares three active learning strategies: pool-based sampling, stream-based sampling, and query by committee.

*Both authors contributed equally to this research.

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The main contributions of this research are (i) a comparative study between the five most frequently cited machine learning algorithms for automated defect detection and (ii) three active learning approaches (iii) for a real-world multiclass classification problem. We develop the machine learning models with images provided by the *Philips Consumer Lifestyle BV* corporation. The dataset comprises shaver images divided into three classes, based on the defects related to the printing of the logo of the *Philips Consumer Lifestyle BV* corporation: good shavers, shavers with double printing, and shavers with interrupted printing.

We evaluate the models using the area under the receiver operating characteristic curve (AUC ROC, see [4]). AUC ROC is widely adopted as a classification metric, having many desirable properties such as being threshold independent and invariant to a priori class probabilities. We measure AUC ROC considering prediction scores cut at a threshold of 0.5.

This paper is organized as follows. Section 2 outlines the current state of the art and related works, Section 3 describes the use case, and Section 4 provides a detailed description of the methodology and experiments. Finally, section 5 outlines the results obtained, while Section 6 concludes and describes future work.

2 RELATED WORK

Among the many techniques used for automated defect inspection, we find the automated visual inspection, which refers to image processing techniques for quality control, usually applied in the production line of manufacturing industries [1]. Visual inspection requires extracting features from the images, which are used to train the machine learning model. This procedure is simplified when using deep learning models, enabling end-to-end learning, where a single architecture can perform feature extraction and classification [10, 18], and have shown state-of-the-art performance for image classification [20].

The use of automated visual inspection for defect detection has been applied to multiple manufacturing use cases. [21] manually extracted features (e.g., histograms) from machine component images and compared the performance of the Näive Bayes and C4.5 models. [9] extracted statistical features from the images and compared the performance of Support Vector Machines (SVM), Multilayer Perceptron (MLP), and k-nearest neighbors (kNN) models for visual inspection of microdrill bits in printed circuit board production. [11] used 3D convolutional filters applied on computed tomography images and an SVM classifier for defect detection during metallic powder bed fusion in additive manufacturing. [15] used some heuristics to detect regions of interest on slate slab images, on which they performed feature engineering to later train an SVM model on them. Finally, [1] reported using a custom neural network for feature extraction and an SVM model for classification when inspecting aerospace components.

While the authors cited above worked with fully labeled datasets, a production line continually generates new data, exceeding the labeling capacity. A possible solution to this issue is the use of active learning, where the active learner identifies informative unlabeled instances and requests labels to some *oracle*. Typical scenarios involve (i) membership query synthesis (a synthetic data instance is generated), (ii) stream-based selective sampling (the unlabeled instances are drawn one at a time, and a decision is made whether a label is requested, or the sample is discarded), and (iii) pool-based selective sampling (queries samples from a pool of unlabeled data). Among the frequently used querying strategies, we find (i) uncertainty sampling (select an unlabeled sample with the highest uncertainty, given a certain metric or machine-learning model[17]), or (ii) query-by-committee (retrieve the unlabeled sample with the highest disagreement between a set of forecasting models (*committee*)) [6, 24]. More recently, new scenarios have been proposed leveraging reinforcement learning, where an agent learns to select images based on the similarity relationship between the instances and rewards obtained based on the oracle's feedback [22]. In addition, it has been demonstrated that ensemble-based active learning can effectively counteract class imbalance through new labeled images acquisition [2].

Active learning was successfully applied in the manufacturing domain, but scientific literature remains scarce on this domain [19]. Some use cases include the automatic optical inspection of printed circuit boards[8] and the identification of the local displacement between two layers on a chip in the semi-conductor industry[25].

The use of machine learning automates the defect detection, and active learning enables an *inspection by exception* [5], only querying for labels of the images that the model is most uncertain about. While this considerably reduces the volume of required inspections, it is also essential to consider that it can produce an incomplete ground truth by missing the annotations of defective parts classified as false negatives and not queried by the active learning strategy [7].

3 USE CASE

The use case provided for this research corresponds to visual inspection of shavers produced by *Philips Consumer Lifestyle BV*. The visual quality inspection aims to detect defective printing of a logo on the shavers. This use case focuses on four pad printing machines setup for a range of different products, and different logos. A lot of products are produced every day on these machines, which are manually handled and inspected on their visual quality and removed from further processing if the prints on the products are not classified as good. Operators spend several seconds handling, inspecting, and labeling the products. Given an automated visual quality inspection system would strongly reduce the need to manually inspect and label the images, it could speed up the process for more than 40%. Currently there are two types of defects classified related to the printing quality of the logo on the shaver: double printing, and interrupted printing. Therefore, images are classified into three classes: good printing (class zero), double printing (class one), and interrupted printing (class two). A labeled dataset with a total of 3.518 images was provided to train and test the models.

4 METHODOLOGY

We pose automated defect detection as a multiclass classification problem. We measure the model's performance with the AUC ROC metric, using the "one-vs-rest" heuristic method, which involves splitting the multiclass dataset into multiple binary classification problems. Furthermore, we calculate the metrics for each class and compute their average, weighted by the number of true instances for each class.

To extract features from the images, we make use of the ResNet-18 model [13], extracting embeddings from the Average Pooling layer. Since the embedding results in 512 features, which could cause overfitting, we use the mutual information to evaluate the most relevant ones and select the *top K* features, with $K = \sqrt{N}$, where N is the number of data instances in the train set, as suggested in [14].

To evaluate the models' performance across different active learning strategies, we apply a stratified k-fold cross validation [29], using one fold for testing, one fold as a pool of unlabeled data for active learning, and the rest from training the model. We adopt *k=10* based on recommendations by [16], and query all available unlabeled instances to evaluate the active learning approaches. We compare three active learning scenarios: drawing queries through (i) stream-based classifier uncertainty sampling accepting instances with an uncertainty threshold above the 75^{th} percentile of observed instances, (ii) pool-based sampling selecting the instances a given model is most uncertain about, and pool-based sampling considering a query-by-committee strategy, where the committee is created with models trained with the five algorithms we consider in this research: Gaussian Näive Bayes, CART (*Classification and Regression Trees*, similar to C4.5, but it does not compute rule sets), Linear SVM, MLP, and kNN. Comparing deep learning models remains a subject of future work. Finally, we compare the performance of the active learning scenarios computing the average AUC ROC of each fold and assess if the results differences obtained from each model are statistically significant by using the Wilcoxon signed-rank test[26], using a p-value of 0.05.

5 RESULTS AND ANALYSIS

The results obtained from the experiments we ran, and described in Section 4, are presented in Table 1, and Table 2. Table 1 describes the average AUC ROC per each active learning scenario and model for each cross-validation test fold. We observe that the best model across strategies is the MLP, which achieved the best or second-best performance across almost every fold in pool-based and stream-based active learning. Among those two scenarios, the best results were obtained for stream-based active learning. We observed the same across the rest of the models, though the differences were not significant for all but the Näive Bayes models (see Table 2). Query-by-committee displayed a strong performance, showing best results immediately after the MLP. When assessing the statistical significance between the query-by-committee scenario and results obtained from different models with stream-based and pool-based strategies, we observed that differences were significant in all cases, except for the SVM models. SVM models, most widely used in active learning literature related to automated defect inspection, were the third-best models among the tested ones, immediately after the MLPs in stream-based and pool-based active learning and the query-by-committee approach. SVM models did not display significant differences when compared across different active learning scenarios. The worst results were consistently observed for the CART models.

When analyzing the results, we were interested in how the models' performance evolved through time and significant variations between the first and last results observed. To that end, we assessed the statistical significance between the means of the first and last quartiles of the test fold for each active learning scenario. We assessed the statistical significance using the Wilcoxon signed-rank test, with a p-value of 0.05. While such variations existed and were positive in most test folds (the models learned through time), the improvements were not statistically significant in none of the scenarios.

6 CONCLUSION

In this paper, we compared three active learning scenarios (pool-based, stream-based with classifier uncertainty sampling, and query-by-committee) across five machine learning algorithms (Gaussian Näive Bayes, CART, Linear SVM, MLP, and kNN). We found that the best performance was achieved by the MLP model regardless of the active learning strategy. The second-best performance was obtained through the query-by-committee strategy, while the frequently used SVM models ranked third. We found no significant difference between using pool-based or stream-based active learning approaches. Results from the query-by-committee approach were statistically significant in all cases and better than all the models, except for the MLPs. Finally, we found no case where the improvement between the first and last quartile of the test fold in each active learning scenario would be significant. We believe that further investigation is required to determine if a larger pool of unlabeled images would help us achieve such a significant difference. Future work will focus on data augmentation techniques that could help achieve a statistically significant improvement over time when applying active learning techniques.

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Active Learning scenario	Model	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Fold 6	Fold 7	Fold 8	Fold 9	Fold 10
stream-based	**CART**	0,8168	0,7828	0,7810	0,7694	0,8196	0,7805	0,7843	0,7970	0,8409	0,7940
	kNN	0,9289	0,9121	0,9174	0,8686	0,9024	0,9000	0,9051	0,8960	0,9282	0,9082
	MLP	**0,9900**	**0,9928**	**0,9846**	**0,9563**	**0,9804**	**0,9807**	**0,9710**	**0,9729**	0,9793	**0,9845**
	Näive Bayes	0,8818	0,8668	0,8819	0,8686	0,8829	0,8899	0,8650	0,8877	0,8864	0,9098
	SVM	0,9752	0,9828	0,9725	*0,9530*	0,9816	0,9720	0,9570	0,9412	0,9824	0,9712
pool-based	**CART**	0,7584	0,7904	0,7543	0,7468	0,8441	0,7730	0,8044	0,7701	0,7850	0,7412
	kNN	0,9189	0,9149	0,9161	0,8581	0,9055	0,9036	0,8961	0,8910	0,9224	0,9056
	MLP	*0,9892*	*0,9921*	*0,9845*	**0,9563**	0,9790	**0,9803**	**0,9702**	**0,9723**	0,9806	*0,9840*
	Näive Bayes	0,8800	0,8654	0,8809	0,8677	0,8813	0,8895	0,8637	0,8873	0,8850	0,9090
	SVM	0,9752	0,9819	0,9726	0,9518	*0,9806*	0,9712	0,9562	0,9412	*0,9823*	0,9722
query-by-committee		0,9774	0,9824	0,9714	0,9500	0,9723	*0,9726*	*0,9597*	*0,9571*	**0,9830**	0,9734

Table 1: AUC ROC values were obtained across the ten cross-validation folds. Best results are bolded, second-best results are highlighted in italics.

Model	Active Learning scenarios		
	stream-based vs. pool-based	stream-based vs. query-by-committee	pool-based vs. query-by-committee
CART	0,0840	**0,0020**	**0,0020**
kNN	0,1309	**0,0020**	**0,0020**
MLP	0,0856	**0,0039**	**0,0039**
Näive Bayes	**0,0020**	**0,0020**	**0,0020**
SVM	0,1824	0,4316	0,6250

Table 2: p-values obtained for the Wilcoxon signed-rank test when comparing the average of AUC ROC results across ten cross-validation folds.

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Learning to Automatically Identify Home Appliances

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Abstract. Appliance load monitoring (ALM) is a technique that enables increasing the efficiency of domestic energy usage by obtaining appliance specific power consumption profiles. While machine learning have been shown to be suitable for ALM, the work on analyzing design trade-offs during the feature and model selection steps of the ML model development is limited. In this paper we show that 1) statistical features capturing the shape of the time series, yield superior performance by up to 20 percentage points and 2) our best deep neural network-based model slightly outperforms our best gradient descent boosted decision trees by 2 percentage points at the expense of increased training time.

1 Introduction

Household energy consumption accounts for a large proportion of the world's total energy consumption. The first studies, conducted as early as the 1970s, showed that as much as 25% of national energy was consumed by our domestic appliances alone. This figure rose to 30% in 2001 [1] and continues to increase with an exponential rate. Some researchers even predict that these numbers will double by 2030 [2].

In support of rationalizing consumption, appliance load monitoring (ALM) has been introduced. It aims to help solve domestic energy usage related issues by obtaining appliance specific power consumption profiles. Such data can help devise load scheduling strategies for optimal energy utilization [2]. Additionally, data about appliance usage can provide useful insight into daily activities of residents which can be useful for long-distance monitoring of elderly people who prefer to stay at home rather than going to retirement homes [2]. Other applications include theft detection, building safety monitoring, etc.

The two different ways of realizing ALM are intrusive load monitoring (ILM) and non-intrusive load monitoring (NILM). While ILM is known to be more accurate, it requires multiple sensors throughout the entire building to be installed which incurs extra hardware cost and installation complexity. NILM, however, is a cost-effective, easy to maintain process for analyzing changes in the voltage [3] and current going into a building without having to install any additional sensors on different household devices, since it operates using only data obtained from the single main smart meter in a building. The obtained data is then disaggregated and each individual appliance and its energy consumption are detected.

One promising approach to ILM for automatic identification of home appliances is the use of machine learning (ML). For instance, in [4] they used ML to find patterns in the data and extract useful information such as type of load, electricity consumption detail and the running conditions of appliances [4]. More recently, [5] focused on the study of design trade-offs during the feature and model selection steps of the development of the ML-based classifier for ILM. In their study they considered various statistical summaries for feature engineering and classical machine learning techniques for model selection. We complement the work in [5] by extending the feature set with additional shape capturing values and considering deep learning (DNN) and gradient boosted trees (XGBoost) as promising modelling techniques. The contributions of this paper are as follows:

- We explore a variety of different statistical features and show the ones capturing the shape of the time series, such as *longest strike above mean, longest strike below mean, absolute energy and kurtosis* yield superior performance by up to 20 percentage points.
- We show that our best DNN based model slightly outperforms our best XGBoost by 2 percentage points at the expense of increased training time. We also show that our models outperform the results from [5] by 5 percentage points.

The paper is organized as follows. Section 2 summarizes related work, Section 3 formulates the problem and provides methodological details, Section 4 focuses on the study of feature selection trade-offs, while Section 5 discusses model selection. Concluding remarks are drawn in Section 6.

2 Related Work

Existing work that uses machine learning for ALM, such as in [6] investigates the performance of deep learning neural networks on NILM classification tasks and builds a model that is able to accurately detect activations of common electrical appliances using data from the smart meter. More complex DNNs for NILM classification tasks are presented by the authors in [3], where they introduce a Long Short-Term Memory Recurrent Neural Network (LSTM-RNN) based model and show that it outperforms the considered baselines. In [7] they approach a similar problem by proposing a convolutional neural network based model that allows simultaneous detection and classification of events without having to perform double processing. In [8] authors train a temporal convolutional neural network to automatically extract high-level load signatures for individual appliances while in [9] a feature extraction method is presented using multiple parallel convolutional layers as well as an LSTM recurrent neural network based model is proposed.

3 Problem formulation

Our goal was to design a classifier that when given an input time series T, it is able to accurately map this data to the appropriate class C, as shown in equation 1.

$$C = \Phi(T) \tag{1}$$

where Φ represents the mapping function from time series to target classes and C is a set of these classes, where each class corresponds to one of the following household appliances: computer monitor, laptop computer, television, washer dryer, microwave, boiler, toaster, kettle and fridge. The appliances and measured data illustrated in Figure 1 available in the public UK-Dale dataset are used. The UK DALE (Domestic Appliance-level Electricity) contains the power demand from 5 different houses in the United Kingdom. The dataset was build at a sample-rate of 16 Hz for the whole-house and 0.1667 Hz for each individual appliance. Data is spread into 1 hour long segments, each dataset sample contains a time series with 600 datapoints as depicted in Figure 1.

For realizing Φ, we perform first a feature selection task followed by a model selection one. For selecting the best feature set, we perform feature selection in Section 4. For model selection, we go beyond the work in [5] and consider deep learning architectures enabled by Tensorflow and advanced decision trees that use on optimized distributed gradient boosting technique available in the XGBoost open source library as detailed in Section 5.

4 Feature selection

As can be seen in Figure 1, the time-series corresponding to each device has unique shape and patterns, therefore an intuitive approach to feature selection is to extract statistical properties of the time series that would capture the unique properties of the signals. For instance, a summary such as the peak-to-peak value is able to capture the difference between the maximum and minimum value in a time series signal while one such as skewness is able to describe the asymmetry in the distribution of datapoints in a particular sample. A good combination of such feature would be able to inform the model with relevant information about the power consumption of each appliance, making it easier to find patterns in the data and perform classification task more accurately. Recently, standard tools for computing a large range of such summaries

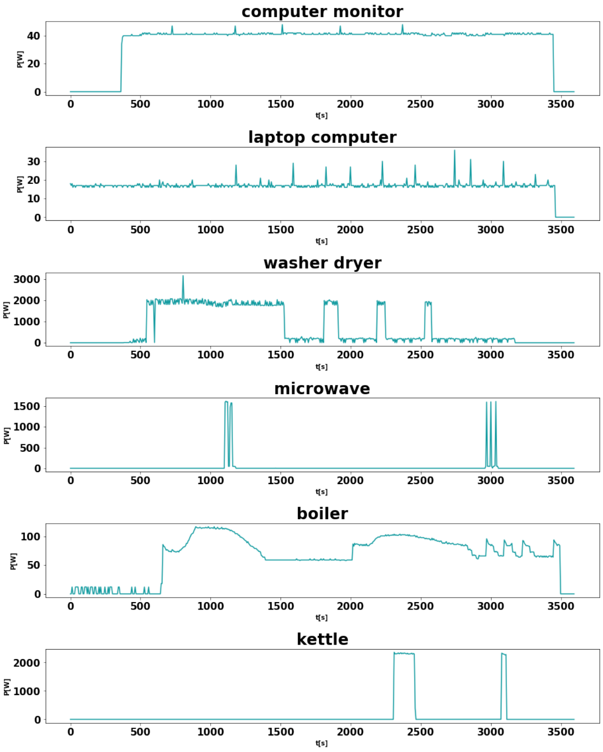

Figure 1: Selected appliances, showing power in relation to time over a 1 hour interval.

are provided by dedicated time series feature engineering tools such as tsfresh [1].

Following an extensive evaluation of combinations of time-series, we report the results for a representative selection of three feature sets as follows:

FeatureSet1 - This feature set consists of the raw time series, containing 2517 time series samples, each with 600 datapoints. It is used as a baseline to see the performance achieves with the available data.

FeatureSet2 - This feature set consists of: $mean\ value, maximum,\ minimum, standard\ deviation, variance, peak-to-peak, count\ above\ mean, count\ below\ mean, mean\ change,\ absolute\ mean\ change, absolute\ energy$. The count above and below mean counts the numbers of values in each sample that are higher or lower than the mean value of that same sample and helps quantifying the width of a pulse such as the ones for the toaster and microwave from Figure 1. The mean absolute change gives the mean over the absolute differences between subsequent time series values. The absolute energy represents the sum of squared values, calculated using formula shown in equation 2 and provides the information on whether a specific appliance has large consumption profile or not.

$$E = \sum_{i=0}^{n-1} x_i^2 \tag{2}$$

FeatureSet3 - After taking a deeper look into the features from FeatureSet2, we noticed that minimum is re-

[1] *https://tsfresh.readthedocs.io/en/latest/text/list_of_features.html*

dundant as it is usually zero in every sample and peak-to-peak is in most cases equal to maximum value due to the lowest value mostly being zero. This feature set consists of: $maximum$, $standard\ deviation$, $mean\ absolute\ change$, $mean\ change$, $longest\ strike\ above\ mean$, $longest\ strike\ below\ mean$, $absolute\ energy$, $kurtosis$, $number\ of\ peaks\ in\ each\ signal$. The longest strike above and below mean returns the length of the the longest consecutive subsequence that is higher or lower than the mean value of that specific sample. The kurtosis is another metric of describing the probability distribution and measures how heavily the tails of a distribution differ from the tails of a normal distribution.

Table 1: Feature comparison using the best models.

Model	Feature set	Precision	Recall	f1
DNN3	FeatureSet1	0.638	0.595	0.573
XGB3	FeatureSet1	0.799	0.769	0.779
DNN3	FeatureSet2	0.918	0.885	0.889
XGB3	FeatureSet2	0.869	0.864	0.867
DNN3	FeatureSet3	**0.931**	**0.898**	**0.902**
XGB3	FeatureSet3	**0.888**	**0.889**	**0.889**
DNN3	best[5]	0.893	0.887	0.888
XGB3	best[5]	0.861	0.860	0.861
SVM[5]	best[5]	0.851	0.835	0.834

4.1 Results

The results of the feature selection process are listed in Table 1 for the two techniques considered in this paper. As can be seen from the second column of the table entitles instances, the dataset is balanced. From columns 3-5 it can be seen that for the baseline FeatureSet1, the f1 score is 0.57 for the CNN and 0.77 for XGB. By using features that better capture the shape of the time series such as in the case of FeatureSet2, an improvement of up to 20% can be seen as follows: the f1 of the CNN model increasing to 0.89, the precision 0.92 and recall to 0.88. The XGBoost model also performed better with an f1 of 0.87, precision of 0.87 and recall of 0.86. Finally, it can be seen from the table that FeatureSet3 performs the best with the f1 of 0.90, precision of 0.93 and recall of 0.90 for the CNN model and f1 of 0.89, precision of 0.89 and recall of 0.89 for the XGB model. FeatureSet3 performed better than FeatureSet2 because its features had much less correlation between each other as well as all of the redundant features from FeatureSet2 were removed. For FeatureSet3, a variety of different feature orderings were also tested but the results remained more within 1% accuracy variance.

To gain insights into the per class performance of FeatureSet3 with the two techniques, we present per device f1 score breakdown in Table 2. It can be seen that computer monitor, microwave and kettle are classified worst by all three models, as their similar consumption profiles make it difficult for the models to distinguish between them. Nevertheless, the CNN classifies all three the best due to its superior pattern recognition ability.

Table 2: Per class performance, FeatureSet3 vs best [5]

Class	Inst.	CNN f1	XGB f1	[5] f1
monitor	300	0.827	0.833	0.780
laptop	276	0.983	0.932	0.838
television	300	0.992	0.976	0.941
washer/dryer	226	0.941	0.912	0.804
microwave	300	0.688	0.620	0.687
boiler	300	1.000	0.968	0.940
toaster	215	0.949	0.940	0.806
kettle	300	0.756	0.722	0.739
fridge	300	1.000	0.983	0.970

5 Model selection

For analyzing the performance of DNN and XGBoost for our problem we conducted extensive performance evaluations. We started by developing a deep learning sequential model, which at first consisted of three dense layers, each with an arbitrarily chosen number of neurons. By trying different combinations of hyperparameters such as number of neurons, loss functions, optimizers, batch size, number of epochs, number of layers and learning rate, we came closer to finding the best suited model for our problem. For optimizing certain hyperparameters we took advantage of the automatic hyperparameter optimization framework Optuna [2]. We then applied similar optimization techniques on the XGB model, although it's default parameter configuration already gave good results. All the experiments were ran on Google Colab using an instance with Nvidia Tesla K80 GPU and 12.69 GB of RAM.

In this section we present and analyze three representative models from each class, DNN and XGboost respectively.

5.1 Deep neural network

DNN1 - This model consisted of three fully connected dense layers. The first two had 32 neurons each as well as ReLU (rectified linear unit) activation function, while the output layer had nine neurons, each corresponding to one of the nine possible appliances and Softmax activation function.

DNN2 - For this model we took the DNN1 model and added an additional dense layer with 64 neurons as well as changed the activation function to linear in the penultimate layer. With this additional complexity we expected to see better results.

DNN3 - For this model we introduced two 1D convolution layers, first with 128 filters and second with 64. Then we used a flatten layer to reduce the dimensionality of the output space, and make the data compatible with the following dense layer, followed by another (output) dense layer.

[2] $https://optuna.org$

5.2 XGBoost

XGB1 - This is the model with standard configuration, i.e. maximum depth of 3, 100 estimators and learning rate of 0.1.

XGB2 - In this model we increased the maximum depth to 4 as well as first reduced learning rate by 50% (to 0.05) and then increased the number of estimators by 50% (to 200). Doing this gave slightly better results.

XGB3 - For this model we decreased the maximum depth to 2, increased number of estimators to 500 and learning rate to 0.25.

Table 3: Model performance on FeatureSet3.

Model	Precision	Recall	f1	Comp. time
DNN1	0.866	0.851	0.846	10.972s
DNN2	0.900	0.887	0.889	21.026s
DNN3	**0.931**	**0.898**	**0.902**	21.124s
XGB1	0.876	0.863	0.864	1.126s
XGB2	0.884	0.881	0.882	2.518s
XGB3	**0.888**	**0.889**	**0.889**	3.225s
SVM [5]	0.878	0.852	0.852	0.301s

5.3 Results

5.3.1 Classification performance

The classification performance of the models is provided in Table 3. It can be seen that the best performing models are DNN3 with an f1 score of 0.90 and XGB3 with an f1 of 0.88. However, the computation time of XGB3 is only 3.23s while for DNN3 it is 21.12s. The XGB classifier using classical machine learning performed only about 1 percentage point worse than the CNN model, while at the same time being much less complex and able to complete the entire training process about 18 seconds faster than the CNN. In addition, the XGB model is much easier to optimize since it has no hidden layers and a prearranged hyperparameter configuration that usually requires no further optimization at all. From the last line of the table it can be seen that the SVM-based model from [5] performs 5 percentage points less than DNN3 on FeatureSet3.

5.3.2 Computation time

The superior performance of the DNN model comes at a cost of increased algorithm complexity and hence longer computation time. As depicted in Table 3 the first DNN model took 10.97 seconds to complete the training process and the best (most complex one) took 21.12 seconds. XGBoost, on the other hand, was much faster with XGB1 taking only 1.12 seconds. The added depth for the XGB2 caused a slight increase in computation time to 2.52 seconds, which further increased to 3.23 seconds due to the high number of estimators used in XGB3. Finally, the state of the art was the fastest to complete the training process taking only 0.3 seconds but scored the worst in terms of performance.

6 Conclusions

In this paper we investigated the design trade-offs during the feature and model selection steps of the development of the ML-based classifier for ILM. After formulating our problem, we first show that by extracting various statistical features from raw time series data and then training our models with these features, we were able to improve f1 score by up to 20 percentage points.

Second, we propose two different ML techniques and our process of developing the proposed models using these. We show that optimizing hyperparameters to better suit our specific problem can improve their respective performance by around 4 percentage points. However, choosing the right features that better capture the shape of the data has a much greater impact on the end results than optimizing the models. We also show that classical machine learning model does not perform significantly worse than the deep neural network based one, while at the same time being less computationally expensive.

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Volume D

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Insieme Project Workshop

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Matjaž Gams, Primož Kocuvan, Flavio Rizzolio

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FOREWORD

The year 2021 is the first Insieme (ISE-EMH) Workshop since we have reached some achievement to present in the second year of the Insieme Italian-Slovenian Interreg project. Unfortunately, 2021 is also the second year of the Covid-19 pandemics, causing several problems. For one thing, we received less papers for the workshop than expected, although still quite a reasonable number. The second undesired Covid-19 problem is that the participants will not be able to meet in person and discuss the presentations and also the Insieme project progress. There is a certain difference when people meet alive and discuss issues also in the free time after the conference compared to the virtual official-time only events. However, that is the reality that we face these months.
Nevertheless, the Insieme Worksop was proclaimed open to the broader area of Electronic and Mobile health (EMH). As a result, a couple of quite interesting papers were submitted, while on general the quality was extraordinarily high for a workshop. Some of the Insieme and EMH papers seem to bear a huge potential to progress towards decent SCI papers since they indeed tackle important issues and present novel research ideas and methods.
Some of the additional papers deal with the research that yielded 2nd place in one of the top worldwide Xprize competitions for non-pharmaceutical measures against Covid-19. This research also resulted in some other awards, e.g. at the ETAI conference.
There are 13 accepted papers for this year's workshop. Nine of them are related to JSI and the other four to the Insieme project partners. Each Insieme partner submitted at least one paper, which demonstrates the successful cooperation on this project. The workshop consists of two subsections. One is directly related to the Insieme project and the other is for general EMH topics, mainly to the Covid-19, and Comparison between health platforms – another European project Platform Uptake.

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Platform for Multi-Omics Integration (PlatOMICs) applied to skin diseases with alterations in Notch signaling pathway.

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ABSTRACT

Over the last years, a huge amount of information concerning Omics data have been produced and are of crucial significance for the understanding of the molecular mechanisms and for the identification of potential molecular targets associated to many diseases. Indeed, Omics approaches allowed to initially decipher several biological processes found to be critically involved in the context of various pathologies. Despite these remarkable scientific advances, the majority of obtained results are disconnected and divergent, making their use limited. Thus, our team started the deployment of PlatOMICs, a new Platform for multi-omics integration, carrying an user-friendly interface. Currently, PlatOMICs is under deployment in an international cooperation including Brazil, Qatar and Italy and has been divided into three phases. In the present work we report phase I in which multiple database/resource/repositories were interrogated to access data from skin diseases presenting alterations in Notch signaling pathway, as they constitute a cluster of disorders that were extensively studied during the Omics era, in order to perform biological syntactical analysis to be implemented in the next PlatOMICs phases.

KEYWORDS

Omics, genomics, transcriptomics, proteomics, network interaction, skin diseases.

1 INTRODUCTION

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We developed a Platform for Multi-Omics Integration (PlatOMICs) that assembles a set of tools and bioinformatics applications that can allow the retrieval of scientific literature data (genomics, epigenomics, transcriptomics, proteomics and microbiomics) together with the analysis, deciphering, interpretation and integration of all these set of information automatically, therefore building networks of molecular interactions and Omics meta-analysis.
Our goal is to refine the data available in scientific literature and in Omics databases/resource/repositories relative to skin diseases that are characterized by defects in Notch signaling route, seeking to describe networks of molecular interactions in the epithelial tissue potentially involved in the loss of homeostasis in this district, event that may lead to the onset of different skin pathologies.

1.1 Multi-omics integration applied to skin diseases with Notch signaling alterations

An aberrant progression of Notch signaling, either due to altered regulation or direct mutations, can induce skin diseases [1,2]. To date, molecular alterations in Notch signaling pathway have been reported for five human skin diseases including: Hidradenitis Suppurativa (HS), Dowling Degos Disease (DDD), Adams–Oliver Syndrome (AOS), Psoriasis (PS) and Atopic Dermatitis (AD) [1,3]. Therefore, a deep characterization of this cellular route seems to be of pivotal importance in order to clarify potential new pathogenic scenarios involved in these skin diseases. Indeed, considering this critical aspect, in order to further restrict the search, we decided to consider in this study only skin diseases possessing alterations in Notch pathway excluding malignancies.

These skin disorders have been thoroughly studied in the last five years; indeed, 1555 articles regarding these five diseases and OMICs (genomics, transcriptomics, proteomics and microbiomics) studies are available in PubMed [4].

Specifically, considering these five skin disorders possessing alterations in Notch signaling, 821 articles about genome, 225 about transcriptome, 143 about proteome and 602 about microbiome, were published.

1.2 Perspectives on multi-omics integration for skin diseases with alterations in Notch signaling pathway

Currently, PlatOMICs is under deployment in an international cooperation including Brazil, Qatar and Italy. PlatOMICs will be an online platform offering services to access and analyze scientific literature and Omics data automatically with great accuracy. The deployment was divided into three phases and in the present work, we report phase 1. Briefly, the various phases that constitute PlatOMICs multi-omics analysis are given by: phase I, step based on the interrogation and analysis of the whole available literature and Omics databases; phase II, stage regarding the analysis and questioning of previous and new Omics (or multi-omics) studies; phase III, part relative to the merge of findings deriving from phases I and II in order to finally compose the ultimate multi-omics integration in a meta-multi-omics analysis (Figure 1).

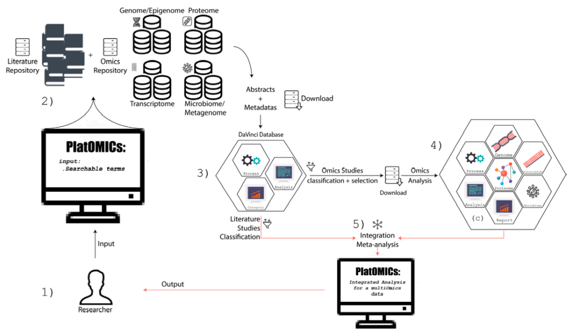

Figure 1. Workflow of OMICs Platform (PlatOMICs) for Omics integration. (1) The user informs the descriptors, categorical terms and keywords in PlatOMICs. (2-3) Through DaVinci tool, the literature and the OMICs databases will be evaluated. (4) Selected omics studies and new ones are (re)analyzed and integrated by standard pipelines. (5) PlatOMICs produces the final meta-analysis multi-omics integration results in a friendly interface.

The first analysis (phase I) outputted by PlatOMICs is performed by the new tool called *DaVinci Literature and Database Analysis* (under submission and not publicly available). Briefly, DaVinci is able to scan several databases, such as PubMed, SRA, GEODatabase and GWAS Catalog, extracting multiple information from summary, abstracts and other meta-data information to report a syntax analysis and molecular panels (genes, variants, tissues, cells and drugs). Next, following the study and sample selection from the previous researches, raw data might be downloaded. The analysis, including the new Omics (or multi-omics) studies, will be carried out by the same standard pipeline when performed, hence securing a more reliable and homogeneous investigation. Therefore, PlatOMICs will contain the results obtained from literature and their integration, databases and new Omics studies.

2 RESULTS

As a validation model, phase I of PlatOMICs was executed on skin diseases presenting alterations in Notch signaling pathway by examining the literature, thus providing molecular insights to multi-omics integration approaches.

2.1 Results deriving from literature analysis: molecular insights to multi-omics integration

The literature scan was accomplished by assessing the following term "(Hidradenitis Suppurativa OR Dowling Degos Disease OR Adams Oliver Syndrome OR Psoriasis OR Atopic Dermatitis) AND (Genome OR transcriptome OR proteome OR epigenome OR microbiome OR metagenome OR metabolome OR omic OR multi-omic) AND 'Homo sapiens'[orgn:__txid9606]" using the DaVinci tool.

A DaVinci literature database (DaVinci Lit) was created with 1252 articles retrieved from PubMed, and amongst all recovered papers 82 were excluded due to the absence of abstract/summary. Next, the remaining 1170 articles were analyzed, classified and categorized. The most cited words were 'skin' and 'patient'. The words ‘immune’, ‘inflammatory’ and ‘inflammation’ were common. 742 (63.4%) of articles cited, at least once, one of the indicated words. Next, we seeked the context of each of these terms, revealing that they were mainly used to explain the immune and inflammatory conditions of each disorder. 'Expression' was cited along 333 (28.4%) articles to demonstrate molecular expression on experimental works of transcriptome (48 articles), epigenome or methylome (36 articles) and proteome (12 articles). The last word worth commenting is 'gut'. Gut was present in 158 articles and refers to the existing relationship between gut dysbiosis and the onset of allergic, the latter also represents a term included in the top cited words, disbalance. The overview of word atomization enabled us to understand what was the main focus of Omics literature for skin diseases with alterations in Notch signaling pathway.

Next, we categorized the whole DaVinci Lit into five classes of Omics. Most of the articles were included as a genome or microbiome (metagenome) study, followed by transcriptome and multi-omics approaches (Table 1). Moreover, in the multi-omics category, the most commonly employed approaches included the combination between genome and transcriptome and genome and microbiome.

Category	Number of article
Genome	245
Microbiome	241
Transcriptome	97
Proteome	32
Metabolome	2
Multi-Omics	95

Table 1. Omic categorization of literature from Omics studies concerning skin diseases with alterations in Notch signaling pathway.

The next step in PlatOMICs is to extract genes and variants from the literature. The goal is to unravel genes/variants previously established as involved with skin disorders characterised by alterations in Notch signaling route. In this circumstance, the gene atomization process retrieved 546 genes. From obtained genes, we extracted each time the context in which the gene was cited. In total, 465 articles and 1308 gene contexts were analysed. Subsequently, four researchers classified, independently, the gene relations as associated or not associated with the disease. Of these, 80 genes were excluded, and 426 genes were associated.

Next, PlatOMICs outputted the top 10 pathways and gene ontology (GO) predicted by these genes (Table 2). Enrichment pathway and a GO analysis were conducted by reactomePA, limma and topGO Bioconductor package. The pathway reveals the role of interleukin (IL) signaling, mainly driven by IL-4, IL-13 and IL-10. GO adds the defense response and interspecies interactions between organisms. Collectively, both descriptions point out that inflammation and skin microbial host defense are to be considered as key outcomes from the global literature findings, suggesting that these pathways and GO should be included in future Omics studies.

PlatOMICs also performed a gene atomization on DaVinci Omics. This analysis was assessed on 158 genes, most of which were found to be similar to the DaVinci Lit output. Equals enriched pathways and GO from Table 2 were found, thereby ratifying the importance of these pathways and GO on multi-Omics integration.

3 CONCLUSION

The scientific goal of PlatOMICs is to promote the understanding of biological mechanisms and molecular networks, underlining both health and diseases states, using existing data. The presented platform for multi-omics integration constitutes a time-saving and cost-efficient approach that might surely guide researches in the advancement of more elaborate and articulated hypothesis. Indeed, PlatOMICs is able to refine, assemble and integrate thousands of information spread around multiple database/resource/repositories. In the future, PlatOMICs will present an intuitive and automated friendly web-end interface with accessible tables, graphs and images.

The accumulation of scientific texts and Omics data settled in various databases may have never been correlated and analysed in conjunction. In this perspective, it is presumable that significant scientific responses may have been generated but are still uncovered. In this critical context, PlatOMICs was developed in order to promote the analysis and integration of the available Omics data, and in the present study we applied PlatOMICs for the analysis of skin diseases as a validation model. Our approach allowed us to further emphasize that our integrated strategy seeks to identify a common link between skin diseases and deregulations in homeostatic processes in epithelial tissues.

ACKNOWLEDGMENTS

This work was supported by a grant from the Institute for Maternal and Child Health IRCCS "Burlo Garofolo/Italian Ministry of Health" (BioHub 03/20), by the grant Interreg Italia-Slovenia, ISE-EMH 07/2019 and by CNPq (311415/2020-2).

Reactome ID	Pathway Description	GO ID	GO Description
R-HSA-449147	Signaling by Interleukins	GO:0034097	Response to cytokine
R-HSA-6785807	Interleukin-4 and Interleukin-13 signaling	GO:0019221	Cytokine-mediated signaling pathway
R-HSA-6783783	Interleukin-10 signaling	GO:0071345	Cellular response to cytokine stimulus
R-HSA-877300	Interferon gamma signaling	GO:0002376	Immune system process
R-HSA-447115	Interleukin-12 family signaling	GO:0006952	Defense response
R-HSA-8854691	Interleukin-20 family signaling	GO:0009605	Response to external stimulus
R-HSA-913531	Interferon Signaling	GO:0044419	Interspecies interaction between organisms
R-HSA-380108	Chemokine receptors bind chemokines	GO:0070887	Cellular response to chemical stimulus
R-HSA-451927	Interleukin-2 family signaling	GO:0010033	Response to organic substance
R-HSA-1059683	Interleukin-6 signaling	GO:0051707	Response to other organism

Table 2: Top 10 Enriched pathway and a gene ontology of 426 genes associated with skin diseases with alterations in the Notch signaling pathway.

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Implementing the INSIEME portal according to the patients and caregivers' point of view

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Figure 1: Official logotype from the project

ABSTRACT / POVZETEK

The 2030 Agenda for Sustainable Development highlights that the spread of information and communications technology and global interconnectedness has great potential to accelerate human progress, to bridge the digital divide and to develop knowledge societies[1].

In the health sector as well, technology can help people tracking and controlling their own health information and make informed decisions about their health but only at two conditions[2]:

- Technology must be really accessible
- Health information must be really understandable, scientifically correct and aligned with the reality

The project Interreg Italia Slovenia ISE-EMH aims to create a health portal integrating useful information about health topics and health facilities related to a specific interregional area both in Slovenian and Italian languages. INSIEME is the name of the portal.

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[1] WHO, Draft Global strategy on Digital Health 2020-2025. Available at http://bit.do/fLkpp

[2] Australia's health 2018, available at http://bit.do/fLkoA

KEYWORDS

Oncology, health topics, health facilities, patients, caregivers, cancer survivors, digital health

1 Introduction

The contribution of the Ca' Foscari University, partner of the project, was to integrate into this portal INSIEME some categories of useful resources related to the cancer topic. The selection of these categories was made with the contribution of a cancer survivors and caregivers association. It is a fact that very often a patient relies on the search engines algorithms to find out the information he/she needs. But it happens that resources ranked as not important by the search engines are actually very useful to him/her. So, the point of view of some individuals, both cancer patients and caregivers, was the main guide to identify the resources to be listed in the portal. Not only the management of the cancer disease is important to a patient but also his/her mental condition, his/her wellness and practical things such as accommodation and work related issues [3]. There are good examples of this integration[4]

2 Results

A preliminary search was made to find out informational resources about cancer to widen the spectrum of categories and services. Then we tried to categorize the cancer services related both to the area of the metropolitan city of Venice and the Region Friuli Venezia Giulia.

In addition to basic services, the search has highlighted the following complementary categories:

- Hospital services
- Social services
- Physiotherapy services
- Physical activities opportunities and related opportunities
- Psychological services
- Accommodation services for patients and/or family members
- Information and counselling services about health topics and patients' rights
- Administrative services
- Local social and health services – screening
- Local social and health services - palliative care
- Voluntary associations
- Independent information on cancer
- Information on fake news

For each category, a minimum of 5 websites was listed if available.

Below a brief summary of the research carried out through the consultation of a large number of websites.

- Hospital health services: nº 15 facilities were found in the province of Venice and nº 24 in Friuli Venezia Giulia.

- Social services: the individual municipalities of the province of Venice and the Region of Friuli Venezia Giulia offer social services to citizenship

- Physiotherapy and rehabilitation services: as far as the province of Venice is concerned, the two main departments of Physical Medicine and Rehabilitation of the San Giovanni e Paolo Hospital of Venice and the Angelo Hospital of Mestre have been described. In addition, the local rehabilitation and physical therapy services in the different health and social authorities have been listed. About the Friuli Venezia Giulia Region, the two University & health agencies of Udine and Trieste have been described, in addition to health services of home rehabilitation

- Psychological services: the family counselors are available in the metropolitan area of Venice and in the Friuli Venezia Giulia Region. In addition, the ANT Foundation 1978 Onlus has been described that offers psychological support at home to all patients.

- Accommodation services: accommodation facilities near the main hospitals have been described with the information of their websites. Some of them are free, others offer low price accommodation. In addition, the channels of Airbnb and Booking.com have been reported;

- Information and advocacy services for the protection of patients' rights: for both areas were listed the main services

- Administrative services

- Local health and social services - Screening: the cancer prevention opportunities of the Friuli Region has been listed

- Local social and health services - Palliative care: the Health District of Mirano and Dolo has been reported with regard to palliative care services;

- Specialized voluntary associations through the useful webtool of Oncoguida [5], the large number of voluntary associations operating in the area of Venice and Friuli can easily be identified.

- websites with dealing with current information about cancer topics and tools to easily discover fake news were also described

- websites with patients stories or personal narrations were also indicated as they are very helpful to patients wellness. Last but not least the websites related to all the hospitals and Health Comprehensive Centers of the Friuli Venezia Giulia Region and Venice area were listed and described.

[3] Truccolo I, Cipolat Mis, C, De Paoli P (eds), Insieme ai pazienti. Costruire la Patient Education nelle strutture sanitarie. Il Pensiero scientifico, 2016

[4] Kildea J, Battista J, Cabral B, Hendren L, Herrera D, Hijal T, Joseph A. Design and Development of a Person-Centered Patient Portal Using Participatory Stakeholder Co-Design. J Med Internet Res. 2019 Feb 11;21(2):e11371. doi: 10.2196/11371

[5] Oncoguida, available at [5] http://www.oncoguida.it/html/home.asp

Figure 2: View of the Oncology section in the INSIEME portal

3 Conclusions

The different categories of resources integrated into the INSIEME portal are not exhaustive of course. They just give a hint of the importance of taking into account both informational and practical resources and involving patients and caregivers in the building of digital health portals

ACKNOWLEDGMENTS

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[4] Kildea J, Battista J, Cabral B, Hendren L, Herrera D, Hijal T, Joseph A. Design and Development of a Person-Centered Patient Portal Using Participatory Stakeholder Co-Design. J Med Internet Res. 2019 Feb 11;21(2):e11371. doi: 10.2196/11371

[5] Oncoguida, available at http://www.oncoguida.it/html/home.asp

An Analytical and Empirical Comparison of Electronic and Mobile Health Platforms

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ABSTRACT

Electronic and mobile health (EMH) is a new way of delivering health services to patients with the use of small portable devices like mobile phones or tablets. The term electronic indicates that doctors and medical personnel use electronic health records or electronic prescribing of medicine for patients. Some countries like Slovenia, use electronic prescriptions of medicine for many years now. According to World Health Organization (WHO), mHealth has the ability to transform the delivery of health services all over the world and bring about a paradigm shift in healthcare delivery processes [6]. By using technological innovations we can overall improve healthcare not only in developed countries but also in countries that are still in the developing phase. In these countries, there is a lack of doctors, so optimizing the process of delivering medicine and information to the patients is very desirable. In this paper, we describe some of the EMH online available platforms and compare them with the one which we developed within the ISE-EMH project.

KEYWORDS

mHealth, eHealth, electronic and mobile health, EMH, comparison of EMH platforms, ISE-EMH

1 INTRODUCTION

From the early beginning of the web when there was only limited information about key institutions, e.g., universities, libraries, and organizations, available on the web and till this day where we can find practically anything including illegal organizations and activities, the public need platforms or portals which will aggregate all useful information on one central place. While anything can be found on the web, it is often difficult to find proper and useful information [9].

To overcome the issues of disinformation especially in the field of medicine and products for the elderly, as part of the ISE-EMH project we implemented a unified EMH platform together with an application for smart hardware devices. We described the application for smart devices in [9]. The EMH platform is a central entity where the user can find key information about health and elderly, and where he can converse with other patients and doctors via text- or video-based call centers, or exchange information, e.g., x-ray images or photographs of the patient skin. We analytically and empirically compare the existing EMH platforms with each other to learn more about the pros and cons, and to improve the ISE-EMH platform in the future.

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The rest of the paper is organized as follows: In Section 2, we describe existing platforms. Section 3 presents the ISE-EMH platform, The results of analytical and empirical comparison of the platforms are given in Sections 4–5. Finally, Section 6 summarizes the paper with ideas for future work.

2 AN OVERVIEW OF EXISTING EMH PLATFORMS

2.1 Genoa

Genoa is a platform that offers telepsychiatry services [5]. It is, for now, available only in the United States. It connects people (patient-doctor) through a system of video-conference technology. Telepsychiatry is a branch of telemedicine where they only provide help for psychiatric and mental disorders.

2.2 DigiGone

DigiGone is a packet of services, including a medical one called DigiMed [2]. Their philosophy is like that of Genoa. However, they offer general medical services, not only for psychiatric problems. For example, when applying as a patient, you get a technical kit. When you have an appointment with a doctor, your nurse or caregiver comes to your home and examines you, and via video conference tells the information to a doctor. In this kit, you have also an ultrasound device, so it can stream the data to the doctor in real-time.

2.3 Doxy.me

Doxy.me is a free telemedicine service, implemented as a web application, thus no installation is needed. It is also accessible from various devices. All you need is a microphone and a web camera. All the data is encrypted and also no account is needed, in contrast to many other platforms [3].

2.4 eVisit

eVisit is a telehealth service that is not free of charge. For the doctors and patients it offers virtual flexible scheduling [4]. For doctors it provides a list of medications for prescription to patients, which is a very convenient and helpful feature that saves time. Other platform services are similar to the already described ones in other telemedicine platforms.

2.5 iPath

iPath is the oldest telemedicine platform from the early beginning of the development of protocols for the internet. iPath is a case-based collaboration platform that is used in telemedicine applications to share information within a distributed group of people. It is being used in the domains of consultation, teaching and research [8]. It is also multilingual like the ISE-EMH platform.

2.6 MedSymphony

The MedSymphony platform is build for telemedicine electronic and mobile health, MedSymphony is directed to accelerate the use of telemedicine as a key platform for providing health care. The key feature is to provide better health care for millions of patients anywhere and anytime. MedSymphony was created to qualify doctors, medical personnel, caretakers and health institutions as well as patients with a complete electronic and mobile health technology platform. The platform includes everything you need to establish a video-based doctor's office. – a completely cloud-based compliant solution with integrated video conferencing, online prescription ordering joined with SMS, MMS, and email integration to facilitate the doctor-patient relationship, and automated billing for recurring and one-time fees [10].

2.7 Bodi Zdrav

Bodi Zdrav (in English "Be Healthy") is a Slovenian health-related platform [1] and it is only meant for patients in Slovenia. Its purpose is to give information about the services and to connect the patients and doctors. It only offers services that are not officially recognized in medicine, e.g., homeopathy, bio-resonance, hypnotherapy, etc. Its main content is a search function through regions in Slovenia and filtering of services from specific medical branch.

2.8 EcoSmart

The EcoSmart project was a three-year project that included the participation of 26 partners. It included smart cities as well as eHealth and mHealth domains. Within the project, an electronic and mobile health system was developed. The purpose of the system was to provide key information about the project partners and municipalities in Slovenia, as well as health domains and prototypes. It also included a smart bot for which the main task was to answer questions to users.

3 THE ISE-EMH PLATFORM

3.1 Basic Information

The ISE-EMH platform is being developed within an Interreg Italy-Slovenia project, where the final goal is to develop a unified telemedicine (EMH) platform for both Slovenian and Italian public and private institutions, with the aim of accelerating the cooperation between Italian and Slovenian stakeholders and transfer knowledge from academic field into practice. The platform includes new diagnostic approaches, advanced sensors, including devices that monitor vital signs, and also methods of Artificial Intelligence (AI) that will help patients overcome anxiety, depression and sedate stress. By connecting various stakeholders, the platform also aims at overcoming the main problem of EMH that is the lack of transfer of innovative services from laboratories into practice, due to the lack of support services in terms of both ICT systems and human partners, and their integration [9].

3.2 Detailed Description of the ISE-EMH Platform

The purpose of the ISE-EMH is to connect different partners, medical personnel, doctors, patients, and end-users. This is done through different logic and programmatic mechanisms. The platform uses the Rocketchat text-based communication system to enable users, e.g., patients to send questions to doctors. Also, the patients can converse with each other in the public channels, where they can exchange thoughts / opinions about their diagnosis, disease or condition. Also, the platform includes a virtual assistant (bot) and connects it with the Rocketchat system. The purpose of bot is to answer questions about medicine, partners, waiting queues, and similar. This is helpful when no doctor is available. There is also an advanced search mechanism, implemented with the versatile, fast, and efficient Elasticsearch.

The ISE-EMH platform development will result in an EMH ecosystem that will include/provide [7]:

- A platform that connects products and services, i.e., the backbone of the ecosystem;
- Integration and connection of existing products, services, and systems through the platform in a complete ecosystem.

4 ANALYTICAL COMPARISON

The described platforms were compared with respect to a set of selected features (see Section 4.1). The comparison was performed analytically and empirically, where the results of the former evaluation are presented in Section 4.2 and the results of the latter one are given in Section 5.

4.1 Choosing the Features for Comparison

The set of features for the platform comparison consists of carefully selected features, selected based on the state-of-the-art research in the EMH domain. Demographic and social characteristics were also carefully taken into account, e.g., if it is free of charge for using it and if it is available in more than one language. We also included some of the other key features which are important for user experience, e.g., if it has a GUI and if it is responsive or not. The selected features are the following:

- Free: Is the EMH platform free of charge to use it?
- Graphical user interface: Does it have a GUI or is it just text-based?
- Dynamic data: Can we insert new data and update the fields via a form?
- Responsive: Is the web platform responsive, which means, does it automatically resize the website when viewing on the different devices?
- Virtual assistant: Does the platform offer the chance to talk with a bot, e.g., about medicine, diagnosis, partners, etc.?
- Use without registration: Can we use the EMH platform without registration?
- Multilingual: Is the EMH platform available in more than one language?
- Official medicine: Does the EMH platform offer services to the people from only official (recognized) medicine?
- Call center: Does the EMH platform offer call centers (text-based or video-based) for getting help?
- General medicine: Does it offer services from different medicine practices or only one?

4.2 Results of the Analytical Comparison

The results of the analytical comparison of platforms are shown in Table 1. Based on these results we constructed a histogram of features, where each bar presents the percentage of included features in a specific EMH platform (see Figure 1). This histogram shows that the worst platforms with respect to the chosen features are Genoa and BodiZdrav.

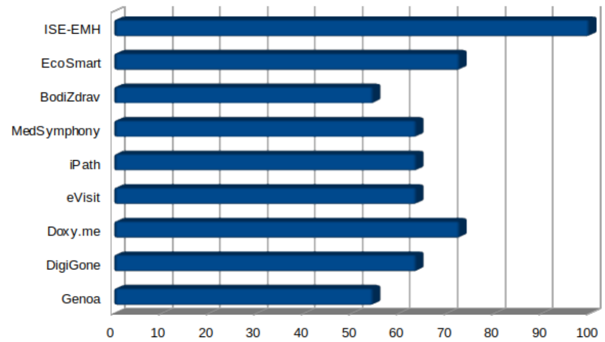

Figure 1: A histogram of platform feature percentages, where each bar represents the percentage of checkmarks from Table 1.

For Genoa the cons are that it is not free, it does not have a virtual assistant, e.g., a bot that can answer your question at any time of the day, you cannot use it without registration, it is not multilingual, and also the usage is limited to only psychiatric conditions, since they are specialized only in telepsychiatry.

For BodiZdrav the cons are that it does not have a virtual assistant, it is only available in the Slovenian language, the services which they offer are not from officially recognized medicine, it does not have call centers, and also they do not have services from general medicine but only alternative medicine.

The most versatile and useful system based on the selected features is the ISE-EMH platform.

5 EMPIRICAL COMPARISON OF SIMPLY ACCESSIBLE PLATFORMS

Among the evaluated platforms, the ones that are simply accessible, i.e., they do not require to create an account to use them, were further analysed. This analysis was empirical, from the user perspective usage, and it also included side features such as user story. Based on the simply accessible criterion, three systems were empirically analysed: Bodi Zdrav, EcoSmart and ISE-EMH.

5.1 Bodi Zdrav User Experience

The Bodi Zdrav platform has a good graphical user interface design. When the user visits the page, it has only one component on the landing page, i.e., a search. The user can select a category and a region, which act as filters for search. As already mentioned, it does not have a virtual assistant nor call centers (see Figure 2).

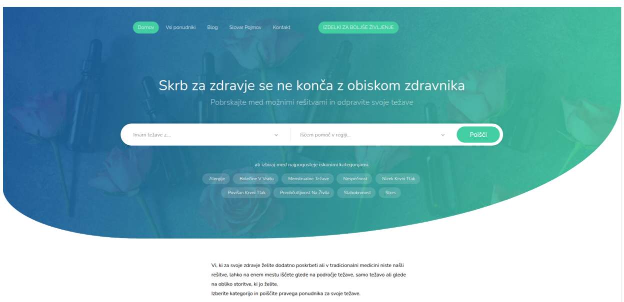

Figure 2: Bodi Zdrav Homepage.

5.2 EcoSmart User Experience

The EcoSmart platform has a simple and sleek graphical user interface design. When the user first visits the page it has ten categories on the landing page. It does not provide a search tool, but it has a link to the EcoSmart bot and other bots on the page (see Figure 3).

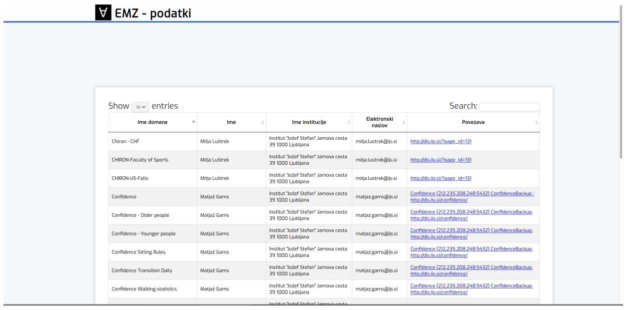

Figure 3: EcoSmart Homepage.

5.3 ISE-EMH User Experience

The ISE-EMH platform has an original graphical user interface design. A user visiting the page for the first time has all the components on the landing page (see Figure 4). These components are a virtual assistant, services, search tool, and button for changing the language. This is very crucial when users need to find specific information fast. The user interface is constructed and designed in such a way that every person no matter the age can use the platform.

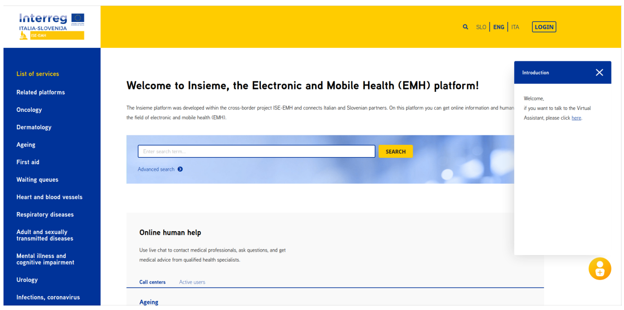

Figure 4: ISE-EMH Homepage.

6 CONCLUSION

In this paper, we described and compared a set of most important EMH platforms that are available on the web. Also, we presented the developed ISE-EMH platform. We also analytically compared these platforms based on a selected set of key features. In addition, a subset of platforms was empirically compared by focusing on a user's point of view. This analysis shows that the best-rated platform is the ISE-EMH platform.

In our future work, we will test our hypothesis stating that a user can find specific information about health-related topics on the ISE-EMH platform in under 30 seconds, instead of searching for more than 30 minutes on other platforms or through the search engine like Google or Bing. We will conduct the experiment with the help of volunteers, where they will try to find 10 randomly selected services on the ISE-EMH platform and also using a general search engine.

	Genoa	DigiGone	Doxy.me	eVisit	iPath	MedSymphony	BodiZdrav	EcoSmart	Insieme
Free	✗	✗	✓	✗	✓	✗	✓	✓	✓
User-friendly	✓	✓	✓	✓	✗	✓	✓	✓	✓
Graphical user interface	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dynamic data	✓	✓	✓	✓	✓	✓	✓	✗	✓
Responsive	✓	✓	✓	✓	✗	✓	✓	✓	✓
Virtual assistant	✗	✗	✗	✗	✗	✗	✗	✓	✓
Use without registration	✗	✗	✗	✗	✓	✗	✓	✓	✓
Multilingual	✗	✗	✗	✗	✓	✗	✗	✗	✓
Official medicine	✓	✓	✓	✓	✓	✓	✗	✓	✓
Call center	✓	✓	✓	✓	✗	✓	✗	✗	✓
General medicine	✗	✓	✓	✓	✓	✓	✗	✓	✓

Table 1: Comparison between the analysed EMH platforms.

ACKNOWLEDGMENTS

The paper was supported by the ISE-EMH project funded by the program Interreg V-A Italy-Slovenia 2014-2020. We thank students Urša Klun, Lan Sovinc and Jan Urankar for helping at the implementation of the ISE-EMH platform.

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Android Application for Remote Monitoring of the Elderly's Parameters

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ABSTRACT

According to the latest predictions, the average age in Europe in 2050 will be 49, whereas today it is only 39 years [3]. Europe, therefore, faces quite a significant population problem. With insufficient numbers of young workers, we need technical, economic, and political solutions to help the elderly maintain vitality and independence. The aim of technical solutions is to delay the departure of the elderly to a retirement home and to help maintaining the economic stability of the country. In this paper, we describe an application that helps the elderly and relieves the society and economy. We present the technical specifications and features of the Android application, which was developed as part of the project ISE-EMH (Insieme) with the collaboration of IPM Digital within the project HoCare 2.0. The Android application is created and intended for usage for the pairs: one elder and one caretaker (e.g relatives, nurses, paramedics).

KEYWORDS

Android application, care for the elderly, elder, caretaker, fall detection, easy to use, ISE-EMH, Insieme, HoCare 2.0

1 INTRODUCTION

Due to the development and introduction of so-called MEMS (Microelectromechanical systems) technologies in mobile devices, these became smarter in terms of tracking and perceiving the environment [1]. This is achieved by using accelerometer, GPS, gyroscope, proximity sensor, and many other sensors. These sensors allow us to monitor the movement of a person, location and brightness of the room in which a person is located. This comes in handy in the research field of ambient intelligence. In our case, we developed an application for the elderly and their caretakers which allows us to use these technologies. In this paper, we will describe the application and its technical features. The paper is thus divided into two central sections. The first describes the functions that an elderly person can use and the second describes the functions caretaker can use. Finally, we describe the advantages and disadvantages of the developed application, which were highlighted by the elderly in the performed focus group.

1.1 Basic information about the project

As part of the Insieme project, we implemented a unified EMH (Electronic and Mobile Health) platform together with software for smart devices. The platform includes new diagnostic approaches, advanced sensors, including wearable devices that monitor vital signs, and sophisticated computer algorithms and artificial intelligence methods that gain new knowledge from data. The main problem regarding the introduction of EMH remains the transfer of innovative services from laboratories into practice, as there is a lack of support services in terms of both ICT systems and human partners and their integration. As a rule, researchers can not find commercial partners for even the most excellent academic prototypes, while the prototypes are rejected due to inertia, despite the indisputable advantages of both ICT and knowledge. It is difficult to implement novel ICT solutions to the elderly. The key purpose of this project is to accelerate the cooperation of Italian and Slovenian stakeholders in the field of EMH and the transfer of knowledge, systems, and services of EMH from the academic sphere to actual use. The other purpose is to enable better connections between users and providers. While anything can be found on web, it is often difficult to find proper information. Bearing these specifications in mind, several applications are being included in the platform, one of them being the Android application presented here.

1.2 Chosen Android OS and programming language

According to the global market share in Table 1, obtained in May 2021, the most used OS for smartphones is Android OS with about 72% market share [2]. Therefore, Android OS was chosen as the operating system for our application. Regarding the programming language, we were deciding between Kotlin and Java. As Kotlin is a fairly new language, we had chosen Java. Java is still a versatile and general programming language that runs inside Java Virtual Machine environment[1].

Table 1: Global market share for mobile phone's OS

Operating system	Market share in procent
Android OS	72.18%
iOS	26.96%
Samsung	0.43%
KaiOS	0.19%
Unknown	0.14%
Nokia Unknown	0.03%

1.3 Overview of the functions

Here is a list of all functions implemented.

The elder has access to these functions:

- reminders,

[1]The Kotlin also uses virtual environment

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- contacts,
- SOS function,
- settings,
- fall detection,
- pedometer,
- alarm when searching for mobile phone,
- alarm as a reminder to charge the battery.

The caretaker has access to these functions:

- overview of elder's parameters,
- history,
- exact location of the elder,
- sandbox settings,
- enable/disable the settings for the elder.

All functions for both the elder and the caretaker will be described in more details in the following sections. The application runs on two advanced mobile phones with Android OS. The general idea is that the elder needs help, support and monitoring of the caretaker, and the mobile phones enable the needed functionality.

2 THE INITIAL SCREEN

First, user has to confirm and enable access to the services of the phone. The user has to grant application permissions of:

- accessing the contacts,
- accessing the location of the device,
- accessing the multimedia and files,
- recording and taking photography,
- sending SMS messages,
- making telephone calls,
- audio recordings.

Figure 1 presents the initial screen of the Android application. The elder and the caretaker enter their role. The selected role is set once for the application, and to change it, the application has to be installed again. On the initial screen, the user can select the language. The application is available in Italian, English, and Slovene. There is also a button on the bottom of the initial screen. By pressing it, a user can start or stop a function of searching the mobile phone by vocal call.

3 THE ELDER'S HOME VIEW AND FUNCTIONS

3.1 Sandbox

Sandbox is a term that denotes the area of elder's home, residence or a safe place defined by the elder during the initialization of their profile. When the elder leaves the sandbox area, the caretaker is notified via SMS message. The elder or caretaker can arbitrarily set the radius of a sandbox area from minimum of 0 meters and a maximum of 500 meters. Changing the distance by elder is only possible when the caretaker allows it in the settings.

3.2 Battery

The elder is alerted when the battery charge drops to 20%. In case the elder does not connect their phone to the charger, the application warns them about it every 5 minutes.

3.3 Mobile phone location and vocal search

The application is periodically sending the location of the mobile phone to the central server. From there, the information is transferred to caretaker's mobile phone. In case the elder's phone

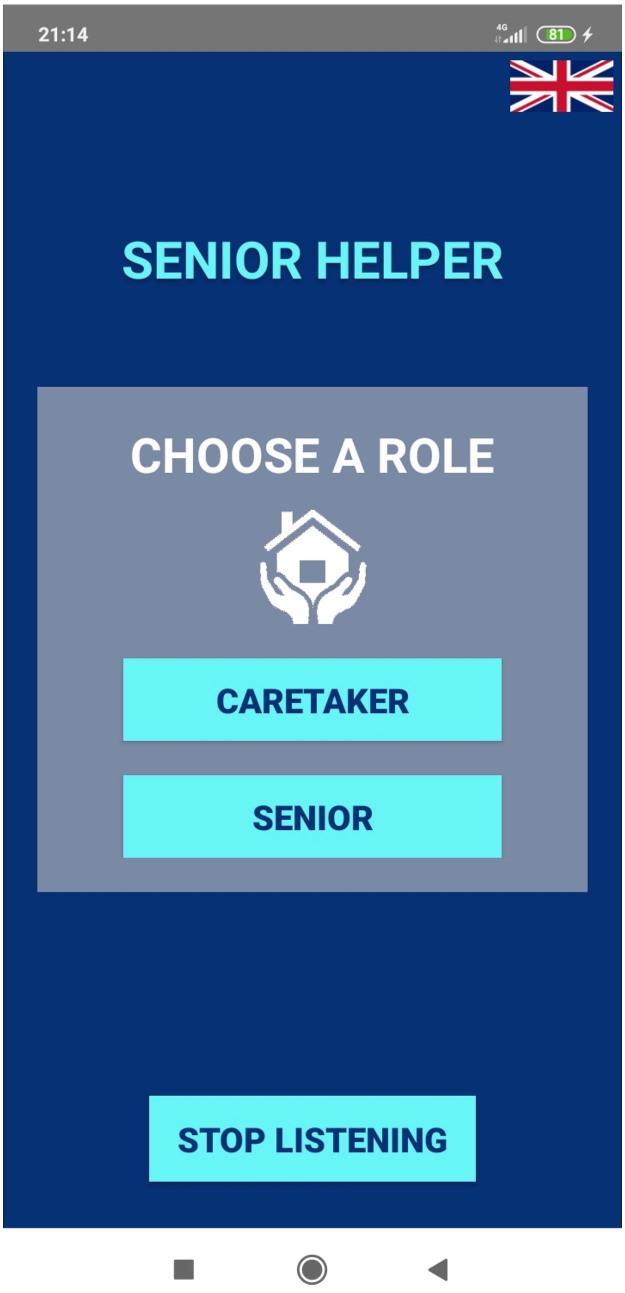

Figure 1: The initial screen, shown during the first use of the application.

has no internet connection or GPS service turned on, the last location on the server is displayed to the caretaker.

The elder can also enable the search for mobile phone function. If enabled, the mobile phone is constantly listening to its environment. In case the elder forgets the location of the mobile phone and wants to find it, they should say the keyword "TSUNAMI" loudly and clearly. The mobile phone will start to vibrate and ring in order to reveal its location.

3.4 Alarms and reminders

The elder has an option of adding one-time or periodic alarms. One-time alarms are designed for non-daily tasks such as visiting

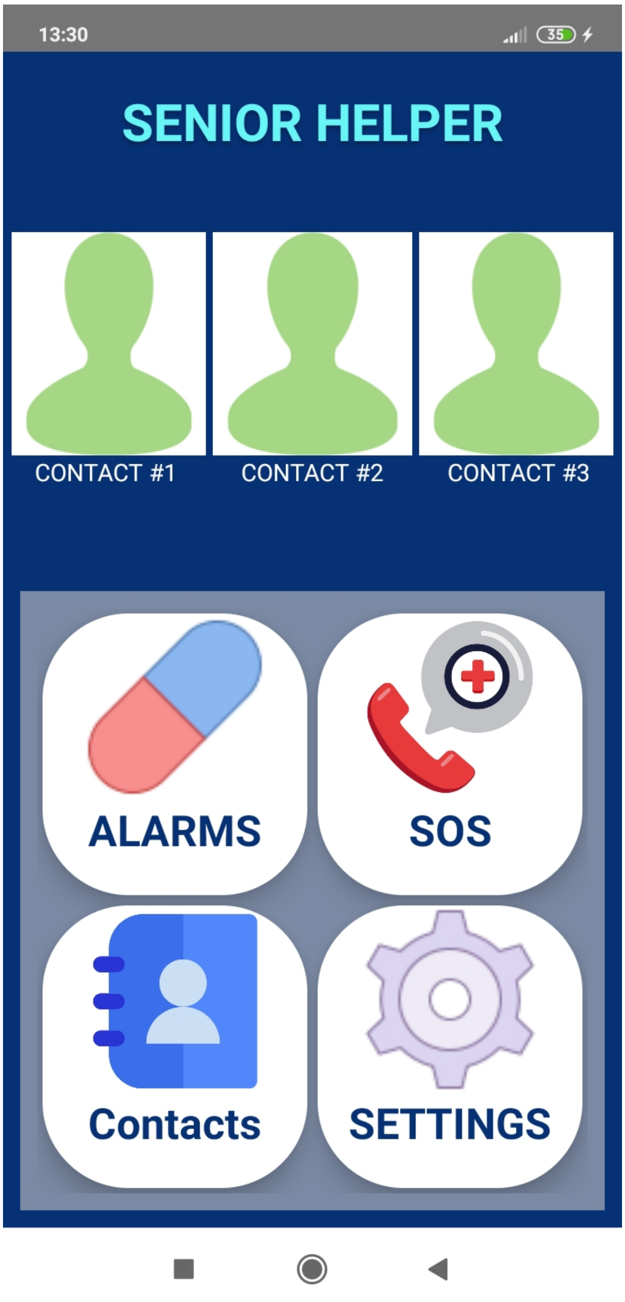

Figure 2: The elder's home view, after they enter their personal data

a doctor. Periodic alarms are designed for daily tasks such as taking medications at a specific time. When the alarm goes off, the elder must confirm it. This sends a confirmation to the central server, from which the caretaker can check the status of alarms. The elder's access to the alarms can be seen on elder's home page, depicted on Figure 2.

3.5 SOS function and fall detection

In the event of problems such as nausea or feeling unwell, the elder can press the "SOS" button, which triggers a call for help by successively calling the contacts on the list. The application calls contacts by the list order, i.e. priority. In case there is no response to the call of the first contact, it calls the second, and so on. The elder can add a maximum of three contacts to the SOS call list.

The application has an implemented algorithm that detects the falls of the elder using the phone's accelerometers. In order to do that, the elder must have a phone that has a built-in accelerometer. In case of false detection, the elder can press the "Cancel Fall" button. A SMS message is sent to the caretaker that either a fall or a false fall has occurred.

3.6 Phone book and pedometer

The elder has the option of storing existing or new contacts in the app's phone book. By arranging the contacts in the directory, priorities are assigned to the individual contacts for the SOS function.

The app measures the number of steps that the elder has taken. Depending on the refresh interval, the application sends the data to the central server, from which the values can be read by the caretaker.

4 THE CARETAKER VIEW AND FUNCTIONS

The motivation for the caretaker's application is that it enables the caretaker to monitor and communicate with the elder. The elder's application, on the other hand, has two modes of work: in case of elder's inability to set technical functions, the elder has access to limited set of functions, such as calls, SOS button and similar. If the elder is still able to control the settings of the application, then all options are enabled. The caretaker has full control of all functions.

4.1 Sandbox

In case of the caretaker, the sandbox area is denoting the home, residence, or safe place of each specific elder separately. The caretaker can arbitrarily change the radius of sandbox area from the minimum of 0 meters and the maximum of 500 meters. They do this by entering the more options extension of settings and using the slider to select the desired distance. In the menu, they can also enable access to the settings of a particular elder.

4.2 Battery

At 15% charge of the elder's battery, the application automatically sends a SMS message to the caretaker. The message contains a warning that the battery status of the elder's mobile phone is low. This gives the caretaker the chance to contact the elder and remind them about charging the phone.

4.3 Mobile phone location and vocal search

The caretaker can see the last known location of the elder by pressing the "Show exact location" button. A Google map opens, where a blue dot indicates the last known location of the elder. If the elder has internet connection and GPS location turned on, the last known location is also the current location of elder's phone. The caretaker does not have the option to perform vocal search for their mobile phone.

4.4 Alarms and reminders

The caretaker sees the confirmation of specific elderly person's alarms.

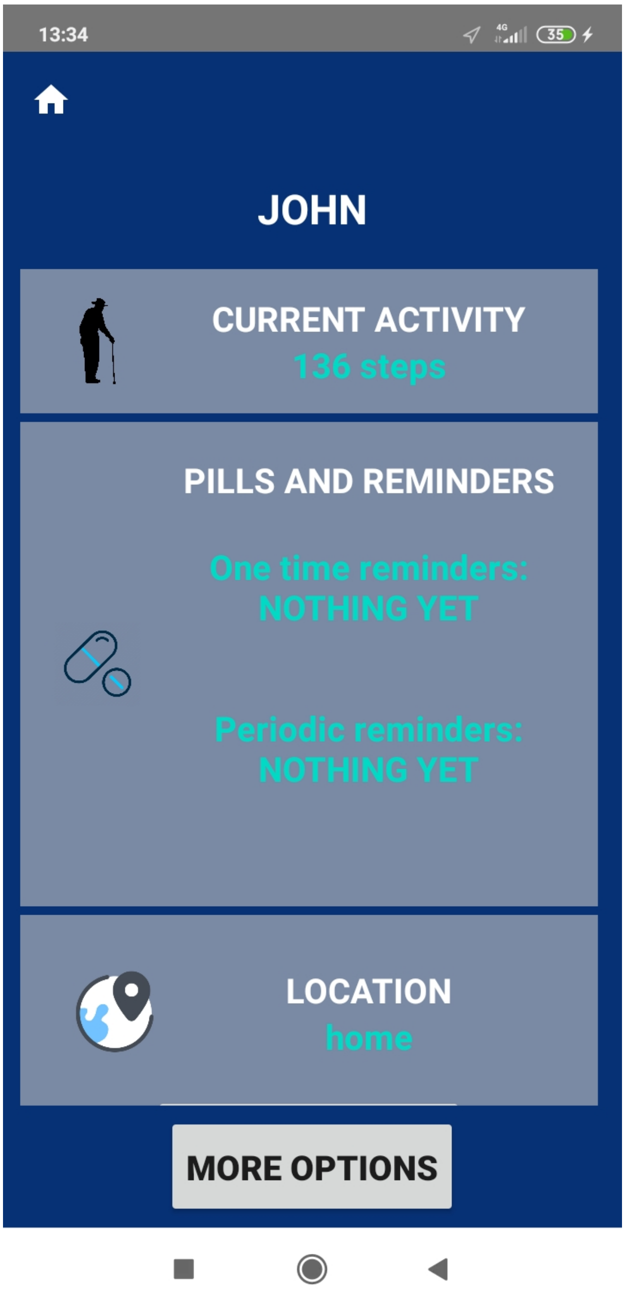

Figure 3: The caretaker's home view

4.5 SOS function and fall detection

The caretaker or elder's relative or anyone on the elder's SOS list receives a call for help. In case of a fall, the caretaker receives an SMS that there was a fall of the elderly.

4.6 Phone book and pedometer

The caretaker does not have a phone book, but a list of the elderly they take care for. The caretaker has the option to call a specific elder by pressing their contact. For the caretaker, the application does not measure the number of steps made. However, the caretaker has the ability to review the number of steps for each elder they take care for. The caretaker can see all the key information of each elder they take care of, e.g. Figure 3.

5 CONCLUSION

We developed the Android application for the elderly and their caretakers. This article describes the features of the application. Sensors integrated into today's smartphones and special software enable us to create applications which help the elderly live more independently. The drawbacks of the software which is now available on Google play market are: complicated usage, high price, lack of features. We designed the application bearing in mind ease of use for the elder and features that allow the caretakers to monitor the elderly anywhere anytime. Also, after the application is fully tested, it will be available for free.

ACKNOWLEDGMENTS

The paper was supported by the ISE-EMH project funded by the program: Interreg V-A Italy-Slovenia 2014-2020. We thank IPM Digital, which organized the focus group as part of the HoCare 2.0 project. We also thank students: Lukas Kranjc, Urša Klun and Jan Hrastnik for helping with implementation part of the project.

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Development and structural design of the frontend for unifying electronic and mobile health platform

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ABSTRACT

Eurostat on 27/03/2020 reported the survey on the use of ICT in households and by individuals, one in two EU citizens (53%) aged 16-74 reported that they sought online health information related to injury, disease, nutrition, improving health or similar [1]. On the other hand, an estimated 7 percent of Google's daily searches are health-related, according to Google Health Vice President David Feinberg, MD and Google's total daily health-related searches amount to 70,000 each minute, according to The Telegraph report [2].

Nobody really enjoys going to a doctor, but there are many reasons why you should avoid simply searching the internet for medical advice. Essentially this can go in two bad ways: either you overestimate your symptoms and end up taking the wrong medication or engaging in the wrong self-treatment, or you underestimate your symptoms and let a condition worsen.

In this paper, we describe a platform that helps an anonymous visitor to find verified health information or even chat with the call-centre operator or health expert when available. We present the technical specifications and features of the Insieme platform, which was developed as part of the project ISE-EMH.

KEYWORDS

Frontend design, the structure of the frontend, health, EMH, medical advice, health-related searches

1 INTRODUCTION

While Google certainly has a vast quantity of information, it lacks selectivity. Although it’s easy to find lists that sound like our symptoms, we don’t have the medical training to understand the other factors that go into making a medical diagnosis, like personal and family history. And neither does Google.

Insieme platform content is organized by professionals and managed by medical experts. The aim of the platform is not only to publish verified content but also to promote other proven platforms and online content. And if the site visitor doesn’t find appropriate content, he can choose to speak with the available trained operator or medical expert.

2 FRONTEND DESIGN

Anonymous visitors come to the site in order to find information about their disease or guidance on where to turn for advice. They have different knowledge not only of disease causes, symptoms, and health domain language, but also of various computer skills. Using user story mapping we isolate six stories:

1. **Browse** – Visitor is knowledgeable and can navigate through the structured content to find information.
2. **Search** – Visitor can describe the main symptoms to search for possible results.
3. **Bot** – Visitor can chat with the bot to narrow down the results and get the best information available.
4. **Chat** – Visitor is having difficulties finding useful results via navigation and he would like to chat with real person to get proper help.
5. **HelpDesk** – Call-center operator or doctor wants to supervise many chat channels and answer messages from the visitors.
6. **Administration** – Administrator of platform wants to manage the content and users (administrators, call-center operators, and doctors).

The frontend is developed as a fully responsive webpage and is also usable on mobile devices.
At this point the platform supports content in three languages (Slovene, Italian, English) as this was the objective of the ISE-EMH project.

3 FRONTEND FEATURES

Application features implement the user stories described in the previous section.

3.1 Browse

To assure to a site visitor effortless navigation through the platform content this was divided into two level services hierarchy. Visitor can select a hierarchy item on left vertical bar to get a list of all the services of the selected group each in few lines. By selecting a service from the list visitor gets detail page of that service.

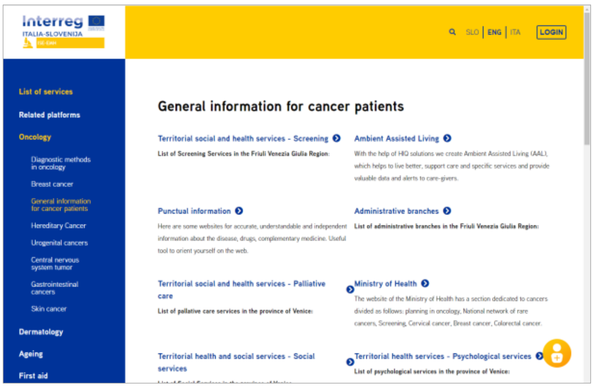

Figure 1: Platform content navigation

3.2 Search

On the middle of the home page a visitor can find a search box to insert the search string. This is sent to the backend to execute the search on the main entities (services hierarchy, companies, user groups, experts) for presence of the search string in name or description. The result is presented as a list of entities grouped by type, each in few lines of description. By selecting a result item from the list, the visitor gets the detailed page of that entity.

Using the Advanced search option, a visitor can filter the results using various parameters.

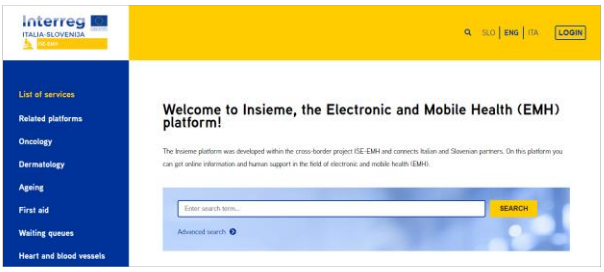

Figure 2: Search panel on the home page

3.3 Bot

Visitor can at any moment decide to invoke bot and start a chat. Bot backend tries to understand the intent of the visitor and offer the platform content, or some implemented functionality (e.g., Waiting times and booking).

Adding more content and functionality to the bot backend, we don't need to change the frontend to enable visitor to use them.

3.4 Chat

On the home page an anonymous visitor sees active operators or experts. By selecting one chat, a pop-up window opens and he can write a message and chat with the selected person as we all do using many chat applications (e.g., WhatsApp, Skype, …).

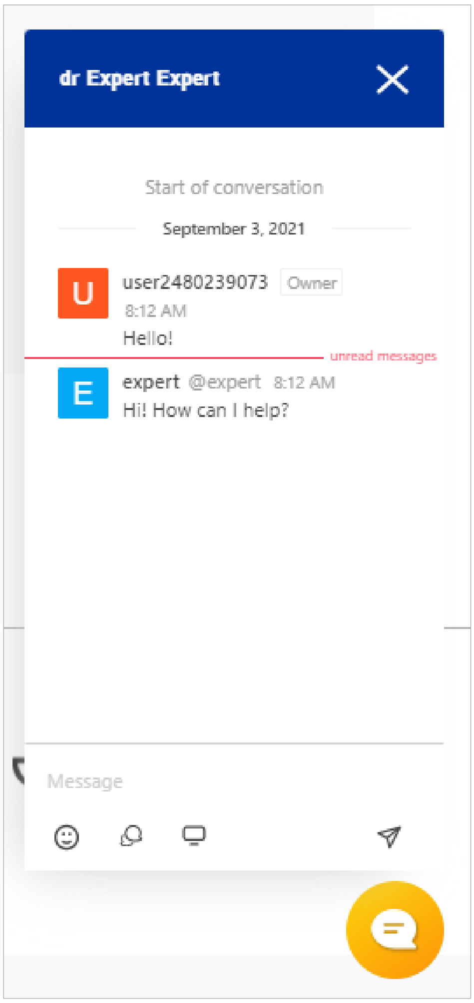

Figure 3: Chat with an operator or expert

3.5 HelpDesk

After logging in the user with the role of expert can select the HelpDesk button to open the chat dashboard with the list of active chat channels. When another visitor starts a new chat, a channel is added to the list and the dashboard user is notified. He can select the channel and chat with a visitor. There is also a possibility to use a shortcut to add a link pointing to the selected platform content to the message he is writing.

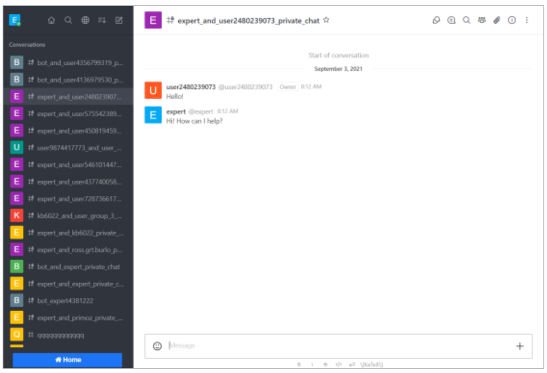

Figure 4: Operator chat dashboard

3.6 Administration

Administrators have to login to gain the possibility to manage users and their properties as roles (call-center operator, expert, …). Further he can define services, experts, companies, user groups and configure various parameters necessary for the correct functioning of the platform. The content can be described in one or more languages to be visible to the visitors of platform in a selected language.

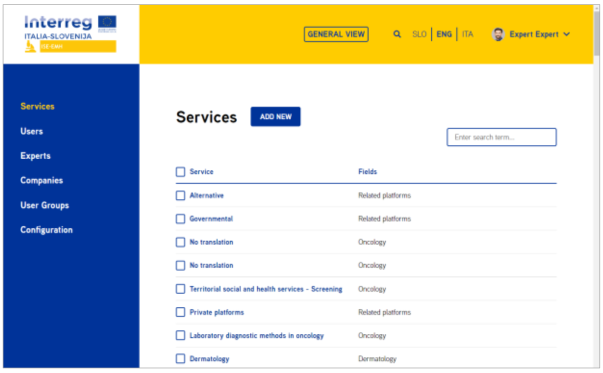

Figure 5: Platform content management

4 CONCLUSION AND FUTURE WORK

The quality and reliability of websites providing health knowledge can vary greatly. Yet despite the chances of unnecessary stress and finding incorrect, or even potentially harmful information, people are searching the internet for health advice.

In this first phase of the project, we've learned how to organize health information and make it accessible to everyone to find answers to their questions or advise them on the best way to proceed. The information can also be accessed by asking the bot or go into detailed chatting with a qualified operator or a doctor if available.

During the next phases we will offer the visitors the possibility to register, so the operator can see his/her name and conversation history. We will improve the bot's conversation recognition capabilities. By saving navigation and search history we can use Machine Learning to understand the visitor's behaviour. With this understanding and adding seasonal (e.g., winter) or exceptional (e.g., Covid) health problems we can enrich search results and bot behaviour.

ACKNOWLEDGMENTS

The paper was supported by the ISE-EMH project funded by the program: Interreg V-A Italy-Slovenia 2014-2020.

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Description of Health Service Selection and Structure of ISE-EMH Platform

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ABSTRACT

Human population is getting older and more prone to diseases. In the information society, it is possible to find lots of helpful information on the web; however, the overload of information makes it hard to find information about a particular health issue. The ISE-EMH platform aims at providing the needed medical information faster and more context-specific than general search engines. The goal is to enable finding relevant services in few minutes instead of seeking for information with general search engine in web browser spending on average half an hour for one of common actions. To achieve such goal, the platform has to be direct and transparent and well structured, and these issues were studied as part of the project. The platform also includes an administrator's webpage. Future work is described at the end of the text, where future stakeholders are mentioned – service providers and medical doctors. Their role will be significant for successful use of the platform, which can hopefully improve access to relevant information about healthcare services.

KEYWORDS

Health service, patient, disease, improving healthcare system, ICD, ISE-EMH platform, workflow diagram, medical doctor

1 INTRODUCTION

Nowadays, all the information is available on web and every user can reach them with just few computer or mobile phone clicks. But the real challenge is how to construct the right question to avoid irrelevant answers. How to access the right information and use it in the proper way? This is even more important in the area of medical or health information, which can improve or hamper health status. Proper help would be achieved by giving the user the relevant physician's contact, sharing a mobile health app or patients' association website. Our project ISE-EMH is trying to provide that – collect the most relevant medical services in the given moment and present it in a quick and efficient way in one place [1].

ISE-EMH stands for Italian-Slovene ecosystem for electronic and mobile health. It is an interregional project financed by the European Regional Development Fund with the main goal to improve e-health in Slovenian and Italian healthcare system with the help of Italian expertise in the field of medicine and Slovenian in ICT (information and communications technology). Service providers in both countries will have an opportunity to add their services and products to platform and therefore improve information flow from patients to healthcare workers and vice versa. Important aspect of the platform is a possibility to establish connections between potential partners in Slovenian-Italian area. This will be supported by the advanced search and recommendation system. As the final result at least six applications will be developed within EMH ecosystem [2].

2 ISE-EMH PLATFORM

2.1 Concept Description

ISE-EMH platform can be seen as highly specific and targeted search engine based on medicine expert's knowledge with just health issues in mind. The platform will be described in details in the following text; however, the main added value of the platform can be described with the following two scenarios:

a) Open preferred web browser, spent approximately 15 to 30 minutes searching medical services that are most appropriate for certain disease in question, critically evaluate them, select the most relevant and discard all dubious.
b) Visit our platform, in a couple of clicks or with search or with assistant get one page at most with most relevant links in several categories, such as internet services, medical professionals, call centers.

To enable the (b) scenario, the medical knowledge from medicine and pharmacy students and some experts was applied to search the web, find and evaluate health services for specific cases.

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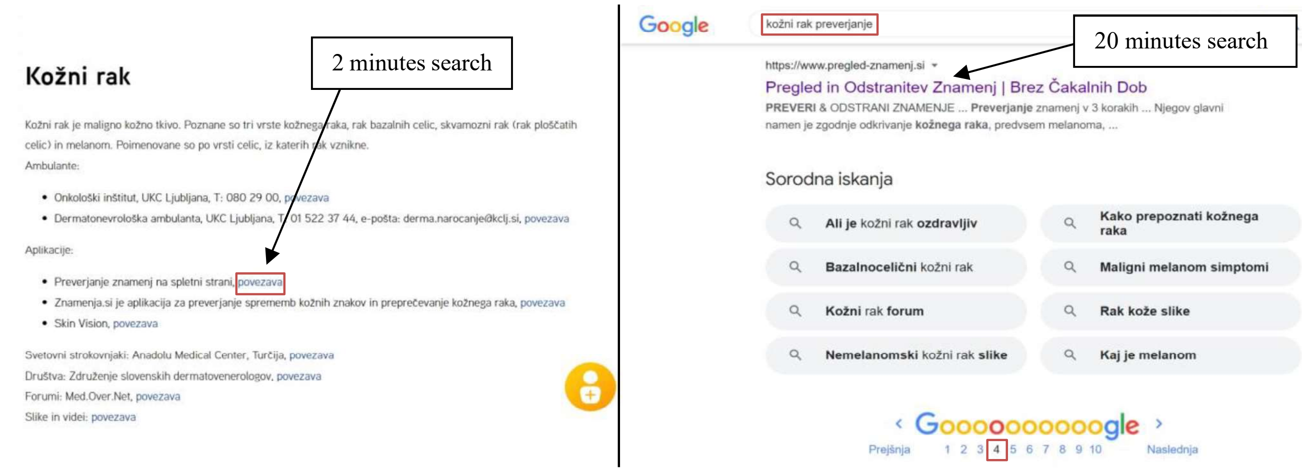

Figure 1: Comparison between searching on ISE-EMH platform and web browser.

2.2 Concept Demonstration

To demonstrate how the platform works and to emphasize its advantages, a simple demonstration is presented in Figure 1. We compared time spent for a user to find an application for skin cancer detection. Firstly, the user visited ISE-EMH platform and tried to find a link to the application. That took him around 2 minutes and can be seen on the left side of Figure 1. After that we used Google search engine to find the same result. The first search was made with word "kožni rak" (skin cancer) and the search engine could not find the preferred application within first hundred results. Then we typed "kožni rak preverjanje" (skin cancer checking) in the search engine and preferred application was found as 38th result. That can be seen on the right side of the Figure 1. This demonstration shows the real added value of the platform.

2.3 Other Health Platforms

European Public Health Association (EUPHA) recognizes public health digitalization as one of the main goals in following years. This will enable higher precision and predictability at diagnosing diseases and faster interaction with healthcare workers [3].

There has already been significant work done in this field. Some of the platforms are presented here.

zVEM is a Slovenian public health platform that enables patients to look at prescribed medicines, make an appointment at selected medical doctor or check medical history [4].

Mediately Register zdravil is also a Slovenian platform (also certified as medical device) used in 8 European countries. It offers prescribing and diagnostic tools for medical professionals and is also a simple platform to search for drug information. That feature is commonly used by patients [5,6].

NHS App is a British public health application, which enables patients to get health advice using NHS website, order their repeat prescriptions and in some cases message their medical doctor online [7].

3 THE ISE-EMH PLATFORM

3.1 Side Menu Layout

The ISE-EMH platform is of a defined structure, which can be seen in Figure 2. More information about the platform can be found on the next link: https://www.ita-slo.eu/en/ise-emh, however the platform is found at another web address [8].

On the left side of Figure 2 there is a menu, which includes 15 big sets of diseases. Each set contains from 3 to 10 specific diseases. Diseases were structured with the help of WHO International Statistical Classification of Diseases and Related Health Problems (ICD), which contains almost 70.000 different diseases and diagnosis. The most common diseases were included in our platform [9].

As an example in Figure 2, there is the Dermatology set shown in the red box, which contains five specific diseases: Pyoderma gangrenosum, Acne, Atopic Dermatitis, Rosacea and Psoriasis. At the moment, there are 82 different diseases and medical conditions included at the website more will be included as the development of the platform is in progress. In future, the platform will be used by users and medical doctors providing more input to be added to the webpage by administrators.

Figure 2: Website layout – set of diseases.

3.2 Disease Webpage Layout

Furthermore, structure of a page for each disease was defined during studying. The structure of these websites is crucial, because web users often decide about staying or leaving the website in few seconds. Therefore, relevant information has to be visible immediately that a user can very fast find and use it [10].

The structure can be seen in Figure 3 and is as follows: at the top of website there is a name of disease, followed by a brief disease definition in the following paragraph. After that it comes the most important part of the webpage – list of services. This includes several categories such as clinics in the state (with direct contact and location), mobile applications that are beneficial for users (for example, Dietary apps that reminds patients with celiac disease when and which food to eat), world leading experts in this field of medicine, patients' associations, forums, pictures and videos of disease symptoms, diets and products that can help patients with disease diagnostics or monitoring. By clicking on website links, users have immediate access to best healthcare providers in the state. We directly copied clinic's phone numbers and e-mail addresses to the ISE-EMH platform that relevant information can be found directly at the platform.

Lymska borelioza

Lajmsko boreliozo povzroča spiralasto zvita bakterija Borellia burgdorferi. Bakterije se prenesejo na človeka z ugrizom okuženega klopa. Prvi in najznačilnejši znak lajmske borelioze je kožna sprememba, ki se pojavi nekaj dni do nekaj tednov po vbodu klopa. Na mestu vboda se pojavi rdečina, ki se postopoma širi. Najprej je enakomerne barve, nato pa začne v sredini bledeti in razvije se značilni rdečkasti kolobar, ki je navadno večji od 5 cm v premeru.

Ambulante:

- Ambulanta za paciente s sumom na kronično lymsko boreliozo, UKC Ljubljana; T: 01 522 26 22, e-pošta: narocanje.kibvs@kclj.si, povezava
- Ambulanta za paciente z zgodnjo kožno obliko lymske borelioze (erythema migrans), UKC Ljubljana; T: 01 522 26 22, e-pošta: narocanje.kibvs(at)kclj.si, povezava
- Testiranje na Lymsko boreliozo, Synlab, Ljubljana, T: 01 436 00 23, povezava

Svetovni strokovnjaki:

- Dr. Daniel Cameron; Mt. Kisco, New York, povezava
- Dr. Franc Strle, Ljubljana, povezava

Društva:

- Društvo bolnikov z boreliozo, povezava
- Združenje zdravnikov družinske medicine, Lajmska borelioza, povezava

Forumi: Med.Over.Net, povezava

Figure 3: Disease Webpage Layout.

3.3 Administrator's Webpage

For administrators there are seven structure elements which can be selected or edited:

- Name
- Description
- Tags
- Regions
- Fields
- Subfields
- Languages

At the end there is also a box "Approved", which is meant for medical doctors, who will check the added service and then decide whether they are relevant or not.

While other elements are straightforward, "tags" needs some explanation. Tags are selected in a way that the platform suggest similar diseases to the one that is currently open. Some of the tags are:

- Organ: heart
- Organ: skin
- Sex: male
- Sex: female
- Duration: acute
- Duration: chronic
- Age: senior
- Age: children
- Progressive disease
- Vaccination option

For every element an administrator can add a text in three different languages – Slovenian, English and Italian.

4 WORKFLOW DIAGRAM

Figure 4 presents the working process at this project. Text in boxes with bold border indicates the work already done or still in progress, while text in boxes with dashed borders indicate future work.

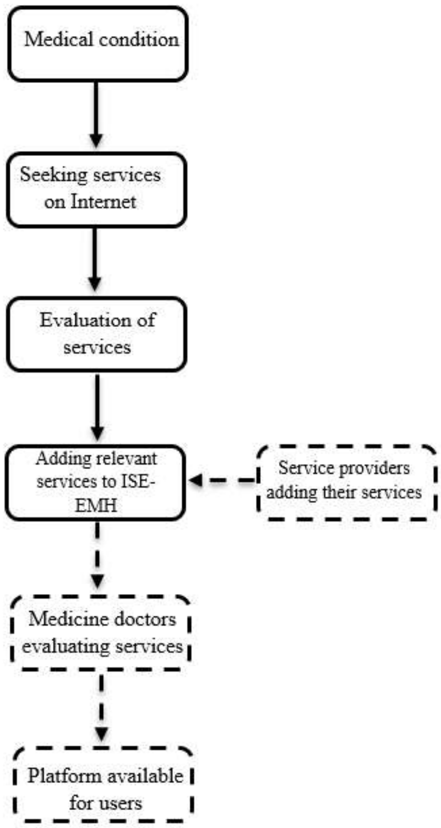

Figure 4: Workflow Diagram.

Several healthcare students cooperated in ISE-EMH project. Their first task was to create a list of common diseases. The main source of information was WHO International Statistical Classification of Diseases and Related Health Problems (ICD). Inside the team we agreed to first include around 75 most common diseases and add more of them later. That number comes from fact that they are 15 sets of diseases included at the ISE-EMH platform and we agreed to include 5 diseases in each set [9].

When all the diseases were selected the team started to write definitions of diseases. They were formulated in few sentences and include information about the cause of the disease, common symptoms, diagnostics and any special warnings about the disease (whether it is contagious or needs immediate treatment).

Next step was searching for any kind of relevant services on Web. For that purpose, we were mainly using Google as search engine and spend around one hour to go through each relevant service for patients. We arranged services in eight categories: clinic services, mobile phone applications, world leading experts, patients' associations, forums, pictures and videos of disease symptoms, diets and special products that helps diagnosing or monitoring the disease.

The relevant and checked services were added to platform. Main criteria in evaluating such services were very good reviews from patients and also healthcare students' knowledge about different clinics. For example, University Clinical Centers in Ljubljana and Maribor are part of tertiary healthcare system in Slovenia and as such have the best available equipment and also medical staff in the state [11].

5 CONCLUSION

In this paper we described the ISE-EMH platform, its detailed structure and the workflow of health service selection. The final structure of the platform is now determined and will hopefully not be significantly changed soon. We believe it is user friendly and all the important information for patients are easily seen. Patients can access information (contacts, locations of clinic) directly on our platform or can visit service provider's website. Workflow of the healthcare students working on the project, was described in detail and is represented with the workflow diagram. It is important to know that process, especially for the students, who will join the ISE-EMH project in future. This text can serve as guideline for them.

In future months, the team will continue adding services to disease webpage and once this will be finished, medical doctors will check the services as the administrators and provide their professional evaluation. After that, the next phase will begin. At that time, the platform will be already available for users (patients). Service providers will be adding their services to the platform and before adding these services to the platform, medical doctors will evaluate them and either approve it or reject it. More diseases will be added by medical doctors and more services by the service providers.

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Usability of smart home and home automation data

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ABSTRACT

Technology and electrical energy are as a matter of fact closely interconnected. The electric revolution and adopted technologies that assure a better standard of living enabled a longer life span.

The demographic prediction is that by 2050, one in four persons living in Europe and Northern America could be aged 65 or over. In 2018, for the first time in history, persons aged 65 or above outnumbered children under five years of age globally. The number of persons aged 80 years or over is projected to triple, from 143 million in 2019 to 426 million in 2050. Growing at a slower pace, world population is expected to reach 9.7 billion in 2050 and could peak at nearly 11 billion around 2100 | UN DESA | United Nations Department of Economic and Social Affairs)

With the more user friendly and affordable technology, the standard of living and the quality of life for the past 60 years was rising, and it enabled to adopt many technologies from the simplest as lighting, heating to more complex as home automation technologies and solutions. The use of this technology, however, has become part of everyday life, which is reflected in the routine management or use of them.

The future demographic structure and longer life expectancy also bring challenges for society. With the increase in life expectancy and the lack of young people who opt for nursing professions, it will be necessary to find appropriate technological solutions that will help maintain the quality of life and assistance of the elderly.

To provide an adequate general care for the elderly, remotely assist them, predict health issues and to alert the caregivers appropriate technological solutions must be in place. In this paper, we describe the way how through energy management we enable to create events based on the behavior or use of devices in homes, apartments, or spatialized caregiving rooms. These events are the foundation for triggering actions for assistance or prevention and safety in the relevant behavior change.

In this paper we describe the role of HEMS (Home Energy Management System) solution and 4G cloud platform in enabling a variety of services and strategies for assisted living and detection of behavior change. In this case HEMS and 4G platform act as an enabler for third party assisted living services.

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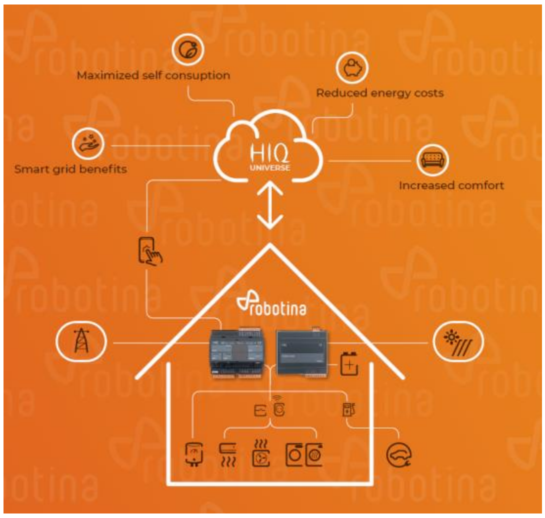
KEYWORDS

HEMS (Home Energy Management System), Smart Home, care for elderly, elderly, change behavior detection. ISE-EMH, Insieme

1 INTRODUCTION

In harmony with sustainable energy use, interconnected devices and solutions for energy management in homes (HEMS), the possibilities of using the captured data for a variety of secondary use open up. Technology of connectable devices, sensors, cloud data technologies and energy monitoring and energy management technologies, such as Robotina's HEMS solution, enable real-time monitoring of energy consumption and based on this, generation of events and patterns of user behavior.



(1)

Figure 2: HEMS system operation and functionalities scheme.

1.1 Basic information about the project

As a part of Insieme project we developed the features for data acquisition, safe data transfer, models of event generation and event logging. For the purpose of third-party data use we developed a standardized Data API on 4S platform based on SMIP cloud platform API service.
For a better understanding of the topic the paper describes the possibilities and the technology behind it.

1.2 Home energy management system as a source of data

The HEMS system monitors all energy production systems and all energy consumers in an individual home and, in the case of a hospital or nursing home, energy consumption at the level of an individual floor or individual room. The feature of the Energy Management System (HEMS) works locally, and at the same time the connection to the cloud allows it to take advantage of all the benefits that cloud technologies allow. To comprehensively cover all business models and services of energy management solutions, Robotina has built the 4S cloud platform, which enables data capture and analytical data services. Event detection, event generation and consequently as the main functionality activity triggering. In case of assisted living as an example triggering a warning to caregivers. Events once generated may be used for other purposes.

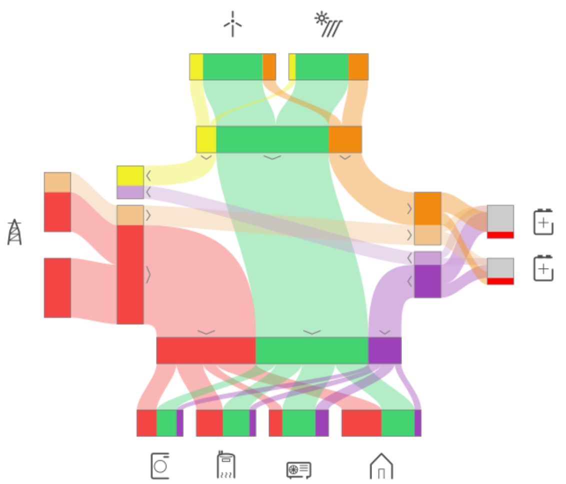


Figure 3: Sankey diagram from HEMS energy management application.

1.3 Overview of available data sets

Energy monitoring and energy management provides us with data on the use of various devices and systems. The collected data give us information on the use of an individual device or system and the time frames for the use of the devices. Depending on the time period, the duration of an individual event and the type of device or system that was used at a given time, we can specifically build events and content interpretations of events that trigger event-specific activities.

Data sets
Time of the event
Duration of the event
Type of the device or system

Additional parameters to trigger actions are:
Age of the person
Current health status

2 DATA AND CONNECTIVITY

Data collecting and data transfer to the cloud are crucial for the interoperability and inter-usability of data by third-party providers of ambient assisted living application information solutions and home care assistance solutions. At the level of the HEMS (Home Energy Management System) solution, connectivity is ensured through the edge technology of the Robotinas IoT Linker product, which ensures that data is securely transmitted to the cloud xEMS platform.

3 EVENT GENERATION

Events are generated out of available data sets and are time stamped.
Event can be generated through result of a simple equation. Let's take temperature as an example. Equation, which would generate variable high_temperature as (TRUE): if (t1)>38 then high_temperature.
More complex events may be result of an algorithm, like counting number of bathroom light_ON events between 22 and 6' o clock.
Finally, events may be result of a complex combination of algorithms, machine learning and artificial intelligence.
Events are defined/described by healthcare specialists and translated into formulas or algorithms. Artificial Intelligence is used, when patterns are not clearly known upfront or when relations are too complex.

3.1 Lighting scenarios

Lighting and its use in rooms is the simplest, but on the other hand the most used device or set of devices in daily life of every person. The data of lighting usage provides us a variety of information. Use at a certain time of the day, the frequency of its use, use in an individual, specific space provides us with valuable data in generating events and patterns of behavior. the logical consequence is that it also allows the detection of anomalies and changes in behavior. A clear example is the non-extinguishing of lights, which can serve as scenarios of causes such as insomnia, dementia or even death. The frequency of lighting in a particular room, such as the frequent use of lights in toilets at night, can provide us with information about the disruption of water drainage, ie the detection of the onset of incontinence or prostate problems in the case of the male population. However, early detection and early diagnosis of the disease can have a radical impact on further prevention of disease development. In the case of homes for the elderly, however, caregivers have the option of comprehensive insight and prompt action.

3.2 Heating scenarios

Heating and cooling are also the most common solutions in any home or building. In this case, energy management and HEMS also provide us with information on a person's health through monitoring the operation of heating and cooling systems. There are, of course, many scenarios. An example of excessive cooling or heating may indicate a physiological change in a person or a change in health.

3.3 Energy consumption scenarios

Comprehensive energy management and monitoring through HEMS provides us with rich data to interpret the behavior of the individual through monitoring energy consumption. An obvious example of such a scenario is the example of "morning coffee". Hems can clearly identify patterns of behavior and deviations, changes, or anomalies in an individual's routine actions or tasks through monitoring peak energy consumption. In this case, "morning coffee," which is routine for most people, can be an indicator of a person's condition. Perceived changes in the performance of routine tasks are systematically interpreted as an event that triggers activities to inform relatives or caregivers.

4 DATA AVAILABILITY

The power of big data is in its usability. To assure 3rd party data use it is necessary to assure the data availability in a standardized way through standard protocols. This ensures to other provider to use the collected data and make them a part of an applicable solution, which provides stand-alone services based on this information or data.

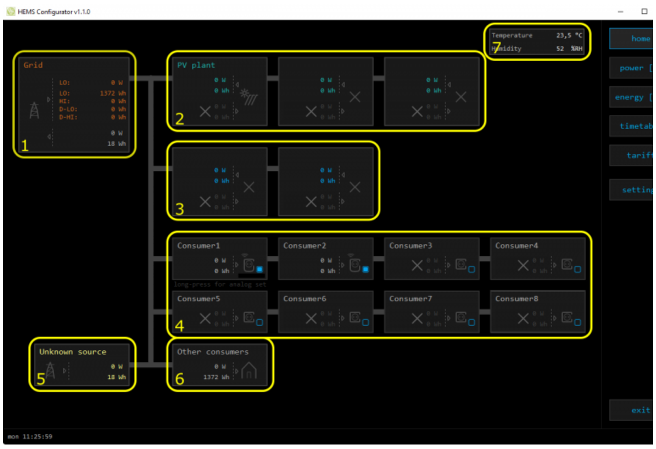


Figure 4: HEMS prosumers and consumers configurator.

4.1 Data API

As mentioned above, Robotinas HEMS (Home Energy Management System) enables to spatialized IT companies to reach key data that enable to build additional services in assisted living and other remote care services. Data API configurations enable devices to be accessible to third-party clients by calling SMIP Data API Web Services. Content developers may define which things and which variables may be accessible to which third-party. Write access to variables is also defined in Data API configurations.

5. REAL LIFE SOLUTION APPLICATION

Through energy consumption and the use of various devices, HEMS can define various events, which, of course, depend on the type of building or living environment and the age or health condition of the person.

5.1 Individual home

For an individual home as we have already mentioned in the paper, the key goal is to monitor the routine through HEMS energy management. Through an appropriate, long enough period to define individual events, the system obtains data to detect changes in routine tasks, define current health status, detect deterioration in health status, or early detection of potential new disease at an early stage. Notifications to relatives or caregivers are generated when routines change. This way they have the ability to check the situation and the ability to act quickly. The benefits of this type of solution are for the elderly and their therapists or doctors, caregivers and, of course, relatives. With the growth of the elderly population, solutions such as HEMS and the Ambient Assisted Living service can indirectly help extend the autonomy of the elderly and the independence of the elderly, as everything takes place automatically and remotely. This is especially important for seniors living in remote locations. All involved stakeholders who directly or indirectly care for a person thus have the opportunity to be informed and to act in a timely manner for the benefit of the quality of life of the elderly person ore their beloved ones.

6 CONCLUSION

We have described the possibilities offered by the energy management solution (HEMS) and the 4S cloud platform in the direction of "Ambient Assisted Living" solutions. We have prepared an environment for the capture, transfer and storage of data and the creation of events that serve to implement other applications of application solutions. We examined the possibilities of using the obtained data to generate events and trigger actions. We have identified scenarios that can provide solutions to the well-being of older people and the early detection of potentially pathological changes and diseases. These solutions can be applied fast and with the least investment in the current infrastructure.

ACKNOWLEDGMENTS

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Intelligent cognitive assistant technology for (mental) health in the ISE-EMH project

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ABSTRACT

The paper presents the inclusion of intelligent cognitive assistant technology in an electronic and mobile health system under development for the ISE-EMH project. After introducing the project and the intelligent cognitive assistant technology, the paper describes the included assistants in the developing electronic health system. The main focus of the paper is its emphasis on the current state of the design of an advanced adaptive and personalized assistant for mental health. The most in-depth description focuses on the utilization of a generative pre-trained transformer (based on OpenAI's GPT-3) to respond to users' self-reports about their mood and mental health issues.

KEYWORDS

Attitude and behavior change, digital mental health, electronic and mobile health system, intelligent cognitive assistant technology

1 INTRODUCTION

Electronic and mobile health system (emHealth) describes healthcare services that are largely enriched by the use of information and communication technology (ICT) for its functionalities. This mostly includes computers and mobile phones, which make healthcare more flexible and available at all times, but can also extend to newer technologies, such as robots. ICT is made useful in a wide range of services, from data keeping to predictive modeling. One of the existing and still evolving technologies that benefit emHealth the most is the intelligent cognitive assistant technology.

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Intelligent cognitive assistant technology (ICAs) has been defined as a technology powered by complex information processing agents. These can acquire information, put it into action and transmit knowledge, bringing together perception, intelligence, thinking, calculation, reasoning, imagining and, in the end, conscience [1]. ICAs aspire to: understand context; be adaptive and flexible; learn and develop; be autonomous; be communicative, collaborative and social; be interactive and personalized; be anticipatory and predictive; perceive; act; have internal goals and motivation; interpret; and reason. Such agents are usually deployed either as conversational agents – computer systems that converse with humans in (usually written) natural language – or robots. All these characteristics make them very suitable for various functionalities inside an emHealth platform, some of which will be presented in this paper, as they also play a role in the ISE-EMH project.

The ISE-EMH project encompasses a platform of emHealth and is co-financed by the European Regional Development Fund. As a result of a collaboration of multiple Slovenian and Italian partners, it connects cross-border healthcare systems. The project consists of three main components: a mobile application, a web page and a chat system. The mobile application, available for OS Android, is developed specifically for elderly persons and their caretakers. The goal is to simplify and improve quality of seniors' lives. This is achieved through a design that provides simple usage and implementation of multiple integrations, such as alarms for taking medicines, fall detection and an SOS call option. The web page consists of several relevant information about health concerns, diseases, and fields of medicine, along with useful links for booking certain services, for waiting queues for procedures, and of presentations of other helpful platforms. Because all data are gathered in one place and easily available, it allows better access to the healthcare itself, as searching for information is intuitively designed. The chat system is implemented in the web page, and is intended for all users that have questions concerning health problems or are simply looking for more information about certain services. Its main goal is to provide answers, give advice to users, and present information about waiting queues for certain procedures and services. This is possible through the use of ICAs.

This paper presents the use of the ICA technology in the ISE-EMH emHealth platform, and focuses on an adaptive and personalized ICA for attitude and behavior change in mental health, which is planned to be implemented into the platform.

2 INTELLIGENT COGNITIVE ASSISTANT TECHNOLOGY IN THE ISE-EMH PROJECT

The ICA technology in the ISE-EMH project, similarly as other chat possibilities, is integrated in Rocket.Chat [2], a widely used open source communicating platform. The ICA technology is mostly deployed when a professional is not available to chat with the users. At that moment, the answers are provided by various ICAs. Three assistants are implemented directly in the platform, all of them with different domains they cover in terms of their semantic understanding: the JSI assistant, an assistant for waiting queues, and an assistant for service searching. They all provide their answers, but users can alternatively select only one of them. Others assistants (e.g., an assistant for information on hepatitis) are also included, but are not integrated, and they can be accessed through a link, suggested in the chat window. The three major integrated assistants are described below:

1. **The JSI assistant [3]**: An assistant developed in Bottle (Python). Jožef Stefan Institute (JSI) is a partner of the project, and this ICA's purpose is to give answers to any question related to the JSI institute and its employees. It can also provide answers to more general questions. It works by enacting the following pipeline: 1) all stop-words are removed in given text to obtain relevant keywords; and 2) lemmatization, a procedure that returns the root of a word, is used on these keywords to provide more efficient searching through the database.

2. **An assistant for waiting queues**: An assistant developed in Django (Python), which provides information on waiting queues in the Slovenian healthcare system of a given health service. The data of all the possible procedures are obtained from the website https://cakalnedobe.ezdrav.si/, which makes them non-obsolete. Based on the selected health service, urgency and the region of procedure, information on the medical institutions that provide the service along with first available time slots are given. For avoiding any misunderstandings about what procedures the user wants, stop words are removed and a lemmatizator is used. The user then chooses among all the suggested services. If a procedure is not available, other solutions are suggested, such as searching in all the available regions. This makes searching faster and more precise as well as easier to use, which is enabled through the button-based chat implementation.

3. **An assistant for service searching**: The assistant is implemented as a service search; the services are available on the ISE-EMH platform website as well. The ICA uses entered keywords to provide descriptions of services, including many useful links. With the stop-words removal and the use of Elasticsearch (a search engine that allows faster searching and analyzing large amounts of data [4]) on trigram words, it allows fast and precise searching.

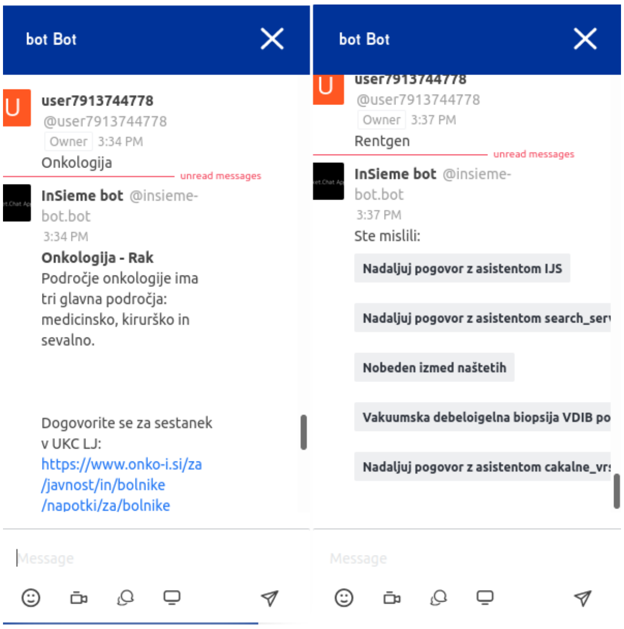

Figure 1. Left: An assistant for waiting queues giving information on oncological procedures. Right: Various possibilities from different ICAs when more answers are possible.

Another planned ICA integration is an intelligent cognitive assistant for attitude and behavior change in mental health. This is going to be an advanced adaptive and personalized ICA, planned to be state of the art (SOTA) in the field of ICAs for mental health. Its design is described in the next section.

3 DESIGN FOR AN INTELLIGENT COGNITIVE ASSISTANT FOR ATTITUDE AND BEHAVIOR CHANGE IN MENTAL HEALTH

To be able to understand how to design such an ICA, the mental health issues in the society have to be overviewed. Stress, anxiety and depression (SAD) are on the rise in the entire world, with figures in certain groups reaching 71% for stress, 12% for anxiety disorder and 48% for depression [5]. This opens the doors for technological and scientific interventions to help mitigate the occurring mental health pandemic. One such technology is persuasive technology (PT), which tries to change attitudes or behaviors without coercion or deception. ICAs can be effective vessels for such goals., as they can communicate in natural language. By employing ICAs in mental health, the benefits can be numerous: they can be free of charge, available 24/7, and available in remote locations [6]. Furthermore, people tend to be more comfortable talking to an ICA than to a person [7].

To discover what SOTA in this field was, three major ICAs for SAD were reviewed, also because only rare review articles on this topic exist [8]. An ICA by Yorita, Egerton, Oakman, Chan and Kubota [9] is based on the Belief-Desire-Intention architecture with three models: "a conversation model for acquiring state information about the individual, measuring their stress level, a Sense of Coherence (SOC) model for evaluating the individuals state of stress, and Peer Support model, which uses the SOC to select a suitable peer support type and action it" [Ibid., p. 3762]. The ICA teaches users how to improve their mental resilience to stress, which it succeeds in in the reported experiment. Another effective ICA is called Woebot [10]. It is based on a "decision tree with suggested responses that accepts natural language inputs" [Ibid., p. 3]. It intervenes by outputting educational content, personalized messages, and scripted advice by collecting data on users' emotions and identifying their errors in thinking. In one experiment, Woebot was more successful in helping with SAD symptoms than the government-prescribed material. The last reviewed ICA is called Tess, which "reduce[s] self-identified symptoms of depression and anxiety" [11]. It uses an extensive emotion ontology to identify the emotions of its users from the text. It uses prepared scripts to help the users, and collects journal data and user feedback to improve its outputs. In one experiment, Tess significantly reduced depression and anxiety symptoms as opposed to the government-approved eBook for self-help.

Reviewed ICAs seem to already be at least partly successful, but they do not fully exploit the possibilities PT offers (e.g., attitude and behavior change theories, user modeling, adaptation, personalization). The ICA we are designing takes that into account. In this paper, we focus on describing a module in the ICA that utilizes a generative pre-trained transformer (based on GPT-3 [12]) to formulate outputs.

Our ICA surpasses the SOTA by possessing a 'theory of mind'. This is achieved by the ICA a user model with the data on users' emotions, mental states, and personality, which relies on behavioral and cognitive sciences advances; a reinforcement learning algorithm to learn from historical interactions between the ICA and the user, thus capturing which strategies work and which do not; and ontologies on attitude and behavior change, stress, anxiety, and depression. The focus is however on the following module and its architecture:

Module architecture:

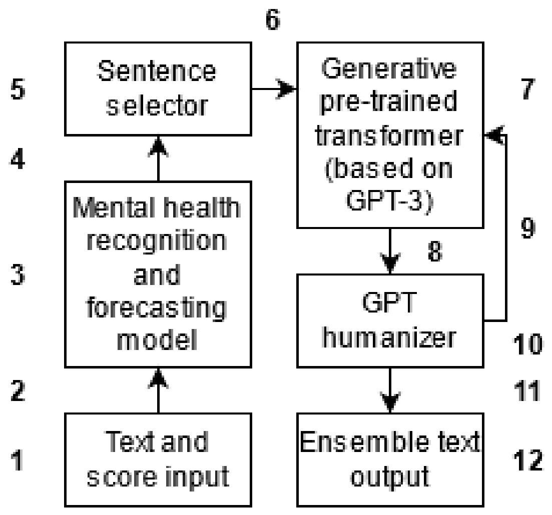

Figure 2. A module for detecting and forecasting mental health issues, and responding to the detected and forecasted issues by utilizing a generative pre-trained transformer, based on GPT-3.

The module architecture represents the following pipeline:

1. Information input. Users answer quantitative questionnaires on their mental health, and provide a textual input on their mood, their experiences while in that mood, and similar. If the user has already provided quantitative scores for enough time, only text is necessary.

2. The scores and text are automatically preprocessed to extract the features.

3. A pre-trained model is used first to recognize moods, emotions, sentiment, and other mental health markers in the text, and it uses this on conjunction with the quantitative scores to forecast mental health trends of the user. This part determines various metrics: the severity of mental health problems, the specificity of mental health problems, and the short-term trend of mental health problems.

4. The three metrics are sent to the next part of the module.

5. A pre-written text is selected according to the metrics, determined in the previous part. The text serves to mitigate the user's mental health problems, and, if the forecasted trend is negative, to try to break that trend.

6. The text is sent to be augmented with the next part of the module.

7. The text from the previous part is enriched by a generative pre-trained transformer based on GPT-3 with additional text. This makes responses more varied and alive for the user.

8. The enriched text is passed to the GPT humanizer.

9. GPT humanizer return the original text for enrichment if deemed risky for the user.

10. GPT humanizer decides whether the added text by Generative pre-trained transformer based on GPT-3 is acceptable in terms of risk for the user. It consists of a rule-based model that rejects text with certain words, sentiment analyzer that rejects text that fails to reach a certain positive sentiment threshold, and a pre-trained model based on a dataset of risky sentences that rejects text if it is detected as risky.

11. The final text goes through some additional modifications to check that everything is in order.

12. Output of the final text.

Example:

1. The user inserts text "Today I have felt very bad. I feel a lot of stress because I have a deadline at work coming, and I fought with my partner yesterday. I am anxious to talk to them tonight. The deadline is a bit scary because I did not do a good

job last time, and if it happens again, it might trigger my depression."

2. Features are extracted. This includes performing sentiment analysis, creating n-grams, vectorizing, calculating basic statistical features, and applying psychological and cognitive lexicons on the text.

3. The features from the second step are used for detecting the user's specific mental health problems, their severity and, if there is historical data of the user, the short-term trend. The model returns abnormal levels of stress and depression, and it forecasts a negative trend.

4. The information on the mental health of the user is sent to the sentence selector.

5. Due to the abnormal levels of stress and depression as well as a negative trend forecasting, the text, which also takes the user's personality, which is more easily persuaded when addressing their social circle, into account, selects the text "*Tackling stress and depression is hard, especially since many people have problems with them, but it is not impossible. Try to think outside of the current situations and discuss them with your friends. They probably have some experience with them and can offer advice as well as another perspective on the situation.*".

6. The module takes the selected text and sends it for enrichment.

7. The text is enriched with the following two sentences: "**Don't ignore or repress the problem if you need to seek help. You are not a burden and you do have worth.**" (This was an actual output of GPT-J [13]).

8. The enriched text is passed to the GPT humanizer.

9. Does not occur.

10. GPT humanizer extracts features from the added text. It does not find any risky indicators.

11. The final text is passed to the final stage without modifications.

12. The user receives the full text output: "*Tackling stress and depression is hard, especially since many people have problems with them, but it is not impossible. Try to think outside of the current situations and discuss them with your friends. They probably have some experience with them and can offer advice as well as another perspective on the situation.* **Don't ignore or repress the problem if you need to seek help. You are not a burden and you do have worth.**"

4 CONCLUSION

The paper presented an emHealth platform being developed in the ISE-EMH project. First, the paper focused on the ICA technology used in the project, and later it focused on one particular ICA, an advanced adaptive and personalized ICA for attitude and behavior change in mental health.

The field of emHealth is still developing as advancing technologies are being integrated into various domains of our society. The project ISE-EMH represents one such use case of integrating the domain of healthcare with the ICA technology.

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Analysis of a recommendation system used for predicting medical services

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ABSTRACT

Recommendation systems are widely used in prediction of user preferences given a set of data. More often these preferences are part of the domains of the entertainment or general goods industry, striving to improve recommendations for items such as songs, movies, electronics, etc. In this work, we give an overview of using a recommendation system in a electronic and mobile health platform, showcasing the applicability of such a system for recommending healthcare services and keywords relating to user's initial search query.

KEYWORDS

Electronic and mobile health, recommendation systems, Insieme

1 INTRODUCTION

Recommendations systems have been proven to provide solid recommendations in various tasks, such as movie recommendations, song recommendations, general goods recommendations on online shopping platforms, etc. With their help, using online platforms and services has become more enjoyable since they tailor suggestions in respect to each individual user. Focusing on the healthcare domain, we can see that recommender systems are able to offer help in many aspect of a patient's health [3]. Similarly, they are also used by the healthcare professionals, aiding them in decision making scenarios in order to decrease the risk of errors. An interesting approach is proposed by [2], where the entirety of the recommendation system is build as a whole platform. Their platform takes into consideration the user's health status and finds healthcare services which it considers would be of value to the user. Our work is interested in analyzing a recommender system in conjunction with an electronic and mobile health (EMH) platform. We want to recommend relevant healthcare services to the users based on their search queries. Having good recommendations allows the user to find relevant services in a faster and easier way.

Problems with recommendation systems

A recommendation system has the most difficult time achieving good results at the beginning of its work period. This is widely known as the "cold start" problem. This problem is due to the fact that a system can not infer any significant information about its users or items because previous information is scarce. There are several approaches one can take while designing a recommendation system, such as:

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Collaborative filtering

Collaborative filtering is based on the idea that users who have similar interest in the past, will be more likely to rate future items the same way. The recommendation is gathered from data from various users, but it is tailored just for the specific user that is doing the query.

Item-item collaborative filtering

Another form of collaborative filtering is the item-item collaborative filtering. Instead of looking at users which are similar based on their previous ratings, it looks at the items that are rated by one user and it suggest a new item which has the highest similarity between the previously rated ones. This form of filtering performs well when the number of users is higher than the numbers of items, which is a good fit for our problem.

Insieme

The environment where the recommendation system will be analyzed is called ISE-EMH (Insieme). It represents an EMH platform which connects various medical institutions and patients. The platform provides information about services which are obtained from medical institutions. An example use case is a patient that requires information about certain illnesses, queries information through keywords on the platform and the platform returns the relevant information.

The users who are using Insieme are not required to have an account to use its services. Because of that, a session based recommendation system is used, meaning the user's queries (searched keywords) are only relevant in only one session. The user may be able to search for different illnesses in different sessions, but we can not assume their previous searches are related to the current one.

2 EXPERIMENT

In order to carry out the analysis of the recommendation model for project Insieme, we decided to simulate a small set of input data due to lack of real data. First, we chose a subset of services and then we simulated some users' choices. The simulation was done by generating use cases which simulate a typical user using the EMH platform and choosing appropriate services. This was done because real user interaction data was unobtainable.

Input data

Insieme services are organized into medical categories. For the purpose of the experiment, we chose the following medical categories: dermatology, oncology and infections. From each of those we chose 3 to 4 services, thus obtaining 10 various medical services. Each service has keywords describing it. Since the services refer to the diseases, the keywords refer to the affected part of the body and describe some additional properties of the disease.

services \ keywords	dermatology	oncology	infections	skin	brain	lungs	vaccination	cronic illness
pneumonia			+			+		
acne	+			+				
psoriasis	+			+				+
dermatitis	+			+				+
skin cancer		+		+				
lung cancer		+				+		
brain tumor		+			+			
Lyme disease			+	+				+
tick-borne meningoencephalitis			+		+		+	+
COVID-19			+			+	+	

Table 1: A subset of services with corresponding keywords

services \ users	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
pneumonia	+					+							+								
acne				+				+			+				+	+					+
psoriasis		+						+	+	+							+				
dermatitis		+								+									+		
skin cancer			+								+				+			+		+	
lung cancer	+		+									+	+					+		+	
brain tumor			+				+													+	
Lyme disease				+				+					+	+	+						
tick-borne meningoencephalitis							+						+	+					+	+	
COVID-19					+	+						+	+			+	+				

Table 2: Users' choices of services

When choosing the subset of services, we carefully selected those with various keyword intersections. The services and keywords are shown in Table 1. The '+' sign denotes which keywords are associated with a service.

Next, we have simulated the interactions between users and services. The '+' sign denotes that the user has chosen the service. The users' choices are in Table 2. When preparing the data, we bore in mind the possible reasons to some users' choices. E. g., users 1, 7 and 10 might be concerned about some skin problems, while user 11 might be concerned about the lung problems and user 2 might be investigating all information about cancer available. However, in order to make data more realistic, the majority of users' choices don't have agenda.

Recommendation model

Our choice for a recommendation system is LightFM [1]. The reason for using this implementation is the ability to create tag embeddings by supplying user and item features. In our use case, our item features represent tags that further explain the keywords (items), for e.g. : "Acne" item has the corresponding "Dermatology" and "Skin" items associated with it. The benefit of using embeddings is that they capture semantic similarities between the keywords, which in turn will result in better inference of the model and provide an option to choose top N most similar keywords.

With the help of the learned latent vectors improvement is achieved on "cold start" scenarios. If the item features were not supplied, the model would default back to a pure collaborative filtering model. In addition, an implicit feedback model is used that regards the absence of information in the interaction matrix as negative feedback. The motive for this is that a user already made a conscious choice about what kind of services he needs information for, so the keywords that the user didn't search can be regarded as negative interactions in the interaction matrix.

We built the recommendation model using the LightFM library [1]. We compared the outcome of two various models. The first model is trained on the users' choices of the services only. The second model is additionally trained on keywords describing the service. Using these two models, we obtained the suggestions for each user.

Results

The top recommendations for all users are mostly the same. The differences between the recommended services are minimal, e. g. for user 2:

- pneumonia: 0.13
- acne: 0.18
- psoriasis: 0.13
- dermatitis: 0.15
- skin cancer: 0.18
- lung cancer: 0.18
- brain tumor: 0.13
- Lyme disease: 0.17
- tick-borne meningoencephalitis: 0.17
- COVID-19: 0.16

This data is produced by the model with only interactions. The model with item features has the same recommendations, with slightly lower probability. For each user, the top 3 suggested services are acne, skin cancer and lung cancer. These predictions are not satisfactory, since we would like to obtain the suggestions tailored to every user separately. We assume more data would be needed for training of recommendation models.

3 CONCLUSION

In this work we analyzed a recommendation system that is used with an EMH platform. The goal was to see if such a system is applicable on an EMH platform and offer medical service recommendations to users. Because of limited amount of interaction data, the recommendation system faces difficulties in learning meaningful representations. The system requires data which would be gathered during a longer period of time, in order to give more accurate and meaningful suggestions.

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PlatformUptake Methodology for AHA Solution Assessment

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ABSTRACT

The EU PlatformUptake project aims for AHA solution assessment. It assesses the societal impact of the existing platforms, creates monitoring and evaluation toolkits, collects successful user stories and best practices, promotes interoperability, and defines guidelines for a common evolution of such platforms within existing policy frameworks and initiatives. In this paper we present (i) PlatformUptake methodology for AHA solution assessment and its main objectives, (ii) the results of two ways of clustering, and (iii) the results of taxonomies generation of the text descriptions of the EU PlatformUptake platforms for elderly. After the data was prepared, we ran the K-means algorithm and hierarchical clustering to get the number of clusters. We also created a decision tree of platforms for elderly.

KEYWORDS

uptake, clustering, artificial intelligence, health, elder people

1 INTRODUCTION

Ageing presents one of the greatest socio-economic challenges of the twenty-first century. According to estimates more than 20% of Europeans will be 65 or older by 2025 [5]. Reacting to related puzzlements of demographic shifts and ageing in general, and guaranteeing the availability of the required structure to help Europe utilize the active and healthy ageing sector's opportunities, the EU has devoted a high level of resources to ICT projects in the field of active and healthy ageing. As such a considerable number of open source platforms for the development of innovative solutions in the AHA domain have been created [3].

The EU PlatformUptake methodology for AHA solution assessment assesses the societal impact of these existing platforms, create monitoring and evaluation toolkits, collect successful user stories and best practices, promote interoperability and define guidelines for a common evolution of such platforms within existing policy frameworks and initiatives. Seeking to support the large-scale uptake of the platforms, the project proposes the creating of an online information hub which provides descriptive and support materials on all existing platforms, the organisation of several stakeholder events, as well as Massive Open Online Course for synergies, knowledge exchange and a common understanding among all stakeholders in the Active and Healthy Ageing market [3].

The rest of the paper is organized as follows. Section 2 presents the main objectives of the project, project methodology and platforms for elderly. Clustering and taxonomies are described in section 3. Finally, section 4 concludes the paper with summary and ideas for future work.

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2 METHODOLOGY FOR AHA SOLUTION ASSESSMENT

2.1 Main objectives

The main objectives of the EU PlatformUptake methodology for AHA solution assessment are:

- To identify the critical success factors of the development, deployment and spread of open platforms in the Active And Healthy Ageing Domain, through a sophisticated tailor-made monitoring methodology.
- To develop monitoring and self-evaluation tools to support platform providers and users self-assess their success, uptake, capability gaps and evolution potentials through smart assessment and visualization tools.
- To analyse existing platforms based on the created methodology, by assessing the projects and initiatives hosted by them, their further evolution, uptake, sustainability and socioeconomic benefits.
- To involve end-user communities and related stakeholders to initiate a knowledge exchange cycle for collecting insights on best practices and challenges of platforms' uptake, evolution and costs, etc.
- To leverage the platform uptake by their user communities as well as their continuous improvement and expansion, by elaborating and showcasing best-practice models and evaluation guidelines.
- To disseminate the acquired knowledge to end-users for increasing their uptake of existing platforms, and promote best practice models and identified benefits to foster future developments.

2.2 Methodology

The EU PlatformUptake methodology for AHA solution assessment seeks to deliver an inventory of the state of the art and analyse the use of open service platforms in the Active and Healthy domain, covering both open platforms – such as UnversAAL, FIWARE and partly-open/proprietary platforms developed by industry, and address the interactions between these platforms [3].

To measure the impacts of such platform and enhance their uptake, the project proposal presents a methodology for monitoring open platform development, adoption and spread across Europe, by listing key factors that determine success or hinderance in their uptake by the end-user groups, and also the evolution of their ecosystems and stakeholder networks.

The proposed methodology shall be employed in the project to evaluate the use of open platforms by collecting and processing data from past and currently running European projects and other initiatives that are built upon such platforms. Following the knowledge acquisition, the methodology will elaborate evaluation guidelines and best practice models of integrating multiple platforms, taking account of technical, organizational, financial/business and legal aspects.

Following the assessment of the ecosystem and output of an extended evidence on the ecosystem, the methodology will create support materials for all involved stakeholders to promote the large-scale uptake of existing platforms and also their continuous improvement. In concrete terms this action includes the creation of toolkits for Monitoring and Self-Assessment for both platform providers and platform users, the creation of an Online Information Hub which showcases all information through visually appealing smart tools, and the creation and implementation of a Massive Open Online Course and final project activities to promote synergies and knowledge exchange between the community members [3].

2.3 Platforms

Within the development of the methodology 18 platforms for elderly were analysed. These platforms are:

(1) ACTIVAGE
(2) universAAL
(3) FIWARE
(4) ReAAL
(5) VAALID
(6) GIRAFF+
(7) EkoSmart
(8) PERSONA
(9) OASIS
(10) AmIVITAL
(11) REACH2020
(12) AMIGO
(13) MPOWER
(14) SOPRANO/OPENAAL
(15) INTER-IOT
(16) UNCAP
(17) BeyondSilos
(18) INLIFE

ACTIVAGE consists of a set of Techniques, Tools and Methodologies for interoperability between heterogeneous IoT Platforms and an Open Framework for providing Semantic Interoperability of IoT Platforms for AHA while addressing trustworthiness, privacy, data protection and security.

universAAL enables seamless interoperability of devices, services and applications for IoT enabled smart environments. The platform provides the framework for communication, connectivity and compatibility between otherwise disparate products, services and devices.

The FIWARE Foundation is the legal independent body providing shared resources to help achieve the FIWARE mission by promoting, augmenting, protecting, and validating the FIWARE technologies as well as the activities of the FIWARE community, empowering its members including end users, developers and rest of stakeholders in the entire ecosystem.

REACH represents a solution that seeks to prevent elderly citizens from loss of function and a decline of being able to perform Activities of Daily Living (ADLs) independently leading ultimately to entering Long Term Care (LTC).

VAALID (Accessibility and Usability Validation Framework for AAL Interaction Design Process) is a STREP project of the 7th Marco Program for Investigation and Development of the European Commission, included within the Strategic Objective 'Accessible and Inclusive ICT'; Thematic Priority ICT-2007.7.2.

GIRAFF+ is a complex system which can monitor activities in the home using a network of sensors, both in and around the home as well as on the body.

The purpose of the EkoSmart program is to develop a smart city ecosystem with all the support mechanisms necessary for efficient, optimized and gradual integration of individual areas into a unified and coherent system of value chains.

PERSONA aims at advancing the paradigm of Ambient Intelligence through the harmonisation of Ambient Assisted Living (AAL) technologies and concepts for the development of sustainable and affordable solutions for the social inclusion and independent living of Senior Citizen, integrated in a common semantic framework.

OASIS introduces an innovative, Ontology-driven, Open Reference Architecture and Platform, which will enable and facilitate interoperability, seamless connectivity and sharing of content between different services and ontologies in all application domains relevant to applications for the elderly and beyond.

The general objective of the AmIVITAL project is the development of a new generation of ICT technologies and tools for the modelling, design, operation and implementation of Ambient Intelligence (AmI) devices and systems to be used for providing services and personal support for independent living, wellbeing and health.

REACH2020 represents a solution that seeks to prevent elderly citizens from loss of function and a decline of being able to perform Activities of Daily Living (ADLs) independently leading ultimately to entering Long Term Care (LTC).

The Amigo project develops open, standardized, interoperable middleware and attractive user services for the networked home environment.

MPOWER defines and implements an open platform to simplify and speed up the task of developing and deploying services for persons with cognitive disabilities and elderly.

SOPRANO designs and develops highly innovative, context-aware, smart services with natural and comfortable interfaces for older people at affordable cost, meeting requirements of users, family and care providers and significantly extending the time we can live independently in our homes when older.

In the absence of global IoT standards, the INTER-IoT results will allow any company to design and develop new IoT devices or services, leveraging on the existing ecosystem, and bring get them to market quickly.

UNCAP ("Ubiquitous iNteroperable Care for Ageing People ") makes use of solutions and technologies developed in previous research projects to develop an open, scalable and privacy-savvy

ICT infrastructure designed to help aging people live independently while maintaining and improving their lifestyle.

BeyondSilos aims at further spreading ICT-enabled, joined-up health and social care for older people by developing, piloting and evaluating integrated services based on two generic pathways in a multicentric approach, making extensive use of knowledge and experience gained among early adopters of integrated eCare in Europe.

INLIFE aims to prolong and support independent living for elderly with cognitive impairments, through interoperable, open, personalised and seamless ICT services that support home activities, communication, health maintenance, travel, mobility and socialization, with novel, scalable and viable business models, based on feedback from large-scale, multi-country pilots.

3 CLUSTERING AND TAXONOMIES

Here we present the results of two ways of clustering and the results of taxonomies generation of the text descriptions of the EU PlatformUptake platforms for elderly. There are 18 platforms, each of which is described by 66 features.

First, the text description of the platforms was converted into numeric values, e.g. “yes” gets converted to 10, “no” to 0, “partial” to 5. A part of features couldn’t be directly converted into numbers – mainly features with string-type unordered values, e.g. “Any (web)”, “Windows, mobile, Symbian”, “Java”.

3.1 K-means clustering

K-means clustering is a method of vector quantization, originally from signal processing, that aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean (cluster centers or cluster centroid), serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. k-means clustering minimizes within-cluster variances (squared Euclidean distances), but not regular Euclidean distances, which would be the more difficult Weber problem: the mean optimizes squared errors, whereas only the geometric median minimizes Euclidean distances. For instance, better Euclidean solutions can be found using k-medians and k-medoids [2].

The goal of clustering is to determine how many and which cluster groups represent the platforms best, based on the descriptions of EU platforms for elderly, created by the EU PlatformUptake project in Spring 2021.

In Figure 1 we can see the results of k-means with four clusters. In Figure 2 we can see the results of k-means with four clusters with labels. The platforms are divided into:

- cluster 1: VAALID.
- cluster 2: AmIVITAL, EKOSMART, INLIFE, OASIS, sensiNact, UNCAP, UNIVERSAL.
- cluster 3: ActivAgeR, FIWARE, Giraff+, InterIoTL, REACH, SOFIA2.
- cluster 4: AMIGO, BeyondSilos, PERSONA, SOPRANO.

It should be noted that there are only 15 dots visible in Figure 1 although there are 18 platforms. The reason is that 4 dots are overlapped one over another, and therefore are not seen in Figure 1 separately.

3.2 Hierarchical clustering

Hierarchical clustering also known as hierarchical cluster analysis, is an algorithm that groups similar objects into groups called clusters. The endpoint is a set of clusters, where each cluster is distinct from each other cluster, and the objects within each cluster are broadly similar to each other [1].

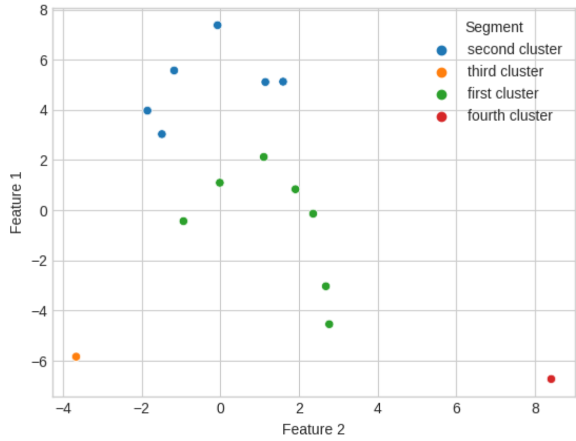

Figure 1: Result of k-means with four clusters.

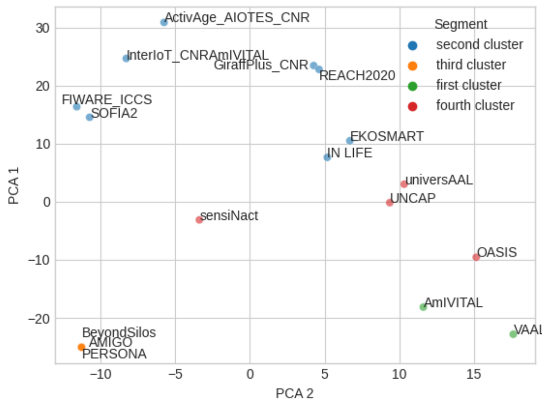

Figure 2: Result of k-means with four clusters with labels.

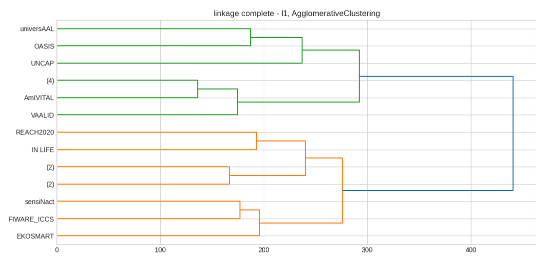

Figure 3: Result of hierarchical clustering.

Hierarchical clustering starts by treating each observation as a separate cluster. Then, it repeatedly executes the following two steps: first, identify the two clusters that are closest together, and second, merge the two most similar clusters. This iterative process continues until all the clusters are merged together. The main output of hierarchical clustering is a dendrogram, which shows the hierarchical relationship between the clusters [1].

We got the best result using complete linkage (linkage determines which distance to use between sets of observation).

Figure 3 shows the dendrogram for the hierarchical clustering. In general, closer and shorter lines present greater similarity. There are three clusters. One is green colored, one is orange colored and the combined one is blue colored.

3.3 Taxonomies

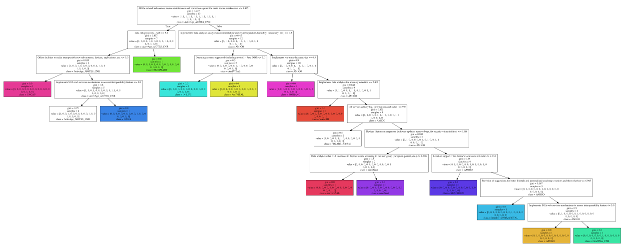

Figure 4: A decision tree of platforms for elderly.

According to Wikipedia [4], taxonomy is "the practice and science of categorization or classification based on discrete sets." It is a hierarchical classification, in which things are organized into groups or types. Many taxonomies are hierarchies in the form of a tree structure, but not all are. Creating taxonomies often corresponds to machine learning (ML) of a decision tree from input, where each leaf in a decision tree corresponds to a specific object, e.g. a specific plant species, or in our case – a taxonomy description. The input for the taxonomies generation in this section is the same as for the all other approaches in this text, e.g. clustering. There are Initially 61 features. Most of these features have values that can be easily converted into numeric values, e.g. "yes" gets converted to 10, "no" to 0, "partial" to 5. A part of features couldn't be directly converted into numbers – mainly features with string-type unordered values, e.g. "Any (web)", "Windows, mobile, Symbian", "Java". These features have been broken (hot encoding) into a bigger number of new features, e.g. "is web", "is Windows", "is mobile", "is Symbian", "is Java". After the transformations, there are 66 features.

Figure 4 represents the generated taxonomy on the platforms analyzed in the EU PlatformUptake project. It is a decision tree where most of the leafs correspond to only one platform. Starting from the root (the top of the decision tree), it contains all the platforms, hence all 1s in the "value" field. The set of all platform descriptions gets split into the left and the right node based on the feature/question "All the related web servers ensure maintenance and corrections against the main known weaknesses <= 1.875?". According to the question that was found the most relevant for this decision tree / taxonomy, the set of all taxonomies splits into two: (1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 0) in the left subtree and (0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1) in the right subtree. The procedure repeats until ideally there is just one platform left, i.e. all the other platforms do not correspond to the set of questions except the one. For example, the yellow leaf corresponds/represents to the "AmIVITAL" platform. It's parent node splits platforms looking at the feature named "Operating systems supported (including mobile) – Java OSGi". If the value is <= 5, it continues the graph over its left arrow; if the value is > 5, it continues the graph over its right arrow, in this case for a leaf "AmIVITAL". Therefore, the features (questions) leading to the yellow node, i.e. the AmIVITAL platform, are:

- All the related web servers ensure... <= 1.875
- Implemented data analytics analyze environmental ... <= 0.5
- Operating systems supported (including ... <= 0.5

In a similar way, all descriptions of the platforms can be obtained from the generated tree, best differentiating between them. The only exception is the second node from the left where it is not possible to distinguish between the three platforms. While the previous features lead to all three of them, the algorithm is not able to create further questions to differentiate between them, i.e. using additional features.

4 CONCLUSION AND DISCUSSION

We presented the EU PlatformUptake project for AHA solution assessment, its main objectives and its 18 platforms for elderly chosen because they allow elderly to live more healthy and more independently. We studied similarities and differences between the 18 platforms, and presented the results by two ways of clustering, and the taxonomies generated from the text descriptions of the EU PlatformUptake platforms. We conclude that the platforms can be clustered into similar categories and that an effective decision tree taxonomy can be created for the platforms. Clustering and structuring taxonomies for elderly in the proposed way enables an integrated understanding of the field of EU platforms for elderly.

In future work, deeper analysis of the clustering is required. With k-means it is possible to get better and more clear results with 6 or more clusters. It is feasible that hierarchical clustering could also yield more clusters which would be better for deeper analysis.

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What-If Analysis of Countermeasures Against COVID-19 in November 2020 in Slovenia

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ABSTRACT

Choosing best sets of countermeasures against COVID-19 is a difficult task, and it is often not clear whether the the countermeasures that were actually chosen were justified. In this paper we studied if the introduction of masks and school opening in the times of exponential growth in November 2020 in Slovenia were justified or not.

KEYWORDS

COVID-19, epidemiological models, multi-objective optimization, non-pharmaceutical interventions

1 INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease that has rapidly spread across the world. Due to its high mortality rate [4], most countries deemed it too disruptive to let it run unchecked and have thus implemented countermeasures against it. The main type of countermeasures, in particular in the times when the vaccines were not yet available, were the *non-pharmaceutical interventions* (NPI) that include lockdowns, closure of schools and workplaces, and required mask usage. Due to the lack of precedent in the recent history, and several variables that influence the effect in a particular country, e.g. weather and cultural circumstances, it was and still is hard for decision-makers and domain experts to determine which NPIs to implement in a given epidemiological situation and what effect would a particular combination of NPIs have.

As we are now in the second year of the pandemic, large databases of data regarding the spread of the virus and implemented NPIs aimed at stopping it, became available. This in turn allows for the use of artificial intelligence (AI) methods to analyze the data, create predictive models, and consequently help the decision-makers in their task. It also enables reevaluation of the influence of particular NPIs at a particular time.

In our previous work [5] we built such an AI system, as part of the XPRIZE: Pandemic Response Challenge. At that competition, our system achieved second best results, and was significantly upgraded since that time.

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In the study reported here we used the improved version, specialized for Slovenia, to objectively answer a few what-if questions, such as whether school closure and mask usage were justified at a particular point in time, or were they an unnecessary burden.

These questions were posed to us by the Slovenian Ministry of Health. Namely, in August 2021 we sent the our XPRIZE system to all EU Ministries of Health with the motivation to help decision-makers better select NPIs. No ministry was able or eager to use the system itself so far, but we got some replies and requests for particular studies, such as the one tackled in this paper.

2 DATASET

Our system was trained on the data from 235 world regions between the dates of March 1, 2020 and April 14, 2021. While taking data from Slovenia only might result in a more localized model, this data does not provide the necessary range of implemented NPIs and their combinations.

The main source of data was the "COVID-19 Government response tracker" database, collected by the Blavatnik School of Government at Oxford University [2], that defines which (and in what time interval) NPIs were implemented in each country. The NPIs in this database are listed in Table 1. The database also provides the strictness of the implementations in the form of numbers, e.g., "Workplace closing – 1" represents that government only suggests closure, while "Workplace closing – 3" strictly demands it. The detailed description for each level of strictness is provided by the database authors [2].

Other key data needed for training the system are the numbers of infections and deaths, obtained from the same database. In addition we used data on weather, mobility, hospitalizations, vaccination and 93 features based on country characteristics (e.g., culture, development) from our previous work [3].

3 METHODS

The results in this work were made using an upgraded version of our XPRIZE system that can predict the number of infections given the active NPIs, and propose best NPIs to counter them.

The whole system is thoroughly described in our previous work [5]. Here, a quick overview is provided. The system first uses historical data of all regions to create a model that predicts COVID-19 infections given a set of NPIs. A SEIR epidemiological model is used for this purpose, combined with a machine-learning model that predicts the SEIR models's parameters as a function of NPIs. This model is used to predict the infections resulting

Table 1: The NPIs used in our study, and the range of values representing their strictness.

NPI	Value range
C1: School closing	[0-3]
C2: Workplace closing	[0-3]
C3: Cancel public events	[0-2]
C4: Restrictions on gatherings	[0-4]
C5: Close public transport	[0-2]
C6: Stay at home requirements	[0-3]
C7: Restrictions on internal movement	[0-2]
C8: International travel controls	[0-4]
H1: Public information campaigns	[0-2]
H2: Testing policy	[0-3]
H3: Contact tracing	[0-2]
H6: Facial Coverings outside the home	[0-4]

from a sequence of NPIs (referred to as "intervention plan") – its benefit.

The system also estimates the cost of each intervention plan. Calculating costs of NPIs is a complex issue that will be discussed in a forthcoming paper. In brief, they consist of economic costs (due to disruption of business and similar), for which some sources are available in the literature [6, 1], and social costs (due to isolation, restriction of freedom and similar). The cost of each plan is traded off against its benefit, as stricter plans results in fewer infections, but are costlier. Finally, the system uses multi-objective optimization to find intervention plans with good trade-off between benefits and costs.

The two major improvements of the system for the purpose of this paper are: 1) the added possibility to set a constraint on the maximal number of infections allowed – no plan exceeding this constraint is generated and 2) the added possibility to limit the strictness of any individual NPI. This two changes allowed us to analyze the what-if scenarios of what would happen if a certain NPI were not implemented, and what plans can we implement to have a similar number of infections, but not the undesired NPI.

The plans presented in this paper were evaluated using only their economic component (estimated GDP loss [in %] for that month), but not with the social one. While we repeated all the experiments using social costs, the results were similar, and the social costs we used are less objective than the economic ones.

4 RESULTS

All the predictions were made for the time interval 30. 10. 2020 – 30. 11. 2020, for Slovenia. That time interval was chosen because of the high number of infections observed and strict countermeasures imposed.

In the first experiment, we tested what would have happened if masks were not worn in closed spaces, and all other NPIs would remain the same as the actually implemented. The results are shown in Figure 1. They indicate an increase of infections, which was expected considering that we are simulating lowering the countermeasures during the epidemic peak, and no other NPI was simulated instead of masks.

A similar experiment was made for the hypothetical case where schools fully re-opened for a month. The results (Figure 2) show that the number of infections would grow even faster. This happens due to the exponential nature of the epidemiological model, encapsulating the actual nature of the virus infection in favorable conditions. Obviously, this reduction in strictness

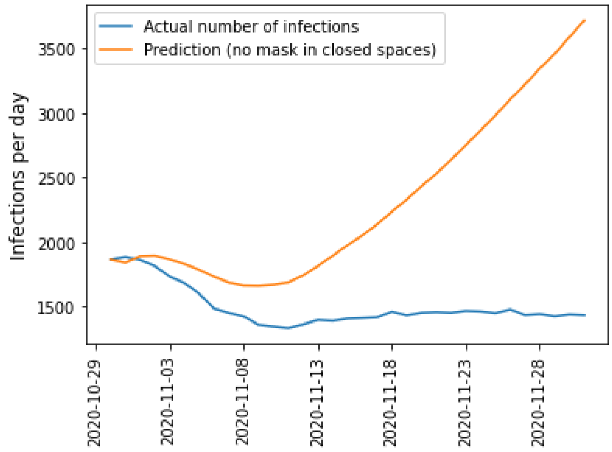

Figure 1: A comparison of actual number of daily infections, with predicted number of infections for the hypothetical case where masks were not used.

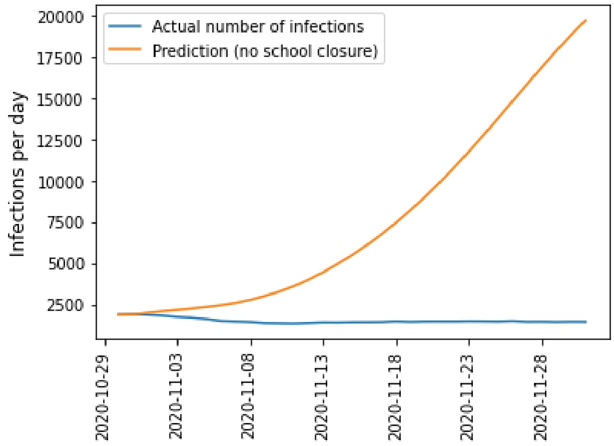

Figure 2: A comparison of actual number of daily infections, with predicted number of infections for the hypothetical case where schools were re-opened.

greatly changes the reproduction rate and consequently leads to the exponential growth.

Such fast growth as was predicted in these to experiments is probably too pessimistic, as in reality in the case that the number of infections were starting to grow so alarmingly, the population's behavior would likely become more cautious – counterbalancing the growth. Nonetheless, the model indicates that the school closure is a major contributor to regulating COVID-19, even more important than the masks. Please note that scale of the y axis differs between Figures 1 and 2.

The two described experiments show that removing an NPI from the implemented intervention plan will likely result in substantial growth, which decision-makers would not allow. Therefore, we attempted to compensate for the missing NPIs with other NPIs to prevent the exponential growth.

We used multi-objective optimization to show the best plans one can make given the restriction that a certain NPI cannot be used, at least not with a strictness exceeding a given threshold. These plans were compared based on the predicted infections

Table 2: The weekly strictness of selected intervention plans. The letters identify the plan on the Pareto front approximations in Figures 3 and 4. Strictness 0044 would indicate that the lowest strictness is used for the first two weeks, and highest for the last two ones.

NPI	a	b	c	d	e	f	g	h	i
C1: School closing	3333	3333	3333	2222	2222	1111	1111	3333	3333
C2: Workplace closing	2222	0000	2000	1000	3000	3002	3301	0000	3000
C3: Cancel public events	2222	2222	2222	2222	2222	2222	2222	2222	2222
C4: Restrictions on gatherings	4444	4444	4442	4444	4444	4444	4444	4444	4444
C5: Close public transport	0022	2222	2222	2222	2222	2222	2222	2222	2222
C6: Stay at home requirements	2222	0010	1100	1111	1110	1111	1111	1100	3110
C7: Restrictions on internal movement	2222	0000	1000	1000	2000	2011	2210	0000	2200
C8: International travel controls	2222	4343	4443	4444	4444	4444	4444	4444	4444
H1: Public information campaigns	2222	2222	2222	2222	2222	2222	2222	2222	2222
H2: Testing policy	2222	3333	3333	3333	3333	3333	3333	3333	3333
H3: Contact tracing	1111	2222	2222	2222	2222	2222	2222	2222	2222
H6: Facial coverings outside the home	4444	4444	4444	4444	4444	4444	4444	0000	0000

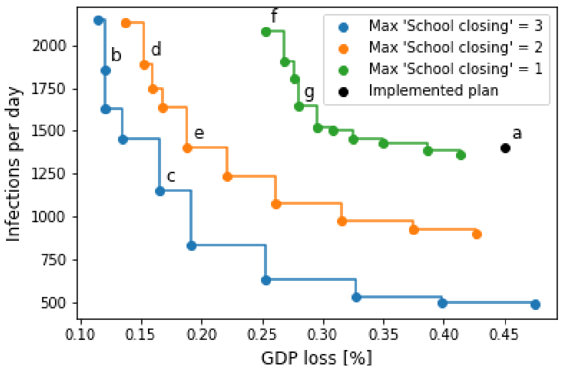

Figure 3: Proposed intervention plans using different restrictions on the value of "School closing". They were evaluated based on the predicted number of infections and estimated GDP loss. The marked plans are explained in Table 2.

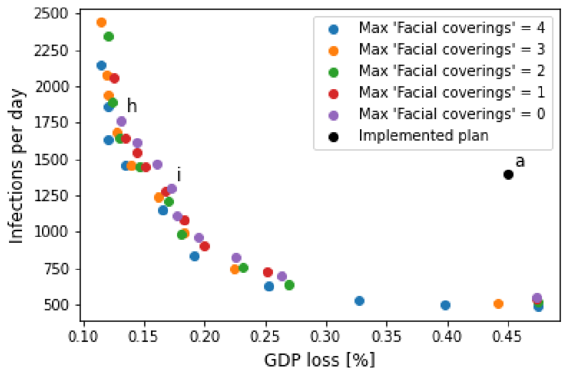

Figure 4: Proposed intervention plans generated using different restrictions on the value of "Facial covering". They were evaluated based on the predicted number of infections and estimated GDP loss. The marked plans are explained in Table 2.

and predicted GDP loss for that month. The resulting Pareto-front approximations for school closure with different levels of strictness are shown in Figure 3.

The blue line in Figure 3 represents the case with no limitations when constructing an intervention plan, and obviously these solutions are substantially better than the intervention plan actually implemented, and the plans with limitations. The orange and green lines represent plans that have schools partially or fully open. These plans are visibly worse in terms of the two desired objectives: this happens because the system is compensating for the lack of "School closing" NPI with "Workplace closing" NPI, which is more expensive. A sample of the generated plans is given in Table 2.

This experiment was repeated, this time restricting the strictness of the "Facial Coverings" NPI. The results are shown in Figure 4 and sample plans are given in Table 2.

For the mask analysis, the system found comparable solutions that compensate for the reduced "Facial Coverings" NPI. While this NPI has a good ratio between benefit and economic cost, its benefit in absolute terms is nevertheless smaller than of the "School closing" NPI, so it is easier to replace by increasing other NPIs.

5 DISCUSSION AND CONCLUSIONS

In this study we analyzed what-if scenarios in regards to reduced wearing of masks and school re-openings for Slovenia at peak infection time in November 2020. The study showed that both of these changes would worsen the epidemiological situation in the country if no other NPI was introduced instead. Furthermore, for school closure the AI model could not find proper replacement in that situation, suggesting that school closure was justified. The closest viable solution was "Solution *e*" that proposes only partial school closing, but compensates it with increased testing and international travel control. On the other hand, the model indicated that mask usage could be almost completely compensated with an increase of other NPIs. It cannot judge whether this is desirable – that may depend on social costs.

The study has a number of limitations:

(1) The study was done using historic data for Slovenia, while the AI system was trained on data from all regions and was only somewhat tuned to Slovenia.

(2) The data and the resulting model do not contain the information on vaccination, as it was not available in the tested period.
(3) The data and the resulting model do not contain the information on the Delta or newer variants, as it was not available in the tested period.
(4) The model does not predict what would happen with a different implementation of the NPI (e.g., stricter testing of students/teachers).
(5) The study uses costs available from the literature and might not fit best Slovenian specifics.
(6) The study does not use social costs, which are certainly important but difficult to set in a justifiable manner.

Because of these limitations, it is not recommended that this study be used as a basis for future policies. For such purpose, we strongly recommend performing new experiments tailored to the problem we try to address.

Comparing best AI-proposed measures with the actual ones by humans reveals a well-known phenomenon that humans cannot on their own consider all possibilities and propose best actions. Although demonstrated only on a couple of cases here, in our opinion that is a fairly general conclusion valid not only for COVID-19 NPIs. In most cases it should still be the human's role to make final decisions, but humans should take advantage of AI assistance when possible.

In summary, school closing and masks in general represent important NPIs, and the decision to use them in peak infection cases when vaccinations are not available or sufficient, seems reasonable. However, unlike the school closing, the masks can be replaced with other NPIs. Furthermore, vaccinations in particular render NPIs less important – if no new variant of COVID-19 appears.

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Effectiveness of non-pharmaceutical interventions in handling the COVID-19 pandemic: review of related studies

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ABSTRACT

In this paper, we analyse 30 articles on studies that focus on assessing the effectiveness of different non-pharmaceutical interventions (NPIs) to flatten the pandemic curve. The articles reviewed use different methods, data sources, and metrics for NPI effectiveness. They also analyse different regions in different time periods. Here, we rank the interventions from each article using a consistent scoring system. This allows us to rank and compare the effectiveness of each NPI.

We conclude that school closure, workplace closure and restrictions on gatherings are the most effective interventions. Public events cancellation and public information campaigns also appear to have a significant impact. Stay at home requirements, facial coverings, restrictions on internal movement and international travel controls have a moderate effect. The least effective NPIs across all studies were found to be public transport closure, testing policy and contact tracing.

KEYWORDS

Non-pharmaceutical interventions, COVID-19, SARS-CoV-2

1 INTRODUCTION

The COVID-19 pandemic has forced governments around the globe to implement several non-pharmaceutical interventions (NPIs). Researchers have studied the effectiveness of such interventions to help governments make more informed decisions in dealing with the crisis.

The aim of this review is to summarize and compare the findings and methods of several articles on the impact of NPIs on COVID -19 and to determine which interventions are best suited to improve the epidemiological situation.

2 METHODOLOGY

2.1 Selection of articles

For this review, we searched for articles that focused on assessing the effectiveness of NPIs in dealing with the ongoing COVID -19 pandemic. To be included here, articles had to include comparisons of at least two interventions so that each could be ranked from most to least effective. Important works on the spread of COVID -19 that do not include a comparison of different NPIs (e.g., Chang, S. et al. [5]) are therefore not included in this review.

Effectiveness of the following NPIs from the Oxford COVID-19 Government Response Tracker (OxCGRT) [14] was assessed: school closure, workplace closure, public events cancellation, restrictions on gatherings, public transport closure, stay at home requirements, restrictions on internal movement, international travel controls, public information campaigns, testing policy, contact tracing and facial coverings. The 12 NPIs listed were chosen because they are independent of each other and cover all radical government interventions used worldwide. For example, curfew is included in the stay at home requirements.

The articles included in this review, the corresponding NPI data sources, the countries included, and the time frame in which the effectiveness of the interventions was assessed can be seen in Table 1.

2.2 Articles not based on OxCGRT data

In articles on studies that obtained NPI data from other sources, intervention policies were checked for compatibility with OxCGRT descriptions wherever possible, using documentation from the individual NPI databases or descriptions provided by the authors (in studies where data collection was conducted by the authors themselves).

In this review, some interventions from the article by Haug et al. [15] were merged into those specified by OxCGRT, with the effectiveness of the merged NPI defined as the maximum effectiveness of the nonmerged ones. In this way, both small and mass gathering cancellations were merged into restrictions on gatherings. Border restriction, travel alert and warning were merged into international travel controls.

Some interventions have been reassigned to the appropriate OxCGRT definitions. Educate and actively communicate with the public was transformed into public information campaigns, enhance detection system into testing policy, and national lockdown into stay at home requirements.

The study by Bo et al. [3] analysed the impacts of four intervention categories, namely traffic restriction, social distancing, mandatory wearing of a face mask in public, and isolation or quarantine. Most of these interventions are a combination of several OxCGRT interventions, so their effectiveness score was assigned to all the NPIs that comprise them. The score of traffic restriction was assigned to restrictions on internal movement and international travel controls, and the social distancing to school closing, public events cancellation, and restriction on gatherings. Mandatory face masks in public was assigned to facial coverings and isolation or quarantine to stay at home orders.

Banholzer et al. [2] estimated the effectiveness of seven NPIs. They treated bans on small and large gatherings as two seperate interventions, so they were merged here into restrictions on gatherings. Venue closure and work-from-home order were merged into workplace closure based on the fact that the authors described venue closure as "closure of some or all non-essential businesses". Their border closure intervention was treated as international travel controls in this review.

In other articles that included the non-essential business closing intervention it was treated as OxCGRT's workplace closure.

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Table 1: Articles included in this review

Authors	Published in	NPI data source	Countries included
Askitas et al. [1]	Nature	OxCGRT	175 countries
Banholzer et al. [2]	Plos One	Collected by the authors	USA, Canada, Australia and 17 EU countries
Bo et al. [3]	ScienceDirect	Collected by the authors	190 countries
Brauner et al. [4]	Science	Collected by the authors	41 countries (of which 34 are European)
Chaudhry et al. [6]	The Lancet	Collected by the authors	50 countries
Chernozhukov et al. [7]	ScienceDirect	Covid Tracking Project	USA
Courtemanche et al. [8]	Health Affairs	John Hopkins University	3138 US counties
Deb et al. [9]	SSRN	OxCGRT	129 countries
Dreher et al. [10]	ScienceDirect	unclear	USA
Ebrahim et al. [11]	JMIR	Hikma Health	1320 US counties
Esra et al. [12]	medRxiv	WHO-PHSM	26 countries and 34 US states
Haug et al. [15]	Nature	CCCSL	56 countries, 79 territories
Hunter et al. [16]	medRxiv	IHME	30 European countries
Islam et al. [17]	BMJ	OxCGRT	149 countries
Jalali et al. [18]	medRxiv	Collected by the authors	30 most populous US counties
Jüni et al. [19]	CMAJ	Collected by the authors	144 worldwide geopolitical regions
Koh et al. [20]	ScienceDirect	OxCGRT	170 countries
Leffler et al. [21]	AJTMH	OxCGRT	200 countries
Li et al. (a) [22]	The Lancet	OxCGRT	131 countries
Li et al. (b) [23]	MDPI	NSF spatiotemporal center	USA
Liu et al. [24]	BMC Medicine	OxCGRT	130 countries and territories
Olney et al. [26]	American Journal of Epidemiology	Collected by the authors	USA
Papadopoulos et al. [27]	medRxiv	OxCGRT	151 countries
Piovani et al. [28]	ScienceDirect	OxCGRT	37 members of OECF
Pozo-Martin et al. [29]	Springer Link	OxCGRT and WHO-PHSM	37 members of OECD
Sharma et al. [30]	medRxiv	Collected by the authors	114 subnational areas in 7 European countries
Stokes et al. [32]	medRxiv	OxCGRT	130 countries
Wibbens et al. [33]	Plos One	OxCGRT	40 countries and US states
Wong et al. [34]	Journal of Infection	OxCGRT	139 countries
Zhang et al. [35]	MDPI	NY Times and CNN	USA

National lockdown was mapped to stay at home requirements. Some studies measured the effectiveness of bans on small and mass gatherings separately. Their results were combined into a single intervention - restrictions on gatherings.

2.3 Ranking effectiveness of NPIs

Different studies estimated the individual impacts of implementing interventions in different ways. We used a simplified ranking system by assigning values between 1 and 4 to the NPIs, with 1 representing the most effective and 4 the least effective interventions. Several interventions from individual studies could have been assigned the same value.

In the articles where the authors have already quantitatively estimated the impacts of individual NPIs, their results have simply been converted to new values, as described above.

Askitas et al. [1] graded interventions only descriptively. They found that the most effective interventions in reducing the spread of COVID-19 were restrictions on gatherings, public events cancellation, school closure and workplace closure, so they were assigned a value of 1. Stay at home requirements were estimated to have a smaller effect after a longer period of time and we graded its effectiveness as 2. International travel controls NPI was less effective. Restrictions on internal movement and public transport closures had a negligible impact.

In the study by Liu et al. [24], the effectiveness of NPIs was measured in two scenarios: maximum effort (i.e., the NPIs are at their maximum intensity) and any effort (i.e., the NPIs are active at any intensity). They described interventions as either strong, moderate, or weak in each of the scenarios. Their results were adapted to the simplified ranking system by assigning a value of 1 to NPIs strong in either both scenarios or in any effort scenario. NPIs that are strong only at maximum effort were graded 2, moderate NPIs were ranked as 3 regardless of the scenario and weak NPIs were ranked as 4.

In the article written by Li et al. (a) [22], the impact of NPIs was estimated 7 days, 14 days and 28 days after its implementation as the ratio between the reproduction number (R) at a given time point (after 7, 14 or 28 days) and the initial R. We simplified this by calculating the average between all three ratios for each NPI and ranking them with values between 1 to 4.

Wibbens et al. [33] estimated the effectiveness of 11 NPIs at different levels of intensity. They were first ranked at their highest intensity and then at an intermediate intensity. Our metric with values between 1 and 4 was then applied based on the average of high and intermediate intensity rankings.

2.4 Comparison with a similar article

While looking for studies to include in this review we found a similar article by Mendez-Brito et al. [25]. Their review included 34 articles on the subject of NPI effectiveness. Here, some of these articles were excluded, most of them because they only found conclusive evidence for the effectiveness of a single intervention policy. Furthermore, the study conducted by Flaxman et al. [13] is also not included in this review because Soltesz et al. [31] proved that the model used was too sensitive to subtle and realistic alterations in parameter values.

Two additional articles were included in this review [1][30]. However, all other studies included in our paper were already reviewed in the review by Mendez-Brito et al. [25]. Despite that, there are a few differences between our findings and theirs. Slight differences occur in grading effectiveness of NPIs from different studies, most likely because many studies did not present a ranking system and so our interpretation of their results might be different than that of Mendez-Brito et al.

There are some articles that do not compare impacts of different intervention policies, but rather only qualitatively mark them as effective in reducing the COVID-19 incidence. The NPIs assessed in those studies were all graded with the same grade by Mendez-Brito et al. They treated those interventions as the least effective according to their scale. Since such NPIs were only found to be effective but it was not determined how effective they were, we could not confidently grade them as the most effective interventions, but their impact likewise could not be treated as negligible. That is why they are marked here as moderately effective, i.e., they are graded with a 2.

3 RESULTS

3.1 Assessed regions and time frames

The reviewed studies assessed the impact of COVID-19 intervention policies in different time frames. Most studies only analysed the first epidemiological wave. Only Sharma et al. [30] focused on estimating effectiveness of NPIs during the second wave. Wibbens et al. [33] analysed a longer time frame - from March to November 2020. Pozo-Martin et al. [29] analysed both waves independently, but the estimates of NPI effectiveness during the second wave were not as statistically significant. Zhang et al. [35] also analysed a longer period including both waves.

The majority of studies (19 out of 30) analysed only country-level data. Two studies [29][28] used data only on countries that are members of the Organisation for Economic Co-operation and Development (OECD). The works [11][26][8][23][18][35][7][10] analysed impacts of NPIs in the United States, either state-level or county-level. The only more detailed analysis for Europe was done by Sharma et al. [30], who analysed 114 subnational areas in 7 European countries.

3.2 Metrics used in studies

The studies in this review used different metrics to evaluate the impacts of the interventions. 10 studies analysed how individual NPIs affect the reproduction number [3][4][10][12][15][20][22][24][26][30]. 8 studies estimated the effectiveness of NPIs based on case incidence or case growth rates [1][2][8][11][19][29][33][35]. 4 articles [6][21][28][32] focused only on mortality caused by COVID-19 and 5 articles [7][9][18][23][27] analysed the impact on both cases and deaths.

3.3 NPI effectiveness estimations

Some intervention policies were included in more studies than others. The ones that were included in most of the studies reviewed are school closure (conclusively assessed in 22 studies), workplace closure (in 22 studies), restrictions on gatherings (in 18 studies), and stay at home requirements (in 20 studies). The distribution of estimated effectiveness of these NPIs across included articles is shown in Figure 1. Contact tracing was only analysed in two articles [33][24] and testing policy in four articles [15][24][29][33].

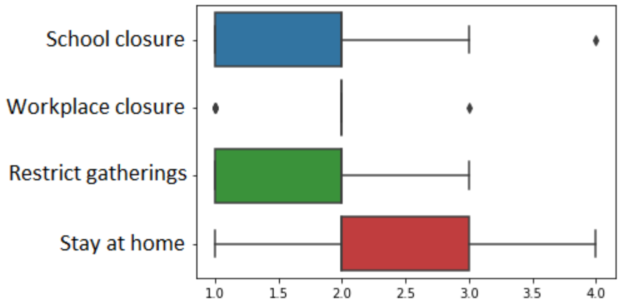

Figure 1: Distribution of effectiveness values for the most frequently represented NPIs (lower values stands for better effectiveness

The impacts of NPIs in the included studies are shown in Figure 3. Blank cells indicate that the intervention was either not included in the corresponding study or that the estimates of its effectiveness were inconclusive. Cells are also color coded according to the strength of the interventions in the corresponding articles. A darker shade indicates that the NPI is more effective. The average effectiveness, median effectiveness and the most frequent value were calculated for each NPI across all articles and are presented in Figure 2 along with inormation on how many articles conclusively assessed each NPI and the standard deviation for each NPI.

4 CONCLUSION

Studies estimating the effectiveness of COVID-19 interventions used different approaches. They analysed data from different regions and in different time frames. They did not use the same models to analyse the data or the same metrics to determine the effects different interventions had on the pandemic. Nonetheless, their findings were often agreed with each other.

The most effective interventions across the reviewed studies were school closure, workplace closure and restrictions on gatherings. School closure was estimated to be among the most effective intervention policies in 9 studies (41% of studies in which it was assessed), workplace closure in 5 (23%) studies, and restrictions on gatherings in 8 (44%) studies. Public events cancellation was also found to be one of the most effective measures in 3 (33%) out of 9 studies. Interestingly, public information campaigns appear to be as effective as cancellation of public events.

Stay at home requirements was also estimated to have a considerable impact, but the interventions mentioned above were found to be even more effective. This could be because the stay at home requirements NPI was often implemented as a last resort

	Mean	Median	Mode	Counts	Std dev
School closure	1.8	2.0	1	22	0.85
Workplace closure	1.8	2.0	2	22	0.50
Public events cancellation	2.0	2.0	2	9	1.00
Restrictions on gatherings	1.8	2.0	1	18	0.81
Public transport closure	3.6	4.0	4	7	1.13
Stay at home requirements	2.3	2.0	3	20	0.86
Restrictions on internal movement	2.6	3.0	3	9	1.13
International travel controls	2.8	3.0	3	13	0.90
Public information campaigns	2.0	2.0	2	6	0.89
Testing policy	3.8	4.0	4	4	0.50
Contact tracing	4.0	4.0	4	2	0.00
Facial coverings	2.5	2.0	2	8	0.76

Figure 2: Averaged effectiveness, median effectiveness and most frequent value (Mode) of each NPI across studies (lower value stands for better effectiveness) along with the number of studies that assessed each NPI (Counts) and standard deviations (Std dev).

in addition to many other interventions and its isolated effect might only be what it adds on top of those.

Facial coverings, restrictions on internal movement and international travel controls were generally associated with having a moderate effect on flattening the epidemic curve. The least effective NPIs were consistently found to be public transport closure, testing policy and contact tracing.

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	Interventions											
	School closure	Workplace closure	Public events cancellation	Restrictions on gatherings	Public transport closure	Stay at home requirements	Restrictions on internal movement	International travel controls	Public information campaigns	Testing policy	Contact tracing	Facial coverings
Askitas et al.	1	1	1	1	4	2	4	3				
Banholzer et al.	2	2		1		4		3				
Bo et al.	1		1	1		3	4	4				2
Brauner et al.	1	2		1		3						
Chaudhry et al.		2		2		2		3				
Chernozhukov et al.		2				2						2
Deb et al.	1	2	2	2	1	1	2	1				
Dreher et al.	2	2				1						
Ebrahim et al.		2				3						
Esra et al.		3	3			1						2
Haug et al.	1			1	4	3	3	2	2	3		
Hunter et al.	1	2		3								
Islam et al.	2	2		1	4	3	3					
Jalali et al.	2											2
Jüni et al.	2	2		2								
Koh et al.		1				2	2	3				
Leffler et al.	2		2					2				2
Li et al. (a)	1	2	1	3	4	2	3	4				
Li et al. (b)		2	2			3			1			
Liu et al.	1	1	2	2	4	3	1	4	3	4	4	
Olney et al.	2			1		1						
Papadopoulos et al.	2	2						2	2			
Piovani et al.	3			2								
Pozo-Martin et al.	3	2		1						4		4
Sharma et al.	4	1		2		3						3
Stokes et al.	1	2		3				3				
Wibbens et al.	2	1	4	3	4	2	1	3	3	4	4	
Wong et al.	3	2							1			
Zhang et al.						2						3

Figure 3: Estimated effectiveness of each NPI in different studies (lower value stands for better effectiveness)

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Napovedovanje trendov in optimiziranje ukrepov v boju proti pandemiji COVID-19: Tekmovanje XPRIZE in naslednji koraki

Forecasting trends and optimizing the intervention plans against the COVID-19 pandemic: The XPRIZE competition and beyond

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POVZETEK

V tem preglednem prispevku predstavimo delo, ki smo ga sodelavci Odseka za inteligentne sisteme opravili v zadnjem letu v povezavi s pandemijo COVID-19. Raziskave modelov, ki predvidevajo prenos okužb v lokalnem okolju in na podlagi tega predlagajo ukrepe za boj proti epidemiji, so najprej potekale v okviru mednarodnega tekmovanja $500k Pandemic Response Challenge, v organizaciji fundacije XPRIZE in podjetja Cognizant. Na tekmovanju se je ekipa JSI vs COVID uvrstila na drugo mesto. V nadaljevanju so potekale raziskave v povezavi z Ministrstvom za zdravje RS, da bi ugotovitve in modele lahko v boju proti pandemiji uporabili tudi v praksi.

KLJUČNE BESEDE

COVID-19, epidemiološki modeli, nefarmacevtski ukrepi, večkriterijska optimizacija

ABSTRACT

We present an overview of the work that was carried out by the members of the Department of Intelligent Systems in the last year, related to the COVID-19 pandemic. We were studying the models that forecast the spread of infection in local environment and tried to suggest the countermeasures based on the trends. The research first took place within the $500k Pandemic Response Challenge, organized by the XPRIZE fundation and the company Cognizant. The JSI vs COVID team won the second place in the competition. In the following months, the research focused on the applicability of the results in practive, in collaboration with the Ministry of Health.

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KEYWORDS

COVID-19, epidemiological models, nonpharmaceutical interventions, multi-objective optimization

1 UVOD

Ko se danes ozremo na prve mesece leta 2020, je jasno, da je pandemija COVID-19 zahodni svet ujela nepripravljen. Ker je šlo za nov virus, se najprej ni vedelo, kako kužen je, kako hitro se širi, predvsem pa kako se pred njim zaščititi in kako preprečiti obremenitev bolnišnic in visoka števila težko bolnih in mrtvih. Zelo hitro se je namreč pokazalo, da v primerjavi z nekaterimi drugimi respiratornimi obolenji več obolelih potrebuje bolnišnično oskrbo, nekateri tudi obravnavo na intenzivni negi in pomoč medicinskega ventilatorja. Zdravniki so poleg tega potrebovali več mesecev, da so ugotovili, kako najučinkoviteje zdraviti paciente s COVID-19. Pomembno je bilo tudi podcenjevanje nevarnosti, ker se je pričakovalo, da bo možno s sledenjem okuženih, ki so npr. prileteli z avionom, zajeziti vdor virusa v državo. Ker je virus sposoben prenašanja tudi preko na videz zdravih ljudi, ta ukrep ni bil sposoben zajeziti vdora oz. blokirati pri majhnem številu okuženih.

Med različnimi pristopi v boju proti širjenju okužb se je zelo hitro uveljavil pristop »lockdowna«, praktično popolnega zaprtja družbe. Ta pristop so najprej uporabili na Kitajskem, v mestu Wuhan, kjer so najprej zasledili virus, v Evropi so prvi začeli z zapiranjem v Italiji, februarja, najprej v posameznih občinah na severu države, kasneje po celotni državi. V Sloveniji so bili prvi primeri virusa zaznani v začetku marca, sredi marca pa je prišlo do zaprtja države. Časovni potek prvih mesecev pandemije je opisan v [1].

Kmalu se je pokazalo, da popolno zaprtje družbe sicer precej učinkovito omeji širjenje okužb, ni pa učinkovito na dolgi rok, saj je izredno drago za državo in prebivalce tako z ekonomskega kot tudi z družbenega vidika. Raziskovalci so zato začeli preučevati kombinacije ukrepov, ki bi po eni strani učinkovito omejili širjenje okužb, po drugi strani pa bi čim manj prizadeli gospodarstvo in državljane. Takih sistemskih rešitev, npr. programov, ob pojavu virusa COVID-19 še ni bilo.

Iskanje učinkovitih kombinacij ukrepov, ki hkrati ne bi prizadeli družbe, je bilo tudi vodilo tekmovanja $500k Pandemic Response Challenge, v organizaciji fundacije XPRIZE in podjetja Cognizant, ki je bilo organizirano konec leta 2020. Na tekmovanje se je prijavila tudi ekipa JSI vs COVID, ki prihaja iz Odseka za inteligentne sisteme IJS, in na koncu osvojila drugo mesto. V pričujočem prispevku najprej predstavimo tekmovanje, nato skiciramo rešitev, ki jo je razvila ekipa JSI vs COVID, na koncu pa orišemo nadaljnje raziskave, ki so potekale v povezavi z Ministrstvom za zdravje Republike Slovenije. Opisana je tudi ponudba evropskim ministrstvom za zdravje za brezplačno uporabo sistema JSI vs COVID.

2 TEKMOVANJE PANDEMIC RESPONSE CHALLENGE

Tekmovanje $500k Pandemic Response Challenge [2] je potekalo med oktobrom 2020 (registracija udeležencev) in februarjem 2021 (razglasitev zmagovalcev). Naloga, ki so jo dobili udeleženci, je bila razviti modele, ki bodo po eni strani čim natančneje predvideli lokalne izbruhe okužb (»prediktor«), po drugi strani pa predlagati čim učinkovitejši načrt ukrepov, tako da se hkrati minimizira število okužb ter ekonomsko škodo (»preskriptor«). Beseda ukrepi se v tem primeru nanaša na nefarmacevtske ukrepe (angleško non-pharmaceutical interventions, NPI), ki jih nekoliko podrobneje opišemo v nadaljevanju. Število sodelujočih ekip je bilo omejeno na 200.

V prvi fazi tekmovanja so se ekipe osredotočile na analizo obstoječih podatkov in strategij boja proti pandemiji v različnih državah. Cilj je bil razviti in ovrednotiti napovedne modele za razvoj pandemije. Pri tem so imele ekipe na razpolago zbirko podatkov o pandemiji za vrsto držav z Univerze v Oxfordu (Oxford COVID-19 Government Response Tracker (OxCGRT) [3]), vključno z ukrepi, ki so bili v državah veljavni v različnih obdobjih, ter vzorce temeljnih prediktorjev in preskriptorjev podjetja Cognizant, Evolutionary AI™.

Prediktorji, ki so jih ekipe razvile, so se nato uporabljali za napovedovanje, napovedi pa so se primerjale z razvojem pandemije v realnem svetu. Ta primerjava je bila osnova za uvrstitev v prvi fazi. Pomembno je poudariti, da so vse ekipe dobile na voljo natanko iste podatke in bile ocenjevane po enakih kriterijih.

Prva faza tekmovanja se je zaključila januarja 2021 z merjenjem dejanskih infekcij. V drugo fazo se je uvrstilo 48 najbolje uvrščenih ekip, ki so prihajale iz 17 držav. V drugi fazi tekmovanja je bil cilj razvoj preskriptorjev. V tem delu seveda ni bilo mogoče testirati v praksi, zato je testiranje potekalo na sledeči način: za predikcije se je uporabljal »standardni prediktor«, ki so ga razvili organizatorji [4]. Vsaka ekipa je predlagala do deset strategij intervencije za vsako državo. Pri ocenjevanju se je upoštevalo, da je ena strategija od druge boljša, če je boljša po enem kriteriju, ne pa hkrati tudi slabša po drugem (kriterija sta tu omejevanje širjenja okužb in cena ukrepov).

Druga faza se je končala marca 2021, ko so bili razglašeni zmagovalci [5]. Prvo mesto je osvojila španska ekipa VALENCIA IA4COVID19 iz Valencie, drugo mesto pa slovenska ekipa JSI vs COVID z zelo podobnim numeričnim rezultatom. Ekipi sta si enakovredno razdelili nagradni sklad pol milijona dolarjev. Še osem ekip je prejelo posebna priznanja in simbolične nagrade.

3 NEFARMACEVTSKI UKREPI

V okviru tekmovanja so ekipe dobile predpisan seznam NPI, ki so ga uporabile za gradnjo preskriptorja, hkrati pa so za vsak ukrep dobile tudi »ceno« uveljavljanja tega ukrepa. Seznam je vseboval sledeče NPI:

1. Zapiranje šol
2. Omejitev prihoda na delo
3. Preklic javnih dogodkov
4. Omejitve zbiranja
5. Omejitev javnega prometa
6. Omejitev izhodov od doma
7. Omejitve gibanja po državi
8. Omejitve gibanja med državami
9. Kampanja osveščanja javnosti
10. Strategija testiranja
11. Sledenje stikov
12. Uporaba zaščitnih mask

Ukrepi so se lahko izvajali v strožji ali v milejši obliki. Ukrep »Omejitve gibanje po državi« v strožji različici tako prepove gibanje izven določenega območja, v milejši pa ga samo odsvetuje, »Omejitve zbiranja« pa z naraščanjem strogosti zmanjšuje število ljudi, ki se lahko zbira. Seveda se je pri ukrepih potrebno zavedati, da se jih ljudje lahko držijo ali ne, in od posamezne države je odvisno, kako strogo bo preverjala spoštovanje ukrepov – pa tudi od tega, kako so ukrepi predstavljeni javnosti in kako jih ljudje sprejmejo.

4 MODELI

Modeli prediktorjev in preskriptorjev so oz. bodo podrobneje opisani v konferenčnem prispevku [6] in v prihajajočih publikacijah, zato tu le skiciramo rešitve.

4.1 Prediktor

Cilj prediktorja je napovedati število okužb na določenem območju (v državi ali v regiji) za vsak dan, za obdobje več mesecev v prihodnost. Pri tem upoštevamo seznam NPI, ki so v državi v danem trenutku v veljavi.

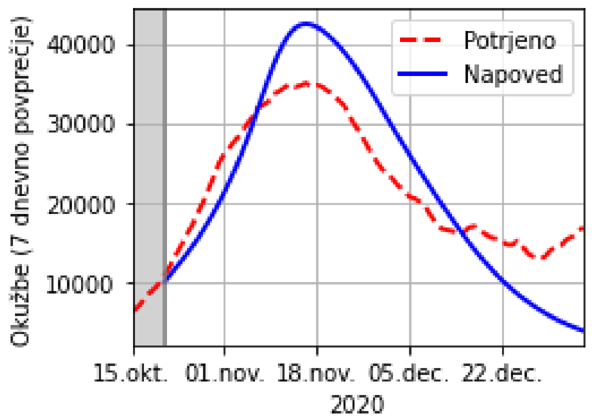
Prediktor uporablja standardni epidemiološki model SEIR, kjer upoštevamo dinamiko med skupinami posameznikov, ki so Susceptible (dovzetni), Exposed (izpostavljeni), Infected (okuženi) in Removed (ozdraveli ali umrli, se pravi niso več dovzetni za okužbo). Model SEIR [7] je sestavljen iz sklopljenih diferencialnih enačb (1), kjer uporabljamo parametre, ki določajo verjetnosti za prehode iz ene skupine v drugo: $S \rightarrow \beta \rightarrow E \rightarrow \sigma \rightarrow I \rightarrow \gamma \rightarrow R$.

$$\begin{aligned} \frac{dS}{dT} &= -\frac{\beta SI}{N} \\ \frac{dE}{dt} &= \frac{\beta SI}{N} - \sigma E \\ \frac{dI}{dt} &= \sigma E - \gamma I \end{aligned} \tag{1}$$

$$\frac{dR}{dt} = \gamma I$$

Pri tem velja zveza $S + E + I + R = N$ (vsi posamezniki). Parametre smo določili na sledeč način: β (merilo za prenos) je bil določen s prilagajanjem modela na realne podatke o okužbah. Z metodami strojnega učenja smo zgradili modele, ki se naučijo napovedovati ta parameter glede na nabor ukrepov. Pri tem smo upoštevali dejstvo, da posamezne države/regije uporabljajo različen nabor NPI in da v posameznih obdobjih število okužb narašča ali pada. β je bil zato prilagojen za posamezno situacijo. Parametra σ (inkubacijska doba) in γ (merilo za okrevanje) smo določili na podlagi podatkov iz literature.

Prediktor, ki smo ga zgradili z naborom različnih vrednosti β, se tako lahko prilagaja ukrepom, ki jih posamezne države uvajajo v različnih trenutkih. Prediktor deluje s časovno ločljivostjo enega dneva. Slika 1 prikazuje primer napovedi prediktorja v primerjavi z realnimi podatki.



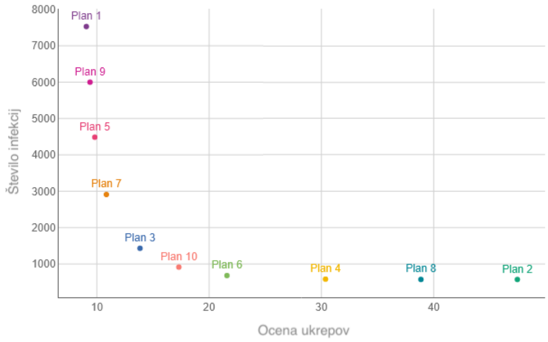
Slika 1: Primer dnevnega števila novih okužb za Italijo jeseni 2020. Modra črta predstavlja napoved, črtkana rdeča črta pa število potrjenih primerov. S sivo je označen interval za vhodne podatke.

4.2 Preskriptor

Cilj preskriptorja je izdelati plane intervencij (NPI) za posamezno obdobje za posamezno državo ali regijo. Pri tem želimo predpisati plane, ki predstavljajo dobre kompromise med omejevanjem širjenja okužb in ekonomsko in družbeno ceno teh ukrepov. Dodatna zahteva pri tekmovanju je bila časovna omejitev za izdelavo načrta, namreč, v šestih urah je bilo treba izdelati načrte za 235 regij, kar predstavlja v povprečju 90 s na regijo.

Preskripcijo planov lahko naravno predstavimo kot večkriterijski optimizacijski problem, kjer želimo minimizirati dva konfliktna si kriterija: (1) povprečno število infekcij in (2) ekonomska in družbena cena ukrepov. Za potrebe optimizacije smo uporabili dobro poznan genetski algoritem z nedominiranim sortiranjem II (ang. nondominated sorting genetic algorithm II – NSGA-II) [11].

Zaradi stroge časovne omejitve (90 s na regijo), smo za oceno kakovosti planov standardni prediktor nadomestili z nadomestnimi modeli. Standardni prediktor je namreč za posamezno oceno potreboval približno 2 s. Z uporabo slednjega bi tako lahko ocenili le približno 45 planov, kar ne zadostuje za algoritem tipa NSGA-II. Natančneje, uporabili smo dva nadomestna modela, enega na osnovi SEIR prediktorja (Sekcija 4.1) in enega na osnovi prekalkuliranih planov za različne poteke pandemije. Slednji deluje tako, da za dano regijo in čas najprej ocenimo potek pandemije in nato predpišemo plane, ki se za dani potek najbolje odnesejo. Med vsemi kompromisnimi rešitvami, ki jih dobimo tako s prvim kot drugim nadomestnim modelom, izberemo 10 takih, ki najbolje pokrijejo množico vseh »optimalnih« kompromisov. Tipičen primer kompromisnih rešitev v obliki fronte najdemo na Sliki 2.



Slika 2: Primer desetih kompromisnih rešitev v obliki fronte, dobljenih z metodo iz tekmovanja.

5 SODELOVANJE Z MINISTRSTVOM ZA ZDRAVJE RS

V okviru delovanja zadnjega avtorja kot državnega svetnika za raziskovalno dejavnost je bil dne 28. 6. 2021 izveden posvet v Državnem svetu na temo uporabe programskih metod za krotenje epidemije z naslovom: »**Problemi COVID-19 in iskanje optimalnih rešitev za naprej«.** Na komisijah DS in na plenarnem zasedanju je bila pogosta debata na temo COVID-19, kjer je avtor prispeval s strokovnimi analizami in napovedmi, dal je tudi nekaj pobud vladi v smeri najboljšega delovanja. Nekatere izmed teh zamisli so bile uresničene, druge ne.

Ministrstvo za zdravje RS je poleg tega naročilo nekaj študij. Del teh študij je prikazan v Vito Janko itd. »What-If Analysis of Countermeasures Against COVID-19 in November 2020 in Slovenia« v zborniku konference Informacijska družba 2021. Tam je pokazano, da je v fazi velike rasti smotrno vpeljati ukrepa tako zapiranja šol kot nošenja mask. Za november 2020 so analize celo pokazale, da se zapiranju šol ne da povsem izogniti, pa četudi uporabimo vrsto drugih ukrepov, če želimo ustaviti rast. Ukrep nošenja mask se glede na naš model izkaže enako učinkovit kot kombinacija bolj restriktivnih ukrepov, vendar je predvidoma do posameznikov bolj prijazen. Družbenih cen posameznih ukrepov v boju proti pandemiji v tej fazi nismo upoštevali, spada pa to med področja, ki jih bomo obravnavali v prihodnje.

6 SODELOVANJE Z EVROPSKIMI MINISTRSTVI

Julija 2021 smo vsem ministrstvom EU poslali pismo, kjer jim dajemo možnost neposredne uporabe programa XPRIZE JSI, specializiranega za njihovo državo. Vsaka država torej lahko uporablja z geslom zaščiteno verzijo programa. Poslali smo jim tudi navodila, kako uporabljati programe in na kakšen način jim nudimo podporo. Razvite rešitve so bile evropski in svetovni javnosti ponujene brezplačno.

Nimamo podatkov, koliko EU ministrstev je aktivno uporabilo ali uporablja programe, a glede na odzive in glede na to, da imamo kontakte le z nekaj ministrstvi, se zdi, da ne prav veliko.

7 ZAKLJUČEK

V prispevku so pregledno opisane programske rešitve, ki jih je skupina Odseka za inteligentne sisteme razvila v okviru tekmovanja XPRIZE. Nekatere med njimi so bile v celoti izvirne in so prispevale k drugem mestu na svetovnem prvenstvu na to temo.

Po tekmovanju smo razvili vrsto dodatnih rešitev. Eno smo uporabili za iskanje ukrepov retroaktivno – ali in v kolikšni meri je bil kak ukrep upravičen. Ena taka študija je zajemala obdobje novembra 2020 v Sloveniji. V večini študij se je pokazalo, da so bili človeški ukrepi daleč od optimalnega in bi uporaba programov, kot na primer razvitih na tekmovanju XPRIZE, omogočila bistveno boljše rezultate. Rezultate smo delili s slovenskim in z evropskimi ministrstvi za zdravje.

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VIRI

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Zbornik 24. mednarodne multikonference

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Zvezek E

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14. mednarodna konferenca o prenosu tehnologij
14th International Technology Transfer Conference

Urednika / Editors

Špela Stres, Robert Blatnik

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PREDGOVOR / FOREWORD

Spoštovani državni sekretar prof. dr. Mitja Slavinec, spoštovani državni sekretar gospod Simon Zajc, spoštovani najvišji predstavniki javnih raziskovanih organizacij, spoštovani udeleženci, lepo pozdravljeni in dobrodošli na 14. Mednarodni konferenci za prenos tehnologij.

Today we are gathered technology transfer experts, researchers, students and post-graduate students with entrepreneurial ambitions, established and future entrepreneurs, innovators and representatives from governmental institutions and policy-making organizations.

Najlepše se zahvaljujemo soorganizatorjem, spin-out partnerjem, programskim partnerjem, promocijskim partnerjem, ter partnerjem, ki so podprli dvostranske sestanke med podjetji in raziskovalci. Za podporo se zahvaljujemo tudi Ministrstvu za izobraževanje, znanost in šport in Slovenskemu podjetniškemu skladu.

Začetni del konference, pozdravni nagovori in okrogla miza bodo potekali v slovenščini, nadaljevali pa bomo v angleščini.

The event, except the pitching section, is being recorded and will be made public in the next days. The welcome addresses and the round table will be held in Slovenian, later sections will be in English.

Po pozdravnih nagovorih bomo začeli z okroglo mizo o prihodnosti prenosa tehnologij v Sloveniji in Evropi s častnimi gosti. Spremljali bomo tekmovanje raziskovalno-podjetniških ekip, ki se potegujejo za naziv najboljše inovacijo iz javnih raziskovanih organizacij, nato razglasitev nagrade Svetovne organizacije za intelektualno lastnino WIPO IP Enterprise Trophy. Vzporedno se bodo odvijali vnaprej dogovorjeni posamični sestanki med raziskovalci in podjetji. Osrednjo temo konference, premagovanje izzivov financiranja v t.i. dolini smrti, nam bosta predstavila spoštovana gosta: Matthias Keckl, managing partner sklada Fraunhofer Technologie-Transfer in Natalija Stošicki, direktorica Oddelka za naložbe in evropske programme, SID banka. Nato bodo uveljavljeni strokovnjaki iz Slovenije in tujine predstavili znanstvene prispevke o prenosu tehnologij in intelektualni lastnini ter izbrane raziskovalne projekte. Vzporedno bo izvedena še sekcija za šole, pred zaključkom konference pa bomo razglasili tudi prejemnika nagrade WIPO Medal for Inventors.

Program je, kot vidite, res bogat, saj se dotika množice aktivnosti, pri katerih smo v pisarnah za prenos tehnologij osrednjega pomena.

Organizacijski odbor 14.ITTC / Organizing Committee of the 14.ITTC

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Technology Transfer Fund - Central Eastern European Technology Transfer (CEETT) platform

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ABSTRACT

This article describes the importance of technology transfer funds in financing the transition of discoveries from the laboratory to the market, which is called bridging the commercialization gap or the “valley of death”. Presented is the newly established Central Eastern European Technology Transfer (CEETT) platform, the first multinational technology transfer investment platform ever introduced in the European Union, as well as its importance and expectations in the protection of intellectual property and technology transfer from public research organizations (PROs) to industry in Slovenia and Croatia.

KEYWORDS

Technology transfer, venture capital, proof of concept, technology transfer fund, commercialization gap, valley of death, Central Eastern European Technology Transfer platform, CEETT

1 INTRODUCTION

Much of what is used today was born in a laboratory — but how did it develop from research to a product that can be bought? Technology Transfer (TT) funds commercialise promising research, allowing it make that crucial step from the prototype world into the commercial space. Technology transfer (TT) can be broadly defined as the process of converting scientific findings from research organisations into useful products by the commercial sector [1]. TT is also known as “knowledge transfer or knowledge sharing” [1], the process whereby an enterprise converts scientific findings from research laboratories and universities into products and services in the marketplace [1]. This understanding is adopted for the purposes of the present article. The transformation of scientific findings into products can take place through a number of means, in particular through the collaboration between research organisations and industry, the licensing of intellectual property rights, the creation of start-up businesses or university spin-out companies.

Although Technology Transfer seed investments in Europe are in the radar of some investors, academic research is often considered to be 'too new' or 'too high-risk' to be transferred out of the research laboratory and financed by the traditional investors [2]. New discoveries and technologies may not realize their potential unless they become attractive to industry or downstream investors, so the aim of the European Investment Fund (EIF) [3] is to play an important role.

Venture Capital (VC) is usually available to start-ups or other young companies that show potential for long-term growth.

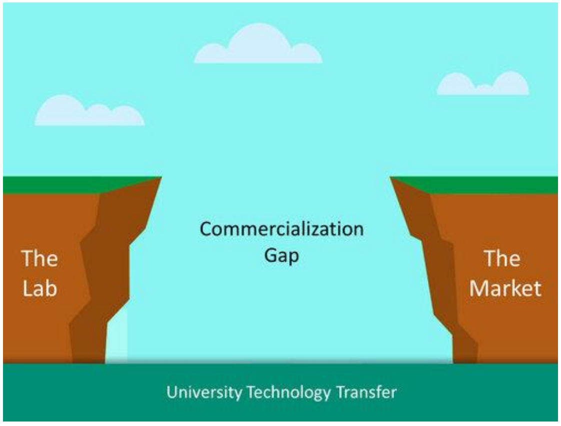


Figure 1: Commercialization gap [4].

On the other hand, there is a lack of funding to develop laboratory discoveries to prototypes suitable for the market because this step is risky for investors. Between the laboratory and the market is a commercialization gap (Figure 1) that has to be bridged to successfully put the discovery on the market as a product or service.

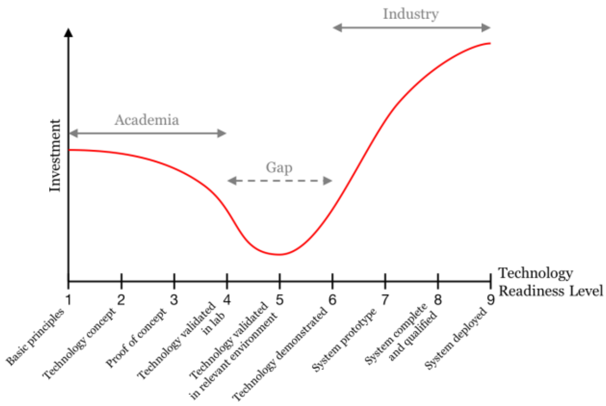


Figure 2: Technology readiness levels and the “valley of death” [5].

The journey of new technology from research to commercialization goes through a number of technology readiness levels (TRLs). The latest version of the scale from

NASA includes nine TRLs and has gained widespread acceptance across governments, academia, and industry. The European Commission adopted this scale in its Horizon 2020 program.

Academia tends to focus on TRLs 1–4, whereas industry prefers to work with TRLs 7–9, rarely 6. Therefore, TRLs 4–6 represent a gap between academic research and industrial commercialization. This gap, show in Figure 1 as the commercialization gap, is colloquially referred to as the technological "valley of death" (Figure 2) to emphasize that many new technologies reach TRLs 4–6 and die there.

2 TECHNOLOGY TRANSFER FUNDS

Venture capital (VC) funds are pooled investment funds that manage the money of investors who seek private equity stakes in startups and small- to medium-sized enterprises with strong growth potential. These investments are generally characterized as very high-risk/high-return opportunities. Although investments of VC funds in start-ups are risky, investments in development of technology between TRL4 and TRL 6 are even more risky. As a result, VC funds with private equity participation do not typically invest in bridging the "valley of death". So, special technology transfer funds are needed to financially support the development of discoveries from TRL 4 to TRL6.

Technology transfer still remains a rather political investment field, but one that offers economic opportunities with a growing potential for commercialization. Even though private investors become more and more interested in this field, the European Investment Fund (EIF) [3] remains a crucial player, often taking the role as lead investor. The EIF is a specialist provider of risk finance to benefit small and medium-sized enterprises (SME) across Europe. It is part of the EIB Group. EIF's shareholders are the European Investment Bank (EIB), the European Union, represented by the European Commission, and a wide range of public and private banks and financial institutions. EIF carries out its activities using either its own resources or those provided by the European Investment Bank, the European Commission, by EU Member States or other third parties. By developing and offering targeted financial products to EIF's intermediaries, such as banks, guarantee and leasing companies, micro-credit providers and private equity funds, EIF enhances SMEs access to finance.

EIF also seeks to support financially sustainable **Technology Transfer structures** or **funds**. These intermediaries typically invest into projects or start-up companies, at proof of concept (PoC), pre-seed, seed, post-seed to A & B rounds, where the companies can be financed further by the normal Venture capital / Private equity investor. The EIF have become one of the main European investors providing guidance and cornerstone funding to players in this emerging market segment. Between 2006 and 2018 the EIF alone invested an amount of about EUR 1.7 billion in 38 TT funds throughout Europe [6]. While the market is more advanced in the Nordic countries and Western Europe, two TT funds have recently been established in Germany in cooperation with the Fraunhofer Society and the Max Planck Foundation, respectively. The number of TT funds funded by the EIF [3] between 2006 and 2020 is shown in Table 1. There are very few other TT funds in Europe not funded by the EIF (if any).

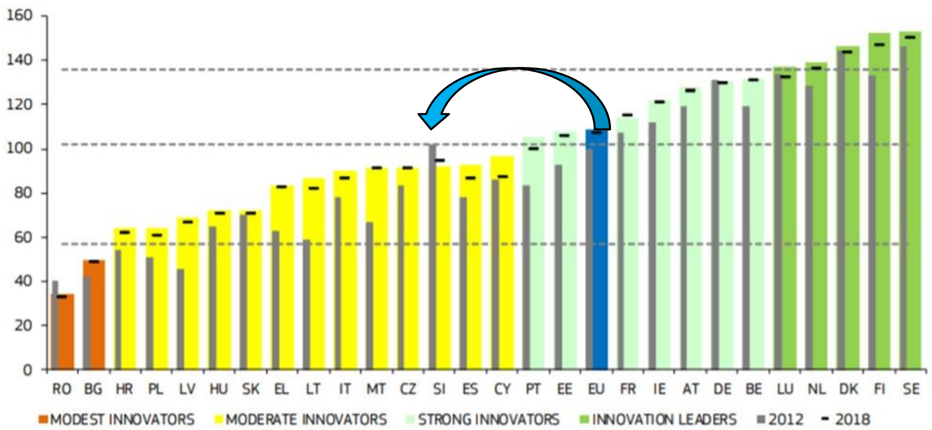
Table 1: Technology Transfer (TT) Funds funded by the EIF by country and year of start of funding.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	sum
France					1	1	3	3	1			2	1			**12**
United Kingdom	1		1				1	2			1					**7**
Italy												1	2	1	2	**6**
Belgium		1			1	1				1	1					**5**
Netherlands									1	1		1				**3**
Turkey										2						**3**
Germany														2		**3**
Sweden			1		1											**2**
Norway									1				1			**2**
Portugal									1							**1**
Spain											1					**1**
Ireland											1					**1**
Finland														1		**1**
Switzerland															1	**1**

In terms of best practices, the most relevant somehow are IP Venture [7] in UK and CD3 [8] in Belgium. Another very interesting is Innovation Industries [9] in Netherlands. Of the Italian ones that the EIF funded through ITAtech [10], each is quite interesting, especially because they have been funded through a similar initiative (and the only one such initiative at the moment). Particularly interesting would be Sofinnova Telethon [11] (Sofinnova is one of the most important VC firm in Europe, and the strategy is focused on rare and genetic diseases), or Progress Tech Transfer [12] and Eureka [13] (both first time team/first time funds, and both good examples of how a fund should collaborate with the research institutes).

3 CENTRAL EASTERN EUROPEAN TECHNOLOGY TRANSFER (CEETT) PLATFORM

In July 2021, the European Investment Fund (EIF), part of the European Investment Bank Group, the Slovenia's national promoter bank, SID Banka, and the Croatian Bank for Reconstruction and Development (HBOR) signed an agreement



Coloured columns show countries' performance in 2019, using the most recent data for 27 indicators, relative to that of the EU in 2012. The horizontal hyphens show performance in 2018, using the next most recent data, relative to that of the EU in 2012. Grey columns show countries' performance relative to that of the EU 2012. For all years, the same measurement methodology has been used. The dashed lines show the threshold values between the performance groups.

Figure 3: Slovenia's innovation performance fell in 2012/18 (source EIS [17]).

on establishing a regional technology transfer platform, Central Eastern European Technology Transfer - CEETT platform [14], from research institutions to the economy, amounting to at least 40 million euros. The scope of the EIF's SEGIP (Slovene Equity Growth Investment Programme) and CROGIP (Croatian Growth Investment Programme) mandates has been expanded to include the support for business applications of Slovene and Croatian academic research via a commitment to a technology transfer fund operating in the two countries. The resulting joint initiative is the first investment programme under the Central and Eastern European Technology Transfer (CEETT) initiative, to which SID Banka contributed an additional EUR 10 million to SEGIP, HBOR contributed additional EUR 10m to CROGIP and the EIF made further EUR 20 million available for investment. Thus, the total available funding amount indicatively represents EUR 40 million.

The CEETT will invest in venture capital funds and finance innovative technological research projects and the protection of the intellectual property of universities and research institutes in Slovenia and Croatia. It will also fund the commercialisation of scientific achievements and research projects.

This is the first multinational investment platform for technology transfer ever launched in the European Union. The EIF estimates that the universities and research institutes in Slovenia and Croatia targeted by the platform will generate more than 350 patent applications and 100 spin-off companies in the next five years [15].

Investment in innovation and technology transfer will be key to the long-term sustainable green economy, job creation and global competitiveness of the European Union.

3.1 Benefits of the platform from the point of view of the research organization

The Center for Technology Transfer and Innovation (CTT) at the Jožef Stefan [16] is the largest and the most experienced technology transfer office (TTO) in Slovenia at public research organizations (PRO or JRO in Slovene). In January 2015, Dr Špela Stres, the head of the CTT, was invited to an "ad-hoc meeting on the design of the EC's pilot Technology Transfer Financial Facility (TTFF)". As the only representative from the EU13 countries, together with 14 colleagues from more innovative and open environments in Western Europe, she participated in the final stages of creating the Technology Transfer Financial Facility pilot, from which Invest EU later grew and the participation of the European Investment Fund with various actors in Europe in the creation of the Proof of concept (PoC) funds. They all shared the opinion that the European Commission's initiative to finance the technology transfer of research results from universities and other public research organizations to the economy and society is crucial for the development of processes linking excellent and prioritized science and knowledge transfer to the economy and society.

3.1.1 Why is such a Proof of Concept (PoC) Fund measure urgently needed?

The strong European, Slovenian and Croatian research success is currently not translated into innovation due to the lack of breakthrough innovations that create new markets. Two financial gaps (2 "valleys of death") prevent innovations:

1) The transition from laboratory to enterprise and
2) Scale-up (growth) for high-risk innovative start-ups.

In addition, many national and local ecosystems have been established, but they are fragmented and unconnected. In addition, not all PROs (JROs in Slovene) and all talents (especially not women and young people) are systematically involved in innovation processes. It is at least partly due to such a situation that e.g. Slovenia's innovation performance decreased in the period 2012–2018 (Figure 3). Slovenia fell 6 places (for an extra place in 2019) and went from strong innovators to moderate followers. The trend shows an even more worrying picture, as Slovenia is only slightly below average in terms of results, but with the most negative trend of all EU28 countries (Figure 4).

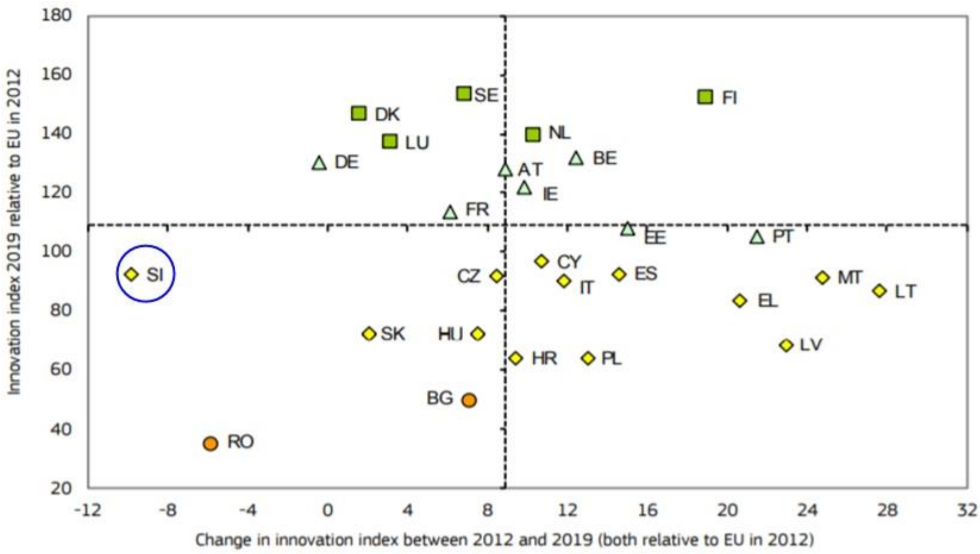


Figure 4: Performance and trend of EU members in the field of innovation – Slovenia is slightly below average with the most negative trend (source EIS [17]).

Meanwhile, Croatia is positioned slightly worse than Slovenia, but its development innovation trend is average compared to the EU28.

In the case of Slovenia, therefore, it is not so much a matter of deteriorating the absolute situation as of not improving it. The main issue of Slovenia lies in its diminishing innovation capacity from 2021-2019, where Slovenia's position has dropped from Strong innovators to Moderate innovators (source: European Innovation Scoreboard [17]). Even though the public R&D expenditure remains at the EU average, the Slovenian scientists overproduce with 155 % in number and 105% in highly cited the EU average. On the other hand, the product/process innovation and the number of SMEs innovating in house is at 80% of the EU average, IPR, in particular patenting issues place Slovenia at 93 % of the EU average, which all results in the sales of new market and firm products at 84% of the EU average. The main solution for this issue is to push for scientific knowledge, created and collected at the Public Research Organizations (PROs), to be used in the national economy and increase its competitiveness. It is expected that the CEETT platform will play a very important role in reversing the negative innovation trend into a positive one.

However, the funding gap for scaling up highly innovative startups and SMEs in significant, as US venture capital investments in the period from 2016-2020 were 4-5 times higher than in the EU (source: Invest EU, Pitchbook) and the number and market value of "unicorn" companies (those valued at over 1 EUR billion) in Europe (according to CB Insights [18] in January 2021) is 3-4 times smaller than in North America and Asia. And Slovenia lags behind Europe. There are not as many spin-outs in Europe and in Slovenia as there are in the USA or Asia, neither per capita nor per researcher, because there is no career path that would enable a return to the PRO, because there is no PoC fund and because in Slovenia failure is punished with ridicule and do not reward with a smile [19]. Therefore, the establishment of interconnected, integrated instruments that enable the growth of technology and researchers with it, in fast-growing companies, European, Slovenian, Croatian gazelles, is absolutely necessary.

3.1.2 What are the benefits of the Proof of concept (PoC) fund for a research organization?

The easiest way to answer is the Jožef Stefan Institute's (JSI) example. Today, there are over forty companies operating directly based on JSI technology and knowledge. As early as 2010, the JSI adopted detailed procedures that prevent conflicts of interest and encourage researchers on their entrepreneurial path. JSI has had an internal PoC fund for more than 20 years, and the fund is not financed from the budget, but exclusively from royalties. However, there are certainly many more examples that could / should be supported on their way to the market than can be financially supported by public research organizations themselves. At JSI alone, around 30 technology offers have been identified that are currently waiting for a clear interest from the economy, or to be internally developed with the help of the PoC fund to the extent that they can be marketed independently. There are even more such offers of research results at all four universities and public faculties, as well as 17 public research institutes in Slovenia and all public research institutions in Croatia. Therefore, following the example of 48 similar European funds established in previous years, intended specifically for cases from public research organizations, a multi-million PoC fund, which will be established by SID Bank together with HBOR and the European Investment Fund (EIF), is urgently needed.

It is crucial that a significant share of funding will also go to the pre-incorporated phase, ie projects that are still within the PROs and are preparing to spin off into new start-ups. And it is this risk, the investment in the pre-incorporated phase of bridging the valley of death, that is key to the successful transfer of knowledge from public research organizations into practice and separates it from other instruments available.

3.1.3 What are the direct benefits of the new fund for research organizations?

The new platform will also offer funding in the early stages of TRL development, which will enable a smooth transition of projects from the research environment to the market. Funding will be open to all innovators in any priority area. The platform will act as a path finder for advanced research into new technologies and enable the growth of TRL, which is essential for the transition from the laboratory to the commercial environment. The platform will also provide access to business promotion services (coaches, mentors, companies, investors and knowledge partners). It will further enable the development of a vision for breakthrough, portfolio management and integration with ecosystems, and crowd-sourcing of other investors. The PoC fund will give teams from public research organizations enough time to come up with technology according to market needs, to decide on their further research and business path, to regulate intellectual property relationships, to establish relationships that will reward both those who will remain researchers at the parent organization and those who will also operate within new start-ups.

3.1.4 Could public research organizations cope without the Proof of Concept (PoC) fund?

In 2015 it was and still is the opinion that there is enough money. That there is certainly no shortage of money to move from research to the economy. This is partly true. It really isn't just money that is lacking and really the most proactive and skillful can find money in any country, in any situation, despite all obstacles, as long as they are persistent enough. This is called entrepreneurship. As Professor Howard Stevenson, the godfather of the study of entrepreneurship at Harward Business School, put it, entrepreneurship is the pursuit of opportunity beyond resources controlled. Entrepreneurs need to show significant progress in raising funds, and time alone is consuming available funding.

But the goal of society that funds research and development through gross domestic product is not just to fund excellent inventions and then place them at the start of a mountain trail that gets lost between rocks and impassable overhangs leading to the market. The aim of society is by no means to place as high an obstacle as possible to the transfer to the economy and entrepreneurship, obstacles that can only be overcome by the naturally most talented and most stupidly persistent. The goal of the society is sensible and proactive management of innovations arising from the research system in such a way that as many useful inventions find their way to the market (instead of just in the drawers of public research organizations). The goal is for as many innovations as possible to find their niche in the market, the goal is to establish a clear, transparent path, a motorway that is easily followed by those who want it, and others who would like to remain in the safe haven of publicly funded research can stay there. continue to contribute constructively. Smooth paths to the market are necessary for the renewal and progress of society in a double transition and as a basis for a decisive breakthrough of Slovenia and Croatia between competitive and research-based society with sustainable development, which will catch up with the most productive and competitive countries in the world. life in the conditions of a rapidly aging society based on digitalisation and in the conditions of aggravated climate change. At the same time, development will raise the quality of life in the conditions of a rapidly aging society based on digitalisation and in the face of intensified climate change.

4 CONCLUSIONS

Establishment of a regional technology transfer platform, Central Eastern European Technology Transfer - CEETT platform, the first multinational investment platform for technology transfer ever launched in the European Union, intended for Slovenia and Croatia, is a great opportunity for technology transfer from public research organization to industry in both countries. The established technology transfer fund will enable the public research organizations to bridge the commercialization gap or the "valley of death" and to improve the successful rate of technology transfer from the academia to industry.

The successful operation of CEETT will require an appropriate manager with experience in the field of venture capital investments and cooperation between research organizations and companies. In addition, he will have to be aware of the specifics of Central Europe region, especially Slovenia and Croatia, as well as the specifics of public research organizations in both countries.

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Software Protection and Licensing Challenges in Europe: An Overview

Izzivi na področju zaščite in licenciranja programske opreme v Evropi: pregled stanja

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ABSTRACT

With the transition of innovation to the digital sphere, software has become an important part of contemporary inventions and creations and it is also an extremely important part of intellectual property – in Slovenia and in Europe. The software protection in the European Union – that is, in Europe – not considered fully arranged. Computer scientists face a number of challenges when it comes to exploiting intellectual property rights in software. The field therefore offers many opportunities for further work. In this paper, we discuss software and focus mainly on the challenges computer scientists face in protecting and licensing software in the European innovation arena.

KEYWORDS

Software, patents, protection and exploitation of intellectual property rights, challenges, Europe.

POVZETEK

S prehodom inovacij na digitalno področje je programska oprema postala pomemben del sodobnih izumov in stvaritev, hkrati pa predstavlja izjemno pomemben del intelektualne lastnine – tako v slovenskem kot evropskem prostoru. Stanja na področju zaščite programske opreme v Evropski uniji oz. v Evropi s pravnega vidika še vedno ne moremo obravnavati kot povsem dorečenega, prav tako pa se znanstveniki na področju računalništva soočajo s številnimi izzivi, ko gre za izkoriščanje pravic intelektualne lastine iz programske opreme. Področje zato narekuje številne priložnosti za nadaljnje delo. V prispevku obravnavamo programsko opremo, pretežno pa se posvečamo izzivom, s katerimi se znanstveniki na področju računalništva soočajo pri zaščiti in licenciranju programske opreme v evropskem inovacijskem prostoru.

*Article Title Footnote needs to be captured as Title Note
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KLJUČNE BESEDE

Programska oprema, patenti, zaščita in izkoriščanje pravic intelektualne lastnine, izzivi, Evropa.

1 INTRODUCTION

Computers are part of almost every area of contemporary life and they are becoming more advanced every day, with increasingly small gadgets performing increasingly complicated tasks. Consequently, the number of new inventions seeking patent status in the field has been rising steadily. In fact, patent applications for computer-based inventions display one the highest growth rates across all patent categories arriving at the European Patent Office (EPO). A thorough examination process awaits all new applications in this field. The crucial aim is to distinguish between legitimate technological innovations which contribute to the overall technological progress and straightforwardness and inventiveness of computer-implemented inventions. [1]

Over the last decade there has been an intense debate over the extent to which software should be the subject to patent protection as opposed to copyright protection for a program. Different understanding applies to the US, Europe and the rest of the world. Many companies in the software industry are apprehensive of the perceived difficulty of defining the scope for software patent. Inappropriate scope definitions can result in legal proceedings involving large fees where plaintiffs have the advantage of patent ambiguity. Others feel equally strongly that the software industry needs strong software patents. [2]

Currently, 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 application can be granted if a technical contribution is demonstrated. Under EPO rules, if this criterium is fulfilled software must be connected to the hardware. [3] Part of the reason for the lack of appropriate legal instrument is that such inventions are very specific and proving their technical contribution and industrial applicability can be challenging. [3] In order for computer scientists to successfully market software, the Public Research Organization (PRO) system needs to provide

the motivation and reward computer scientists for it. The present state of European innovation arena contains nothing to motivate computer scientists in this respect.
The current situation calls for a study to identify the most critical points in order to update some of the legal bases, to address this area more clearly and to resolve the issue of rewarding computer scientists (described in this document with the focus on software), also in terms of Technology Transfer Office (TTOs) role.

2 SOFTWARE IN THEORY AND PRACTICE

The European Patent Convention stipulates in Article 52(2) (c) that programs for computers are not regarded as inventions [4]. European Patent Convention in this Article excludes computer programs from patentability. It is important to emphasize the distinction between "software patents", which are excluded according to the aforementioned Article, and "computer-implemented inventions", which are accepted by EPO [5].

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 a graphical interface can be protected as a registered design, whereas a patent for computer or mobile application can be granted if a technical contribution is demonstrated. Under EPO rules, if technical contribution is successfully demonstrated the software must be connected to the hardware. [3]

Although the European Patent Convention excludes "computer programs" from patentability to the extent that a patent application relates to a computer program "as such", this is interpreted to mean that any invention that makes a non-obvious "technical contribution" or "solves" a "technical problem" in a non-obvious way is patentable, even if the technical problem can be solved by running a computer program. [6]

The problem of strictly classifying software similar to a literary work arises when one considers that computer programs have other elements that are usually not protected by copyright. Software is not just a literary expression – lines of code have a function that does not depend on their grammatical construction. Issues related to protection of additional elements of computer programs have created a perceived need for software patentability. Today, the three largest patent offices in the world – in the EU, US and Japan – allow patenting of certain software, although there are differences in the criteria they use when accepting applications. In the US, all new and non-obvious software that produces a useful material and tangible result is eligible for patent protection, whereas in Europe the technical contribution of the invention must be defined as described above (also applies to Slovenia). These discussions led to the widely accepted principle that computer programs should be protected by copyright, while apparatus using computer software or software-related inventions should be protected by patent. [6]

Protecting and obtaining intellectual property rights in fast-growing areas such as artificial intelligence is a particular challenge. Artificial intelligence provides entirely new approaches to creation of intellectual property. Questions arise as to the eligibility of patent protection, authorship and rights ownership of a newly developed technical solution or creation that is autonomously created, enabled or co-created by a program. Methods of resolving the question without stifling innovation potential are subjects of intense debate and accelerated activity at the EPO [7].

3 SOFTWARE AND EXPLOITATION OF INTELLECTUAL PROPERTY RIGHTS

3.1 Software Licensing Process

Intellectual property is an essential tool for protecting the value created by software. As a general rule, almost all software is protected, including the smallest libraries and subroutines. Intellectual property rights are divided into economic and moral rights. [8]

Economic rights give the holder the right to exploit the work and prevent others from using it without consent, and are aimed at economic gain. The right to use can be granted by license. Exclusive license allows the holder to exclude others from using the intellectual property in question and, if it is transferable, it allows the holder to grant third parties the rights to use it. A license is a permission granted by the licensor to the licensee to use an identified asset under certain conditions. In doing so, the licensor may determine at their discretion the extent of the exclusive intellectual property rights granted in respect to the asset (and, conversely, the rights it reserves for itself). Moral rights include the right to authorship, the right to publish the work anonymously or under a pseudonym, and the right to integrity of the work. In most countries (including all EU countries), copyright protection lasts throughout the author's lifetime and extends 70 years after their death. [6]

As we have seen above, software is very specific as far as intellectual property is concerned – it can be protected by several types of intellectual property rights ranging from pure creations of the mind to technical inventions. But a whole new level of complexity arises from intangible nature of software, variety of uses and different means of creating value from software. As a consequence, the means of creating value from software can vary considerably depending on the exploitation scheme chosen and associated ecosystem to which the use of software in question is directed. Nevertheless, licensing plays an essential role in creating value through management of intellectual property associated with software development. Business models are formalized in a contract, usually in the form of licensing agreements which impose specific rules of use on third parties who intend to exploit the software. Figure 1 shows some typical software licensing models. [6]

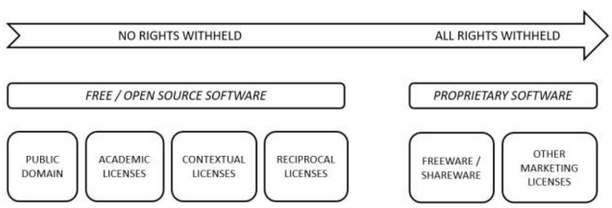

Figure 1: Classification of typical software licenses

Free and open-source software rights include use, inspection and modification, and distribution of modified and unmodified copies. They typically allow it to be used for any purpose without restriction. When the code is reviewed and modified, it requires that the modified code is made available again under the same conditions. The rights also allow distributing modified and unmodified copies of the software. When free and open-source software is modified, derivative works are created, and when various components of the software are assembled, composite parts of the underlying components are created. When Component A and Component B are assembled and Component A is also modified, Component C is created, which is both a derivative work of Component A and a composite work of Component B. Different economic rights may arise from the use of open-source and free software. Free software derives from licenses granted by the Free Software Foundation, while open-source software is defined by the Open Source Initiative, which has a more business-oriented approach. We consider the following types of such licenses [6, 9, 10, 11]:

1. Academic licenses are extremely open, permissive licenses which allow licensees to perform, modify, and distribute derivative works without restrictions, although licenses for derivative works may lead to new licensing terms, including proprietary ones. Such licenses are generally accepted in academia.
2. Contextual licenses allow licensees to use, modify, and distribute derivative works, provided that the derivative or composite works are distributed under the same license. Specific form of such license is called a "Copyleft license" which is the practice of granting the right to freely distribute and modify intellectual property with the requirement to preserve the same rights in derivative works created from that property. The main advantage of such license is to ensure joint investment, as no derivative or major works can be licensed under another license. They allow the original licensor to be granted the same rights in the derivatives as those originally acquired by the original code licensees.
3. Reciprocal licenses are very complex as licenses of major works using an unmodified version of the original component under a contextual license are not limited by the original license and derivative product containing a modified component must be released under the same license.

Many different types of contractual relationships or contractual sets of rules can be derived from proprietary licenses, all of which typically require a financial contribution from the end user. Exceptions are:

1. Freeware, where the software is available free of charge but any modification of the code is prohibited.
2. Shareware, where the user is free to use the software for a limited period of time or with limited functionality, but in order to gain access to the full unrestricted version an additional license must be obtained.

All proprietary licenses prohibit modification of the software, impose strict conditions of use and usually do not allow access to the source code. Typical models for proprietary licenses are:

1. End-user licensing where the license can be used by a specific user while sharing with other users is not allowed. However, the license can be used by the same user on different devices.
2. Node licensing, where the license can be used by multiple users, but on the same device rather than at the same time.
3. Site licensing (licensing for use on a dedicated website), where the software may be used by multiple users on multiple devices in a specific area or company, but the number of users may be limited.
4. Network licensing (floating licensing), where the same software may be used by multiple users at the same time, but a central server authorizes access to the application. [6, 9, 10, 11]

3.2 Management of Intellectual Property Rights for Software

Managing intellectual property in software requires the strategic and complementary use of different types of intellectual property. Exploitation and licensing strategies need to be carefully considered, taking into account all associated costs and market opportunities. Two basic issues should be addressed in the assessment and planning process [6, 12, 13]:

1. *Why was the software created: was it intended to generate income through licensing to end users or was it developed as part of a scientific project without an exploitation strategy in mind*? Even if we focus only on the technical challenges of R&D, we should not neglect the long-term benefits of protecting intellectual property not only from a revenue perspective but also in light of reusing the developed software in future applications.
2. *How was the software developed: which are our own components, what have we obtained from elsewhere, and, if obtained from elsewhere, under which licenses?* Developing from third-party components can result in legal challenges as the individual licenses of different third-party software may not be compatible.

Derivative works based on academic license software components may be re-licensed under the same type of license or upgraded to contextual or reciprocal licenses which are compatible. If necessary, contextual licensing code can be re-licensed by reusing the same license, upgrading the license to a newer version that remains in the same contextual field, or switching to reciprocal licenses. It is not allowed to embed free and open-source software in proprietary software. However, it is possible to combine copyleft-licensed software without copyright and some contextual rights (e.g., LGPL). [6]

However, if the software is protected exclusively by copyright it is possible to easily circumvent all prior rights as long as we have access to the source code: the same idea can simply be implemented in another source code. As previously explained: copyright does not protect the idea, only its expression. A new implementation of the code is the only legal way to convert academic or reciprocal software code into proprietary code and sell and license it under the rights granted by copyright law.

4 CONCLUSION

The situation of software in the European innovation arena can still be considered as neither resolved nor uncertain in legal terms, thus raising a number of open questions and opportunities for further work.

TTOs are deeply involved in the work of organizations where inventions and creations take place. Their expertise primarily helps computer scientists who create software evaluate which problem they are solving and based on that make an informed decision on how to protect intellectual property using copyright or patent. In view of the above, TTOs can contribute to a constructive decision-making process regarding the future of software protection and rewards for computer scientists by participating in (open) public debates and presenting real-life examples of scientists developing software in PRO.

In order to ensure successful marketing of software, the PRO system needs to provide the motivation and a rewarding mechanism for scientists for their enterprise.

It is good to remember that any invention that implements a non-obvious "technical contribution" or "solves a technical problem" in a non-obvious way may be patentable, even if the same technical problem can be solved by running a computer program. Consequently, program code in which technical effect (even if in a non-obvious way) constitutes a technical improvement is patentable by its very nature. The trade secret segment is also important, since disclosure of program code without a suitable proprietary license or any license at all may result in commercial damage. By combining the technical effect of the software code with the trade secret effect, it is possible to register the software code example as an invention and, consequently, ensure a reward for computer scientists.

We therefore propose that regular reflection among computer scientists within PRO is facilitated on new, marketable software code, that verification is introduced to any technical contribution, and that invention based on software code is registered accordingly. TTOs play a key role in this respect, as their specific expertise contributes to the proper assessment and registration of service inventions as well as to the wider popularization of software commercialization (also protected and registered in this way). At the same time, the proposed method allows computer scientists working in the field of software code development to be rewarded for their work.

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European Guiding principles for knowledge valorisation: An assessment of essential topics to be addressed

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ABSTRACT

Knowledge transfer is a complex mechanism of providing the society with benefits arising from all segments of publicly financed research. Knowledge transfer is also an important mechanism to advance and improve technology transfer as its part (as technology is only one of several research outputs [1], [8]), and a reason to analyse the current situation in the field.

This paper has three different parts. In the first part, models of knowledge and technology transfer will be discussed, including the Defense Advanced Research Projects Agency (DARPA) model of operation, as it was the basis for the development of the European Innovation Council (EIC) of Horizon Europe internal management operation in which the author of this paper was involved. The model is essential also for the future development of EU Knowledge Transfer Offices (KTOs). Given its high budget and added operational and substantive value related to Program Managers, the EIC in a way represents the largest - a kind of umbrella - KTO in Europe, which should integrate many small, different and unique European KTOs into one whole. Therefore, it is recommended in this paper that each European KTO reviews and understand the previous DARPA / ARPA-E models and/or the European EIC model. They should use it as a framework for adaptation of operations based on its legislation and the specificities of the industrial and public sector so that each KTO becomes a comparable element of the whole at the European landscape.

In the second part, a brief review of the **knowledge transfer (KT)** literature of the past 15 years will be done, given the KT profession's prevailing state of mind. A lot has been done during this time in KT development and attempts to evaluate the operation of KTOs. It turns out that there are different national environments, so the way KTOs operate may differ slightly from KTO to KTO. Nevertheless, there are common points in the pipeline of all KTOs, namely the KPIs represented in this paper (Table 1), which are not limited to KTO results only (e.g. patents filed, license and R&D agreements), but rather act as indicators of the quality of the KTO activities. The represented nomenclature of KPIs should help set up a uniform path that European KTOs are supposed to follow to achieve the results.

In the third part, specific segments of the *Commission Recommendation on intellectual property management in knowledge transfer activities and Code of Practice for universities and other public research organisations* [1] will be touched upon. These documents are still relevant in their present form. However, some new aspects have arisen and are further addressed in this paper - for example, state-aid issues connected to the intellectual property right (IPR) issues.

To conclude, the idea of further networking between innovation support stakeholders needs to be put forward, particularly regarding Enterprise Europe Network (EEN). In the coming years, EEN plans to pay more attention to the field of KT, as KT is essential for raising the competitiveness of the European economy. In this context, the presented proposal of topics that need to be addressed within new European Commission recommendations will be mutually beneficial in developing new strategies of EEN and KTOs as well. It would be of utmost importance to establish a fruitful collaboration between KTOs and national EEN offices to assure full in-depth support to researchers and SMEs alike in this TRL challenging exercise in between the worlds of academia and industry, in particular given the EEN's core values (Fig.6).

KEYWORDS

Knowledge valorization, knowledge and technology transfer, knowledge transfer office, innovation, public research organization, industry, key performance indicator, licensing, collaborative research, funding, spin-out, spin-off, intellectual property, models, technology readiness level, networking.

1 MODELS OF KT: DARPA AND THE EU KTO WAY

The formal organizational models of KTOs in the EU are ranging from internal KTOs, through institutionally owned enterprises to national, either network-based or private regional entities. This contribution will focus on an internal model of operation of a KTO.

The goal of any innovation intermediary should be to increase the deal flow, increase the number of deals, and increase the impact of those deals. The Defense Advanced Research Projects Agency (DARPA) and the Advanced Research Projects Agency-Energy (ARPA-E) in the US became hands-on innovation agencies to achieve such a goal. This required innovative internal procedures, a new risk-taking mindset and tailor-made management. Its operating concept is to be hands-on, thus involving the activities of a group of people in many segments, very similar to a proactive KTO. This concept is embedded in a set of questions known as the "Heilmeier Catechism", attributed to George H. Heilmeier, a former DARPA director (1975-1977), who crafted them to help Agency officials think through [2], evaluate and manage proposed research programs for maximum impact. By being proactive in managing the innovation side of the financed projects, DARPA and ARPA-E could successfully operate their model for breakthrough innovation.

The DARPA proactive model of operation is also present in the work processes of the European Innovation Council (EIC), with its important new feature, the Programme Managers. As Europe's flagship innovation programme to identify, develop and scale up breakthrough technologies and game-changing innovations, EIC has a budget of €10.1 billion to support game-changing innovations throughout the lifecycle from early-stage research to Proof of concept, technology transfer, and the financing and scale-up of start-ups and small to medium-sized enterprises (SMEs). With its Programme managers and support staff, it can be considered the largest KTO in Europe. The synergies and similarities of KTOs with EIC should be looked into. The EIC builds (and so should the EU KTOs) on active pipeline management (see Fig.1), combined with Proof of concept funding related to a well-defined pipeline of case management. The management is done by highly skilled professionals, combining technical and commercial acumen through a well-defined interface, expanding far beyond the current average public relations activities of the European KTOs [3].

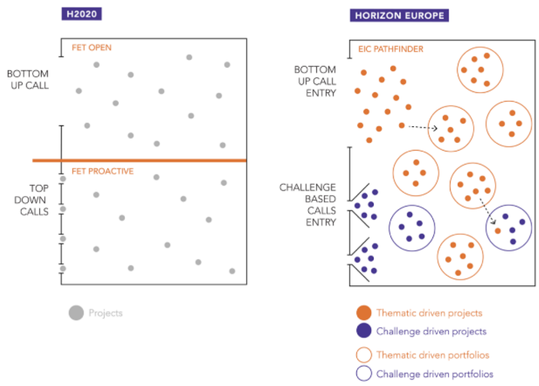

Figure 1: From Horizon 2020 to Horizon Europe: Active Portfolio Management of funded projects [3] A comparison between Future Emerging Technologies (FET) calls in Horizon 2020 as a predecessor of European Innovation Council (EIC) calls in Horizon Europe

The goal of any KTO in Europe should not be to copy the DARPA/ARPA-E or the EIC model. However, it should instead be to translate a known useful model into their context considering the Horizon Europe rules, the national legislation and the current national/regional/local research, development and innovation culture. Only in this way can the innovation intermediaries, the KTOs, create their own unique identity in the European landscape for supporting breakthrough innovations – create the EU KTO way.

Developing the unique EU KTO way is challenging and necessary. It will comprise novel practices supporting the development of breakthrough technologies and actively bringing them to the market. To support breakthrough innovations, the EU KTOs must themselves be an organizational breakthrough in Europe. The main components for achieving this endeavour are centred on the creation of challenge- and thematic-driven pipelines in each of the KTOs, high rejection rate in the acceptance of the cases to the portfolio, active portfolio management of cases, transition activities that bring new solutions to the market and KTO personnel who binds all of this together into complementary practices (see Fig.2). It is crucial to understand that DARPAs results show that this is the right way, and it should be investigated how such a proactive system could be set up in an environment like ours.

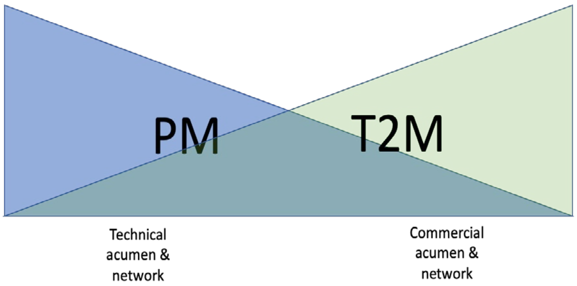

Figure 2: The need for highly skilled personnel in the KTO to active pipeline management, combined with Proof of concept funding related to the pipeline [4]

2 STATE OF THE ART IN KT IN THE EU

2.1 A literature review

For almost 15 years now, the Knowledge transfer flow has been discussed: on the operational and top policy levels. In this section, a discussion about the essential works in this field is given: »Communication (2007)« [5], »Recommendations (2008)« [1], »A composite indicator (2011)« [6], »Knowledge economy (2020)« [6], »Performance indicator system (2021)« [8]. The KT topic was brought into the open by the »Communication« [5], co-signed by the Slovenian commissioner for research Janez Potočnik) in 2007, just before when Kevin Cullen from Glasgow University designed his KT flow in 2008 (Fig.3). Moreover, Kevin's KT flow has been used ever since: in the »Recommendations« in 2008, later shown in the 2011 EC Report »A Composite Indicator« and also in the new 2020 »Knowledge« report.

The view on the KTO role in connecting research to the economy (and its vehicles) has not changed since 2007. To observe this, a comparison between Fig.3 [6] and Fig.4 [7]) can be made. The flow is divided into Research Outputs, KT Channels/Activities, Users/Economic Activity and Impact. The segments are not surprising because the division represents the flow-through of knowledge in the KT system, as described already in 2008. However, the perception of the KT community has changed for the better in the meantime. It has at least changed in terms of the involvement of a KTO in different KT vehicles. In 2013 the Board members and Vice Presidents of the European Association of Technology Transfer Professionals (ASTP) even at this premier knowledge transfer organization's top-level, we could barely discuss the inclusion of Key Performance Indicators

(KPIs) on software and contract or collaborative research endeavours to the KT pipeline in the yearly Metrics report of European KTOs. Most of the time, negative comments regarding the importance of indicators other than licensing deals came from people working in biotech or medical technologies focused public research organization (PRO) environments connected to university hospitals in Western Europe. As these had a prevailing licensing deal flow at the time, primarily with the pharmaceutical industry, their interest in widening the scope of the KT vehicles was limited.

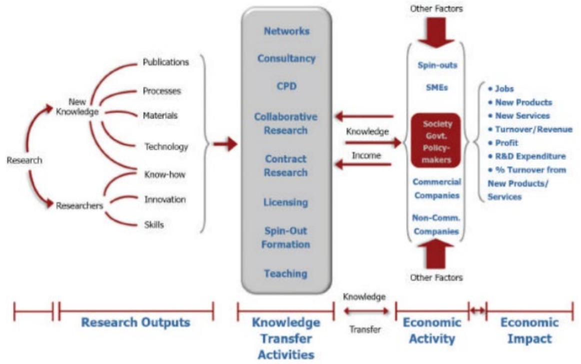

Figure 3: Model of knowledge transfer within the innovation ecosystem [8]

However, gradually through the years, an understanding has arisen that as there are many different national environments, there are many different economic situations, with diverse technological absorption capacity from the industry, requesting and even demanding different vehicles to achieve actual KT. Thus, we recognized that there are indeed many different vehicles, and as KTOs are the primary activity-focused linkage between the Public Research Organizations (PROs) and the industry, they should be appropriately put into the KTO practice. Many KTOs, in particular in the Eastern and Southern parts of Europe, but also such prominent ones as Cambridge Enterprise, started to empower any one of the KT vehicles (including contract and collaborative research and services), which bring results for the global/national/regional/local economy, society and the PRO itself. In this way, the perception of the role of a KTO in the innovation flow system remained the same throughout the last 15 years (if we compare the figures presented in 2011 [6] and in 2020 [7], they are essentially the same), but the understanding and the focus of KTOs rightly shifted from patenting and licensing to other vehicles of KT as well. However, even though progress has been made, the KT community is still struggling to define the KPIs of the KT operations completely [8]. This shortcoming is an echo of the under-developed research activity in the field of KT.

The level of research activity in and on KT is still relatively low in the EU. Primary sources as Joint Research Centre (JRC), TTO Circle and ASTP mainly focus on producing success stories and incomparable status reports, which lack the in-depth definition of KPIs to allow for fair and holistic assessment of the KT system in the EU. As important as success stories, networking and workshops in the field of the KT profession are, these are not enough to professionalize the activities and create a full-pledged and recognized profession. Scientific research, critically analyzing the processes within KTOs, their success and fail factors, and a rigorous scientific approach to monitoring trial and error knowledge transfer practices within the KTOs is needed to improve the EU KTOs.

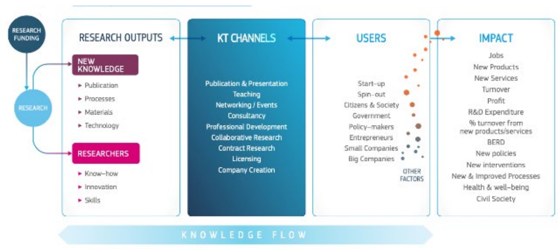

Figure 4: Knowledge Transfer: from research to impact [7]

2.2 The role of the missing KT KPIs

The goal of any innovation intermediary is to increase the deal flow, increase the number of deals, and increase the impact of those deals. To achieve such a goal, DARPA and ARPA-E in the US became proactive, hands-on innovation agencies. In Europe, given the Knowledge Transfer Metrics [7], in 2020, the authors focus on defining the KT indicators in four quadrants, including Internal Context, Environment, Activity, Impact – trying to assess the inputs and the outputs of the KT system (Fig.5). In effect, apart from the Activity indicators, the proposed metrics observes the enabling factors - the success factors of the KTO's pipeline from the outside of the KTOs (which they have little influence over). On the other hand, it observes the final impacts of KTO's operations on society (which are very distant from today's perspective). However, it does not focus into great detail on the internal procedures and pipelines directly under the KTO's influence. Thus, such enabling indicators have a role in evaluating the level of the KTOs possible maximum results, not the quality of its operations.

The KT profession is clearly labelled as inefficient throughout Europe, which is also confirmed by the fact that the Recommendations of 2008 are now being urgently reviewed by the European Commission, but seeking remedies outside the community, not taking responsibility for its actions. In order to improve the operation's quality, it is not enough to assess what is outside of the KTO's reach (internal PRO's context, environment). Moreover, it is not enough to claim that [7] the KTO impact is long term, we cannot measure it right now, we shall see what happens long-term—neglecting evaluations of the internal KTO procedures and their efficiency results in the fact that the profession is not advancing as fast as it should.

The results are indeed dependent on the enabling factors, but are essentially determined by the actions taken by the KTOs [9]. Thus, to improve the quality of the KTO operation in Europe, it is necessary to set up process KPIs to monitor KTO processes and evaluate their quality. The focus should be paid to measuring the efficiency of the KT process, using Detailed Activity or Process KPIs, organized as a funnel, and, on this basis, address the shortcomings in the effectiveness of KTOs. The focus should be given to KTO's internal operation, evaluating the KTO activity in detail: analyzing the deal pipelines, making them professional, flow-through, and improving KTOs' performance by understanding the interdependence of the processes KTOs carry out.

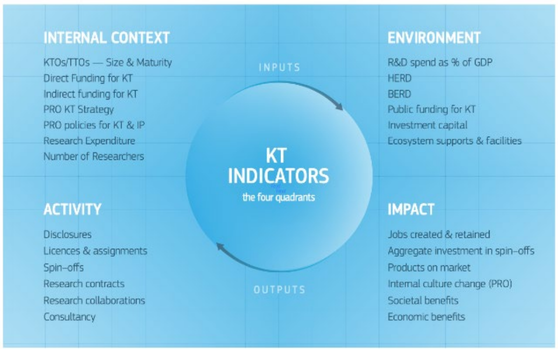

Figure 5: Input and Output KT Indicators: the four quadrants [7]

To monitor the activity within a KTO's pipeline is the only way to observe the points where the activity goes awry. In the »Knowledge economy« report, the valuable parts of the indicators are shown under the Activity part in the quadrant, focusing on the final KTO results only. However, it is not analyzed how the results were obtained. The KTOs are stuck with the KT indicators – they indicate the temperature in the KT system. However, they do not analyze what is going on and how the impactful factors are connected. The problem is similar to the difference between measuring water temperature in a glass and understanding the physical processes behind heating the water. From the measured water temperature, it might be concluded that the fact that we are based in tropical climate influences its heating on the stove, but not how. Likewise, from observing the lower than desired KT results, it might be concluded that the only reason for the unsatisfactory performance of the KT in Europe is the too low percentage of the GDP spent for the KTO or the R&D. To support breakthrough innovations, the EU KTOs must themselves be an organizational breakthrough in Europe.

Moreover, to achieve that, we should focus on the KT process and understand it. We must focus on internal KTO operation, evaluate the KTO activity in detail and set up KPIs to monitor it. We must analyze the deal pipelines, make them professional, flow-through, and improve our performance by understanding our processes.

How can we establish process focused KPIs to evaluate the efficiency of KTO operation? The efficiency of the innovation management system in a country can be evaluated through the share of successful commercialization of patents and secret know-how originating from PROs. The commercialization involving KTOs occurs through new company creation, IPR licensing and sales, and direct R&D collaboration. These are the results of the KT process (but not the impact). Nevertheless, there are many other processes KPIs, which enable us to monitor the efficiency of the KTO process: for example, the number of Market assessments/analyses, Identified topics at meetings with companies for potential collaboration with PRO research teams, Number of Individual Advisory Supports delivered to companies, Number of Individual Advisory Supports delivered to researchers, Active marketing: number of offers prepared for selected companies, Number of received expressions of interest-based on active marketing, Spinout Business Plans prepared, Internal Proof of Concept projects approved, financed and managed and others ...

Table 1: The proposed nomenclature of KT Key Performance Indicators

Description of KPI/Result (all counted in Number of, unless where specified)	
Cases accepted for processing in KT Office	*Number of patent applications filed with full examination*
First meetings with researchers - inventors	*Opinions on continuation of IP protection*
Assessments of the state of the art	*Passive Marketing: Preparation and publication of Technology Offers*
Market assessments/analysis	*Submitted expressions of interest*
First meetings with companies (company visits)	*Active marketing: number of offers prepared for selected companies*
Participations of licensing team member in 1st meetings with companies	*Active marketing: number of offers sent to selected companies*
Second meetings with companies	*Active marketing: no. of received expressions of interest*
Participations of licensing team member at 2nd meetings with companies	*Signing of Non-disclosure agreements*
Third meetings with companies	*Negotiations conducted*
Participations of licensing team member at 3rd meetings with companies	*Cooperation agreements (R&D contracts) signed*
Identified topics at meetings with companies for potential collaboration with PRO research teams	*Licensing agreements (licensing Contracts) signed*
Collaboration topics from meetings with companies identified by licensing team members	*Amount covered by R&D Contracts (EUR)*
Meeting minutes from the 1st, 2nd and/or 3rd meeting with the company	*Amount covered by licensing Contracts (EUR)*
Supplementations by licensing team member, of minutes from the 1st, 2nd and / or 3rd meeting with the company	*New Companies in collaboration with the PRO (via R&D and licensing agreements)*
Collaboration topics disseminated to internal technology transfer coordinators and published in the suitable PR publications (counting by company visit)	*Consultings on Access to financial sources (Tenders, VCs, Commercial Loans)*
Collaboration topics disseminated by licensing team member to PRO Researchers (counting by company visit)	*Spinout First meetings on spinout creation*
Individual Advisory Supports delivered to companies	*Spinout Business Plans prepared*
Individual Advisory Supports delivered to researchers	*Spinout documentations for the establishment of the spinout prepared for consideration by PRO*
Invention disclosures at PRO / decision to acquire the invention by PRO	*Signed contracts for the establishment of spinout companies*

Author: Š. Stres in collaboration with selected members of Center of Technology Transfer and Innovation, 2020 (M. Trobec, F. Podobnik, L. Pal)

Setting up and active monitoring of the entire funnel of KTO KPIs may turn out especially advantageous for young KTOs that have been just established. The "case-by-case" process from preparation to protection and marketing and hopefully conclusion of license and R&D agreement can take a very long time (on average at least 12 - 30 months), and much work has to be done before the final results are earned. During this time, well-established and internationally recognized KPIs might become extremely useful - justifying the existence of such young KTOs to the management authorities and tracking/evaluating their operations. Verified and standardized international KPIs, therefore, illustrate whether the KTOs are on the right path to their goals or not.

With the process KPIs of KTO operations, we can set complete metrics for the Key KT Activities of KTOs. Such metrics are presented in Table 1, *The nomenclature of KT*. These metrics allow for the intertwining of contract and collaborative research in countries where this is necessary, with actual licensing and sales of industrial property (nationally or internationally) and spinout creation. Every country has a specific *distribution* of particular KT Activities and results (final contribution measured much later on by Economic Impact). The efficiency of these efforts measured by KPIs may differ throughout the countries, but the KPIs themselves, the nomenclature, and the results remain the same everywhere: Number of disclosures, Number of licensing, contract, collaborative and service deals, Spinouts established.

3 AN ASSESSMENT OF TOPICS THAT NEED TO BE ADDRESSED WITHIN THE NEW RECOMMENDATIONS

In light of the above analysis of the field and the existing Recommendations**, we suggest topics of concern to be addressed in the amending of the text of the 2008 Recommendations – because these are topics of concern in the current KT endeavors in Europe and they are not covered within the existing Recommendations**. The suggestions areas are listed below.

Operational Issues: Every KTO should have a set of operational principles, an honour code and a code of conduct as a basis of its operation. It could be based on the Code of Conduct of the Enterprise Europe Network (EEN) or built anew.

Accounting issues: Emphasize the importance of registering the intangible assets – in principle, one cannot sell something that has not been registered according to the European accounting principles for intangible assets (including its initial accounting value).

State Aid and Evaluation methods with competition law: Evaluation of IPR is also essential in state aid in collaborative projects (IPR transfer in the context of state aid). Even though not in Horizon Europe, operating under the State-Aid Exemptions, but in all cohesion related funding and national funding for higher TRLs (which are not part of the State-Aid Exemptions). To assess the value, different valuation methods (not valutation) should be understood to set the first value in the accounting books. For this purpose, intangible asset evaluation methods should be analyzed and valuation principles accepted for the KTO usage. **Competition law** – Technology Offers should continuously be published before setting a contract with a specific entity to distort the market's competition. Need to publish the TOs to assure state aid and fairness in terms of competition laws.

Synergies: Look into possible synergies with European Innovation Council (EIC), Enterprise Europe Network ... from operational, not political or networking point of view. KTOs should capitalize on the existing financing available and the existing support networks available.

Broader view on IPR: Registration of models, trademarks, printed circuits, new plant sorts, software should be encouraged. Copyright implications should be addressed, as software is part of the Copyright legislation. Recommendations should be given on how to award researchers for software commercialization and define incentives in different countries (as the legislation in some countries excludes copyright from the rules on awarding researchers in case of commercialization of copyright).

Diversification of KT Activities: Wherever only licensing is mentioned as a vehicle; this should be remedied with other available KT vehicles. The difference between spinouts and spinoffs should be introduced. The specific knowledge and capacity on capital share management by the KTOs should be addressed. The positive impact of spinoffs vs spinouts and vice versa? The need to develop internal PoCs which increase the efficiency of the KTO, the InvestEU with EIF policy introduction. Publishing the technology offers (TOs) and sending them around - active and passive marketing, requiring different knowledge and yielding different success rates, depending on the "name" of the institution.

The use of EEN and its Thematic/Sector Groups for technology marketing is also essential. There is a mutual need to increase KTOs' awareness about EEN and its Sector Groups (mainly "technology-based") and Thematic Groups as a channel for technology marketing, access to SMEs and obtaining the latest expert information in the field of work, respectively. EEN should continue its efforts to emphasize actively seeking Technology Requests at SMEs and linking them to Technology Offers of PROs. Moreover, KTOs should actively harvest commercial databases for technology requests. Several services offered by EEN serve as a prelude to the required (but not always available) expert services of the KTO consultants. Providing a vibrant innovation ecosystem, in which the EEN and KTOs would work in view of signposting and the hub and spoke model, EEN serving as a liaison (account manager), but KTO as a final expert service provider, could work effectively.

A wider approach to science disciplines: Collaboration with social sciences and humanities (for example, the connection with heritage science and alike should be investigated) should be encouraged. In this regard, the »Outputs« as defined in the Research Excellence Framework (REF) of the UK research evaluation system should be studied and possibly all 22 categories, which also include patents) should be analyzed for further usage. Citizen science and science with and for society issues should become more prominent within the work of KTOs.

A systematic research approach to KT content and increasing the quality: Policymaking and lobbying for research projects in the KT – political impact of the EC and JRC is required for this. The explicit notion of the need to upgrade the KTO services from PR activities, and the importance of KT activities to actual execution of such activities, measured by unique KPIs, results should be normalized to research FTE headcount. KPIs are the same in all KTOs regardless of the enabling factors (these only define the maximum KTO output and maximum impact in the economy). Build on the impact factors from the pathway to impact of the EC (commercial, research, societal).

Systemization on the Horizon Europe level: In the same way as »Gender equality plans« need to be published as a prerequisite to a Horizon Europe project approval, also »IP and commercialization policy, including Open Science« should become such a required action for HE projects. The DARPA model and EIC model (with PMs and the support team) are development directions.

Beneficiaries of the KT Activities: It should be emphasized in the Recommendations that students as private persons are not the target of the Recommendations nor the focus of KT activities of the KTO, at least not under the legislation for IP ownership; remedies to assist student-based inventions should be devised under different measures than KTOs (e.g. university, incubators).

Organizational issues in different specific situations: Recommendations on how to organize the system for smaller institutions that do not have the capacity nor the need to retain a full-pledged KTO are needed. Such recommendations are required due to the diversity of personnel needed. Several employees are needed to have a successfully operating KTO. Several models have been tried out: SATT (centralized), Knowledge Transfer Ireland & Slovenia (consortium distributed), Cambridge (University-owned), Leuven R&D (independent internal office) ... It is true that everyone needs to find their way, but there are specifics and criteria which can help find the suitable model. The emphasis on trust-building with the research and economic community is of the utmost importance.

Pooling and open science: Requirements for pooling among institutions on IPR offer should be upgraded in pooling of Open science access. The possible tension between IP protection and Open science, particularly secret know-how, should be addressed in straightforward operational funnels.

Career progression in KT: The career progression of KTO professionals should be addressed, agencies and ministries should be invited to discuss this issue.

Managing the financial return: Recommendation on how the PRO uses the income from commercial activities - should it be used for a PoC fund managed by the KTO for TRL increase of commercialization cases? Or for further IPR cost financing? Why?

Last but not least, an idea of further networking between innovation support stakeholders needs to be put forward, particularly in regards to Enterprise Europe Network (EEN) being active in more than 60 countries worldwide providing support to SMEs with international ambitions. Co-funded by the European Union's COSME and Horizon 2020 programmes, the Network aims to help businesses innovate and grow internationally.

CHAPTER 1 - Core values

PARTNERS
Professionalism
Adding European Value
Responsiveness
Trust
Network
Encouragement
Relationships
SME focus

Figure 6: Enterprise Europe Network Code of Conduct, Annex 2 to the Grant Agreement, 2014

In the coming years, EEN plans to pay more attention to the field of KT, as KT is essential for raising the competitiveness of the European economy. In this context, we believe that the presented proposal of topics that need to be addressed within new recommendations will be mutually beneficial in developing new strategies of EEN and KTOs and strengthening their relations.

4 CONCLUSIONS

- European KTOs should review and fully understand the current European EIC model connected to the successful DARPA / ARPA-E models. They should consider the model as the main framework while adapting its operations to national legislation and the specificities of the industrial and public sector – all with the aim that each KTO becomes a comparable element of the whole community of KTOs at the European landscape.
- There are some common critical points in the pipelines of all KTOs irrespective of different national environments and specifics, namely the KPIs represented in Table 1. Such KPIs are indicators of the KTO activities rather than only general and final KTO results (e.g. patents filed, license and R&D agreements) or remote indicators of KTOs' maximum possible results (limited by the environment). The represented nomenclature of KPIs should help set up a uniform path that European KTOs are supposed to follow to achieve the results.
- It would be of utmost importance to establish a fruitful collaboration between KTOs and national EEN offices to assure full in-depth support to researchers and SMEs alike in this TRL challenging exercise in between the worlds of academia and industry, in particular given the EEN's core values (Fig.6), focusing on the signposting and the hub and spoke model of operation.

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Digital Innovation Hubs and Regional Development: Empirical Evidence from the Western Balkan countries

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ABSTRACT

The Digital Innovation Hubs (DIHs) in Europe are created to support the digital transformation of small and medium enterprises (SMEs). The network of DIHs is in the process of establishing throughout Europe. However, the work of DIHs is not sufficiently investigated neither in developed nor developing countries. In the Western Balkan region (the WB-5), there are 24 registered DIHs, but only five of them are fully operational. Throughout the survey, the authors investigated the WB-5 DIHs and compared their performance with their EU-28 counterparts. The survey results and interviews with the WB-5 DIHs indicate a lower level of their specialization and suggest that they failed to support the digital transformations of local businesses. They also have a great potential to improve cooperation among industry, academia, and governments in the WB-5 countries and between the countries.

KEYWORDS

Digital Innovation Hubs, Business Support Organizations, Small and Medium Enterprises, Quadruple Helix Model of cooperation, developing countries.

Technology Transfer as a Unifying Element in EU Projects of the Center for Technology Transfer and Innovation

Prenos tehnologij kot povezujoči element EU projektov na Centru za prenos tehnologij in inovacij

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ABSTRACT

Technology transfer supports the transfer of knowledge from research institutions to industry through various mechanisms, including those enabled by international project schemes. We analysed how projects, carried out within our unit, the Center for technology transfer and innovation (CTT), based on the outputs and processes developed, align to a technology transfer pipeline on an SME's path to innovation. We also investigated how different projects complement each other in creating a comprehensive innovation support system for SMEs. Projects involving voucher-based financial support of innovative collaboration and highest involvement of researchers emerge as most engaging for future funding applications, with other types of project nevertheless being recognized as important in focusing on individual stages of innovation. Regardless of project, dedicated efforts are important for establishing strong research-industry connections and enabling their continuous collaboration after the project's end.

KEYWORDS

Technology transfer, innovation, EU projects, H2020, Interreg

1 INTRODUCTION

Technology transfer supports the transfer of knowledge from research institutions to industry, enabling laboratory research to progress to an industrial level, and in turn, enabling small-to-medium-sized enterprises (SMEs) to innovate through collaboration with researchers. An SME can use various forms of support offered by a technology transfer office, and the forms of support are frequently part of a national or an international project scheme, such as European Commission's Horizon 2020 and EU's Interreg programs. CTT at the Jožef Stefan Institute has been a partner in several such projects. In this work, we analyzed how our projects align to a technology transfer pipeline on an SME's path to innovation, and how different projects complement each other in creating a comprehensive innovation support system for SMEs. Finally, we identify the type of project most suited for bringing into practice collaborative research that drives technology transfer's ultimate goal, innovation.

2 METHODOLOGY

Ten EU projects analyzed in this work (out of a total of 24) have been selected with the criterion of being geared towards supporting SMEs in gaining new knowledge and/or finding research and/or industrial business partners with the goal of innovation. CTT projects not included were those related to popularizing science and introducing scientific courses into high school programs. National projects were not surveyed due to their different selection process. Projects that ended before December 2014, and more recent projects that didn't entail sufficient involvement and therefore familiarity by one of the authors (D.O.) to enable analysis, were not included. The surveyed projects are listed in Table 1.

To identify projects' alignment to individual stages of innovation and evaluate the extent to which they incorporate elements of technology transfer, we reviewed project deliverables, outputs, and processes developed most relevant to innovation.

To illustrate the range of support types that the projects have offered, and to identify the type of projects most in line with technology transfer goals, we created a simplified project landscape wherein we distributed the projects along two dimensions: (1) level of involvement of research institutions, and (2) innovation stage reached by the project's outcome, from basic raising of awareness to concrete advanced innovative collaboration. The analysis aims to identify type(s) of project towards which most efforts should be directed in future funding applications.

3 RESULTS

Selected project deliverables, outputs, and processes relevant to innovation, are listed in Table 2. All projects lead to raised

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Table 1: EU projects surveyed.

Acronym	Brief description	Duration	Program
KET4CP	Supporting manufacturing SMEs with key enabling technologies provided by research institutions, with the emphasis on environmentally–friendly manufacturing	2018-2021	H2020
Central Community	Supporting life-science-oriented SMEs and research institutions in finding business partners through a platform	2012-2014	Central Europe
Co-Create	Supporting SMEs in involving creative sectors to define new products and services according to social trends	2016-2020	Interreg Mediterranean
EU-GIVE	Connecting SMEs to collaborative, circular and sharing economy actors for increased efficiency of innovation	2017-2019	COSME
finMED	Supporting financing of innovation in green growth sectors through improved delivery of policies and strategies	2018-2022	Interreg Mediterranean
IP4SMEs	Supporting SMEs in defining the role of intellectual property (IP) in creating regional value through interregional IP exchange	2012-2014	Slovenia – Italy Cross Border
KETGATE	Supporting SMEs with access to key enabling technologies through research equipment and services provided by research institutions	2017-2020	Interreg Central Europe
Open I SME	Supporting SMEs in solving technical issues with the aid of researchers via an online tool matching technology requests with research competencies	2014-2016	CIP
Scale (up) Alps	Supporting SMEs by setting up a hub enabling a single entry point to assistance in access to finance, access to talent, and access to market opportunities in the EU	2016-2019	Interreg Alpine Space
SYNERGY	Supporting SMEs in finding potential innovation partners through platforms for submitting technology challenges and enabling crowdfunding schemes	2017-2020	Interreg Central Europe

awareness and new knowledge gained by SMEs, as well as new processes developed at CTT to effectively support SMEs. However, individual projects lead to innovative collaboration to varying degrees.

Based on data from Table 2, we aligned the projects with a hypothetical innovation process in an SME. The relevance of selected projects at different stages of innovation (from problem to innovative solution) is shown in Figure 1. While individual projects are relevant to different stages and support technology transfer to different extents, most have the goal of connecting SMEs to relevant stakeholders and lead to innovative collaboration.

Since technology transfer from research to industry ideally entails participation of researchers, we analyzed the projects not only according to the stage of innovation but also according to researcher involvement. Distribution of projects in relation to involvement of researchers – from none to full - and to role in innovation based on project results and outputs – from indirect to direct – is shown in Figure 2. Both dimensions are descriptive rather than quantitative, and the landscape has been created for illustrative purposes.

The results show that projects such as KET4CP and KETGATE, which include operational support steps from the beginning till the end of the innovation pipeline (Table 2), and have important roles in innovation as well as a high level of researcher involvement, emerge as having the highest potential for technology transfer.

Projects with lower relevance that enter the innovation pipeline in the beginning of the innovation process but do not include mechanisms to sustain active collaboration, such as Open I SME and Central Community, are those that enable matchmaking through platforms but in absence of further innovation support actions they do so with lower impact. In effect, they start the process by introducing potential partners but leave them to carry out setting up the collaboration by themselves.

Projects having the most impact in raising awareness rather than in producing actual collaborative development, such as IP4SMEs, EU-GIVE, Co-Create, and Scale(up) Alps, enter the pipeline at the middle of the process (scouting and innovation potential discovery) and are least relevant, as their impact on technology transfer is most indirect. They make the potential partners aware of the fact that there is an opportunity for collaboration to be seized, but do least about creating an actual collaboration among potential partners.

Lastly, projects that only deal with a singular aspect of the process can be influential in terms of that particular aspect (for example, finMED for financial support setup, IP4SMEs in IP issues), but act out of context in terms of the innovation pipeline.

From the analyses conducted, the KET4CP and KETGATE projects emerge as a type of project most closely in line with the complete collaborative innovation pipeline, involving strong research participation, creating concrete connections and following them through to realization of the opportunity, thus most effective in increasing SME-research collaboration and most attractive in subsequent funding opportunities.

Table 2: Project deliverables, outputs, and developed processes most relevant to innovation, distributed based on the benefit to SMEs participating in the project.

Project	knowledge gained by SME	Instruments / processes developed	registration on platforms, submission of challenges, matchmaking	successful joint research and development projects
KET4CP	map of European technology centers	Cascade funding with evaluation and support process	KET4SME platform	yes (voucher-supported)
Central Community	list of Life Science companies	Process of scouting, matching, and encouraging SMEs towards open innovation	LifeScience Room	
Co-Create	design thinking, co-creation	Design thinking process for inclusion of different stakeholders in traditional SME innovation process	Co-Create platform	
EU-GIVE	map of collaborative economy initiatives	Process of engaging researchers in creating innovative collaborative economy approaches		
finMED	list of financial instruments and mechanisms	Process of including intangibles into financial intermediaries' (as banks) loan capability criteria evaluation		
IP4SMEs	importance of IP	Process of auditing SMEs towards discovery of innovation potential		
KETGATE	available research equipment at JSI	Process of scouting, matching and financially supporting research and SME partners with cascade funding	KETGATE platform	yes (voucher-supported)
Open I SME		Process of scouting, motivating research experts to become available to SMEs for industrial counseling	OpeniSME platform	yes
Scale (up) Alps	list of Slovenian startup ecosystem actors	Process of scouting for expertise, supporting creation of SME (spinout), matching its needs to the support system and allocating relevant support – it being a part of a group of companies with similar needs	Scale(up) Alps support ecosystem	
SYNERGY	list of crowd innovation initiatives	Process of determining entities suitable for crowd sourcing, based on relevant criteria, and of matching them with suitable crowd innovation initiatives	SYNERGY platform	

4 DISCUSSION

In this work, we analyzed selected projects in terms of their contribution to technology transfer. It should be noted that there is a distinction in terms of relevance to individual stages (Figures 1, 2), however, the KET4CP and KETGATE projects emerge as a type of project most closely in line with the complete collaborative innovation pipeline. On the other hand it should be emphasized that each project has its place in the overall innovation process. Consider a hypothetical Company that agrees to participate in all listed projects. The Company benefits from all aspects of innovation (Table 2), and ends up having a complete set of services that are in fact part of technology transfer. It starts by attaining basic knowledge about intellectual property and innovation management (IP4SMEs), its position among other SMEs in a given sector (for example, life sciences; Central Community) and familiarizes itself with the landscape of collaborative economy (EU-GIVE), available technology centers (KET4CP) and research equipment (KETGATE), startup support

(Scale(up) Alps) and crowd innovation initiatives (SYNERGY). The Company then proceeds to learn about the design thinking approach in innovation and the possibilities to connections with the creative sector (Co-Create), and gets an opportunity to explore a host of national and international research and/or business partners via various online platforms (KET4CP, Central Community, Co-Create, KETGATE, Open I SME, SYNERGY) or through attending matchmaking events (KETGATE). The Company receives a comprehensive informative guideline on the possibilities of financing (finMED), and may enter into research and development collaborations (Open I SME), with the possibility of additional financial support by vouchers (KETGATE, KET4CP). Thus, any given project, even if filling

Figure 1: Relevance of selected projects at different stages of innovation (from problem to innovative solution) in an SME.

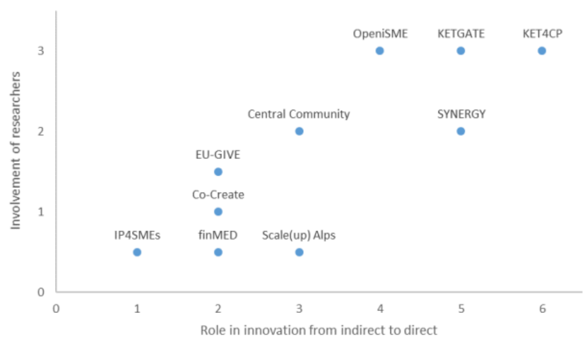

Figure 2: Distribution of projects in relation to involvement of researchers, and to role in innovation based on project results and outputs. Note that the numbers indicate a relative position of the project based on project design rather than any quantitative measure, and are provided for illustration purposes only. Numbers on the y axis indicate no involvement (1), potential involvement (2), or full involvement (3). Numbers on the x axis indicate stages in innovation pipeline as follows: 1 – gaining knowledge about IP and innovation management, 2 – gaining knowledge about design thinking, collaborative economy, or financial instruments 3 – registration on platforms, 4 – matchmaking, 5 – access to equipment or services, 6 – joint research and development projects. In this type of display, the projects located in the upper right part are most suited for supporting technology transfer between research and industry.

just a single innovation stage, can represent an added value for an SME, through providing knowledge about a specific subject, thereby allowing other projects to offer support with the benefit of that gained knowledge.

Low-level- and mid-level-impact projects are thus important since they provide information and knowledge for companies that makes them suitable as target beneficiaries for further forms of support down the pipeline. For example, a highly relevant project, such as KETGATE, may not itself include in-depth analysis of mechanisms for defining intellectual property (otherwise provided by IP4SMEs) or in-depth analysis for setting up familiarity with available financial instruments (otherwise provided by finMED). However, as both are useful traits in signing cooperation agreements and looking for continued financing of pilot projects established within KETGATE, their execution provided grounds for setting up a fully-fledged innovation pipeline support. An SME thus more efficiently benefits from KETGATE services, having previously received services from IP4SMEs and finMED. Ranking of the projects (Figure 2) is therefore not a reflection of their quality or relevance but of their position within the complete support to technology transfer.

The processes developed within individual projects, from discovering innovation potential (e.g. IP4SMEs) to cascade funding of research and development projects (e.g. KET4CP), culminated in the development of a comprehensive SME innovation support system at the CTT that is flexible and adaptable to a company's level of innovation and particular needs. The projects proved important in strengthening of the technology transfer pipeline by developing ways of engaging various stakeholders, their auditing, developing of matchmaking platforms, and protocols for facilitating collaborative research, including voucher-supported cascade financing schemes.

It is the long-term goal of EU projects to not only develop processes for comprehensive SME support but also act as stepping stones for achieving continuing innovation activities between research / industry partners and building strong and inspirational success stories after the projects' closure. This is particularly important in the light of the fact that mechanisms established during a project, such as platforms, are often inactivated once the project is finalized. Efforts are in principle invested towards sustainability of platforms after the project's end, but platform maintenance is rarely guaranteed and/or requires dedicated funding from other sources. It is therefore important to enter into a project with a clear vision of its benefits and strong dedication to reaching relevant goals. Understanding the role of a specific project in the innovation pipeline is crucial to achieve this. Previous experience has shown that prudent attitude towards engagement with project target audience (from identifying relevant companies, identifying the right correspondent individuals, to right type of motivation) can lead not only to fruitful project collaboration but also to continued research-industry collaboration outside of the project.

Finally, we estimate that the culmination of the efforts described in this article will be seen on one hand within the European Innovation Council of the Pillar 3 in Horizon Europe, in particular in the creation of new high-tech-based companies stemming from Public Research Organizations. But the contribution of this myriad of projects should also be seen as important within further financing of the European Commission in the form of cascade funding, available to connect in massive numbers SMEs and the academia. Such numerous collaboration is required to build trust, to execute the contract / collaborative research and to improve the technological absorption capacity ever so needed to be improved in some parts of Europe, ours included.

5 REFERENCES

This work is a result of experience- and output-based analysis and does not include references as such. Below are given links to websites, wherever still active as of 30.9.2021, to individual projects analyzed:

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Co-Create - https://co-create.interreg-med.eu/
EU-GIVE - https://www.eugiveproject.eu/
finMED - https://finmed.interreg-med.eu/
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Open I SME - https://www.openisme.eu/
Scale (up) Alps - https://www.alpine-space.eu/projects/scale-up-alps/en/home
SYNERGY - https://www.interreg-central.eu/Content.Node/SYNERGY.html

Proof of Concept cases at the Jožef Stefan Institute in 2020 and 2021

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ABSTRACT

The development of economy and society is inextricably linked to inventions and innovations from public research organisations. Technology transfer offices identify potentially suitable technologies for commercialization and support researchers in the field of intellectual property (IP), commercialization etc. However, financial resources are necessary for the further development of the identified technologies in order to reach higher levels of technological maturity. In EU, UK, USA and elsewhere the so-called Proof of Concept (PoC) funds are available on institutional, regional, national and international level. In Slovenia till 2021 we only had four PoC funds, all of them were institutional / internal, one of them the Jožef Stefan Institute PoC, created as the first one already in 1996. This paper focuses on the eleven Proof of Concept cases from the Jožef Stefan Institute that were financially supported in 2020 and 2021. We have shown their individual characteristics and the expected benefits for the projects due to the received PoC funding based on the project applications. The projects are dispersed across Technology Readiness Levels (TRL) of the so-called Valley of death (TRL 3-7). Further developments based on the received funding are in line with their current and expected TRLs – the most common are validation in the laboratory and / or in the relevant environment, prototype demonstration and testing. We have also made an overview of possible future scenarios for them on the basis of the expected CEETT Proof of Concept fund.

KEYWORDS

Proof of Concept, Entrepreneurship, Innovative financing, Technology Transfer

1 INTRODUCTION

A Proof of Concept phase (PoC) is a research practice and serves as an instrument of knowledge construction in an individual study and helps to build further understanding of certain objects, data, metrics, apparatus, processes, materials. A PoC research is composed from a set of activities (i.e. actions, movements, analyses, simulations, techniques, tests, etc) for the assessment, understanding, validation and exploitation of, and the learning about particular research object [1]. A PoC is used "to prove a concept through a practical model" [2]. The PoC phase is in research institutions in terms of technology transfer considered as critical for the success of both licensing and the creation of spin-off companies [3]. The POC therefore increases technology transfer office (TTO) chances of a larger percentage of the income stream from the commercialization of innovations so that it can fulfil some main tech-transfer goals, that is, return on investment, job creation, start-up creation, IP licensing and improving reputation at all levels in its own tech-transfer process [10]. Auerswald and Branscomb write that the most vital technology commercialization phase occurs between invention and product development when commercial concepts are created and verified and the best appropriate markets are defined. The PoC phase has a funding gap, caused by information and motivation asymmetries and institutional gaps between the science, technology and enterprises [4].

Such a gap is primarily due to the "embryonic" nature of the research organization-generated inventions, which tend to operate at the frontier of scientific advancements, thus involving considerable risks associated with their subsequent validation, industrialization and commercialization [5]. The time required to transform discoveries into products and the vast amount of resources needed to pursue the required development constitute a mix of high uncertainty and negative cash flows that decrease investment incentives and limit opportunities to secure funding. This pattern is especially pronounced in science-based sectors like life sciences, biotechnology etc. [5]. The gap and PoC positioning in regards to the stage of development and funding sources is also shown in Figure 1.

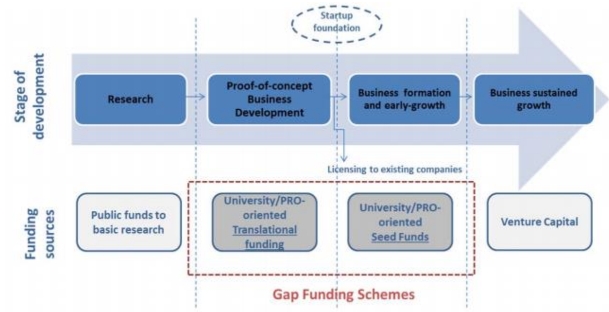

Figure 1: Representation of PoC in regards to Stage of development [5]

The lack of dedicated funding and support to help inventions from public research institutions to mature to the stage at which they are market and investor ready represents a major obstacle to effective knowledge transfer. Different support mechanisms address these gaps, at general policies level as well as on the level of specific, local initiatives, including research organizations funds [6, 7].

PoC funding programs are mechanisms that combine money, expertise and training to help new inventions and discoveries emerge and to demonstrate their technical and commercial feasibility. Such funds can appear under different names like PoC funds, proof-of-principle funds, translational funding, pre-seed funding, verification funding, maturation

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programs, innovation grants, ignition grants [5]. No matter the name they all have common objectives and characteristic, shown also in Table 1: to evaluate the technical feasibility and commercial potential of early-stage research ideas and technologies and to demonstrate their value to potential industrial partners and investors. Under the programs, the researcher/research team gets capital and assistance across a broad spectrum of areas, such as intellectual property rights, business plan development, market studies, networking etc. The ultimate goal is to advance the technology to a point at which it can be licensed to an external industrial partner or a start-up to be created to attract the interest of investors in later stages of development [5].

Table 1: Main characteristics of PoC funds [5]

	PoC Programs
Objective	Evaluate and support the technical feasibility and commercial potential of early stage technologies generated by public research organizations
Focus of investment	Primarily projects by individual researchers or research teams
Investments typology	Typically grants, but other forms are possible (i.e., loan, repayment schemes)
Investment stage	Pre-seed stage (typically before company formation)

As mentioned in the paragraph above, PoC funding schemes can be created internationally and nationally. In Slovenia, we do not have a national PoC funding jet. Some public research organizations have therefore developed their internal schemes. These schemes are available at the National Institute of Chemistry, University of Ljubljana, University of Maribor, and at the Jožef Stefan Institute.

2 PROOF OF CONCEPT FUND AT THE JOŽEF STEFAN INSTITUTE

2.1 Legal framework

The Jožef Stefan Institute (JSI) has in **1998** implemented the Internal Employment-Relate Inventions Act. At the same time, **the innovation fund** of the institute has been created.

The goal of the innovation fund is to enable the projects to increase their technology readiness level (TRL), increase their maturity and attraction towards potential customers, increase their suitability for external calls for proof of concept funds, and establish partnerships with the industry.

The innovation fund of the Center for Technology Transfer and Innovation (CTT) at the institute is filled only from the part of the incomings from the commercialized intellectual property of the JSI. Funds are being distributed through internal JSI calls prepared and managed by CTT based on a detailed internal act.

In this work, we will focus on the 2020 and 2021 cases.

2.2 Jožef Stefan Institute PoC calls in 2020 and 2021 [8]

Calls for funding of projects are intended to help move projects starting from at least the TRL 3 towards higher TRLs. The call is open for JSI researchers with a status of at least 50 % employment at JSI.

Table 2: Approved Jožef Stefan Institute projects in 2020 and in 2021 [9]

Y.	Title	JSI research department, project leader
2021	Upgrading the Open Clinical Nutrition Platform with a mobile application	Computer Systems (E7), Koroušič Seljak
2021	Data gap analysis for biocide regulatory protocol of apatite/gold/arginine as novel antimicrobial agent	Advanced Materials (K9), Vukomanović
2021	Connecting with industry partners to build an automated laboratory	Nanostructured Materials (K7), Suhadolnik
2021	Libra wireless pocket-size kitchen scale	Computer Systems (E7), Blažica
2021	Multifunctional coatings for the protection of metal surfaces	Physical and Organic Chemistry (K3), Rodič
2020	Apparatus for ultra-fast fluorescence lifetime measurement	Experimental Particle Physics (F9), Seljak
2020	Ceramic capacitive pressure sensor with doubled pressure sensitivity	Electronic Ceramics (K5), Malič
2020	Scaling of the synthetic method of electrochemical electrodes	Gaseous Electronics (F6), Filipič
2020	Predicting exacerbation of chronic heart failure based on telemedicine date	Intelligent Systems, (E9), Gradišek
2020	Preparation of synthetic blood substitute for testing medical equipment	Electronic Ceramics (K5), Kuščer
2020	CAUSALIFY – Exemplary in the dynamics of world events	Artificial Intelligence (E3), Grobelnik

The purpose of the call is to:
- define the technology to the extent that it is suitable for the official acceptance of the invention / technical improvement / registration of the intangible asset at the JSI;
- help with application for a larger concept verification and validation call;
- help projects to a higher TRL in order to increase the attractiveness of technology for potential customers or to use technology in a JSI spin-off;
- establish long-term partnerships with the industry.

Expected results for the approved / selected projects:
- upgrading their TRL and therefore increasing the value and attractiveness of the technology;
- higher possibility of selling or licensing the innovation;
- creating links with industry partners;
- getting ready to apply to a bigger tender for testing and validating the concept and
- participation in the selection of the best invention / innovation from public research organization at the International Technology Transfer Conference.

In 2020 six projects were approved and in 2021 five projects.

Each PoC project has its TT guardian in the Center for Technology Transfer and Innovation. The allocated TT experts are guiding the research teams in terms of IP, further financial possibilities, connecting with industrial partners, project preparations, technology assessments etc.

3 ANALYSIS OF PROOF OF CONCEPT PROJECTS FROM THE JOŽEF STEFAN INSTITUTE

We have looked at the approved projects from different points, as a source taking project applications:
- Current and expected TRL;
- Time needed to reach the expected TRL;
- Technological background of the projects and the markets they are targeting;
- The intellectual property protection of the projects;
- The type of the market the researches are targeting, trends on the market and the competition;
- Spin-out vs licensing plans;
- The benefits of the PoC financing for the project development.

As it can be seen from the Table 2, the projects are from three different areas of the Jožef Stefan Institute:
- Physics (2 projects)
- Chemistry and Biochemistry (5 projects)
- Electronics and Information Technology (4 projects).

The majority of projects has been at TRL 3 (6 projects) when applying for funds, 3 were at TRL 4, one at TRL 5 and one at TRL 7. In the next 12 months the TRL of all project will with the received financial help rise for at least one TRL. In two projects the rise would be event from TRL 3 to TRL 7 as shown in the Figure 2. The expected TRL is not known yet in four cases.

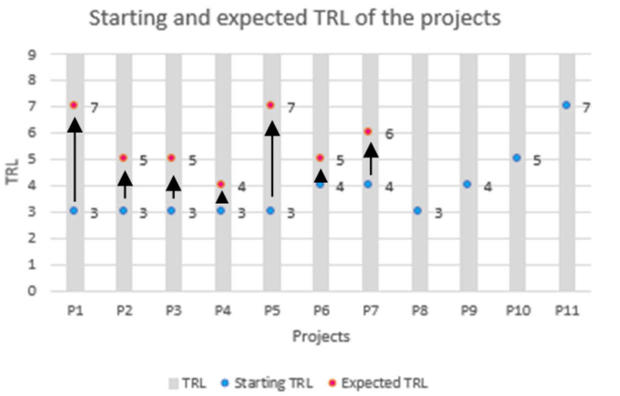

Figure 2: Starting and expected TRL of the JSI PoC cases

Based on the info from the applications, all the projects will be targeting world-wide market. Five of them will develop solutions for niche markets, other six are targeting wider audience – numerous users. It is important that six of the projects are trendsetters, the rest are developing solutions for current “hot” topics like environmental legislative requirements, health issues of the population, ageing population, solutions for non-animal tests in pharmacy, energy consumption. Six projects have little competitors and their competitive advantages are high. It is extremely interesting to observe where the science has its expected effect. This is shown in Figure 3. The Technological areas are the ones of the four broader activities of the Institute (Physics, Chemistry and Biochemistry, Electronics and Information Technologies, Reactor Engineering and Energy). A particular Technological area has been defined based on the research department of the applying team. The expected impacts / the targeted markets are listed as they were identified by the teams.

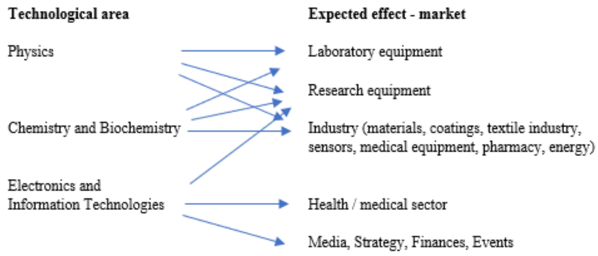

Figure 3: The Jožef Stefan Institute PoC projects and their expected effect on different markets

Three out of eleven teams are seriously considering the option of establishing a spin-out company. The rest wish to license the technology.

The main expected benefits for the projects due to the received financial resources are described below. To assure anonymity, the order of the projects below is not the same as in Table 2:

P1: start test cooperation with industrial partners, construction of a prototype, testing a prototype, preparation of detailed plans for the manufacturing of critical components of the device, applications to EU projects.

P2: analysis for regulatory protocol.

P3: designing a mobile application, user interface design, user testing of the application.

P4: running a trial with early adopters, improving the user experience of the demo, preparation of promo material, lowering the production costs.

P5: experimental / test cooperation with an industrial partner, pilot transfer of the solution to the industry, IP protection.

P6: developing industrial prototype and user interface, testing the prototype.

P7: developing a prototype, testing the prototype with the potential users.

P8: scaling-up the existing prototype, testing it for one of the possible applications, developing a method for simplifying the operating procedure.

P9: pilot testing, improvements needed for clinical testing, promotion.

P10: component validation in a laboratory environment, IP protection, preparation for suitable project calls.

P11: developing protocols for scale-up in the laboratory environment, validation in the relevant environment.

We have grouped the main expected benefits into four most common areas: 1. Developing a prototype, 2. Testing a prototype in a lab, 3. Testing a prototype with industry / potential users, 4. Preparing a support documentation i.e. documentation to fulfil the legislative requirements, IP protection documentation (patent applications and similar), project applications, communication / commercialization promo material etc). As it is shown in Figure 4 in seven projects researchers are developing a prototype, in four cases prototype will be tested in a lab, in nine projects prototype will be tested with industry or other potential users, seven sets of needed support documentation will be prepared as well.

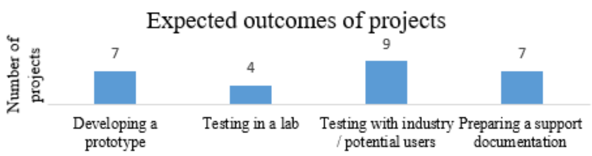

Figure 4: The Jožef Stefan Institute PoC projects and expected outcomes of project

With the rise of TRLs it is expected that the projects will gain also on the following areas:

- The teams will get additional team members with the expertise in business plan development, marketing, technology transfer, certification, etc (relevant for all the projects) or they will licence the technology to a company that will take over the future product / service and launch it on the market.
- Intellectual property (IP) will be better defined, IP management plan will be developed, relationships between researchers themselves and with host organizations will be arranged.
- The key market will be defined. All activities (research, development, financing, promotion) will follow the defined key market needs.
- The research towards the markets that are not promising will be abandoned.
- Further financing will be acquired also from external sources (relevant for all the projects).

4 CONCLUSIONS

Through the calls in 2020 and 2021 the main lessons learned for the the Center for Technology Transfer and Innovation team were:

- It is necessary to have PoC funds available at institutional / JSI level as well as on national level.
- The funds are welcomed by JSI researchers since the application is simple, the results are available soon and the support regarding the project funding and reporting is in-house.
- CTT gets through the application additional insights into the research activities of research departments and can offer its assistance to new research teams.
- Besides the funds that the teams get, it is necessary that CTT supports the projects also with the guidance on IP, further financial possibilities, connecting with industrial partners, project preparations, technology assessments etc.
- Market assessments and defining the target market are crucial for further development. In this step feedbacks from business sphere are priceless.
- The teams are in most cases composed from natural sciences and engineering experts. It is necessary to connect them with experts from human- and economics sphere as soon as possible in order to focus further development based on market needs.

In July 2021 the Central Eastern European Technology Transfer (CEETT) platform has been launched by the European Investment Fund (EIF) together with Slovenian SID bank and the Croatian bank for reconstruction and development (HBOR). The €40 million will be invested in venture capital funds and finance innovative technological research projects and the protection of the intellectual property of research organizations in Slovenia and Croatia (other Central Eastern European countries are not included).

The eleven JSI PoC projects have gained with JSIs' internal PoC funding in the past two years an excellent basis and will be ready for CEETT funding as soon as it is available.

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European Industrial Strategy - a great opportunity to strengthen the role of technology transfer offices

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ABSTRACT

The latest European (EU) industrial strategy of the EU Commission (EC) envisage increasing the innovation of small to medium-sized enterprises (SMEs) with the emphasis on the double transition to a green and digital economy. The Enterprise Europe Network (EEN), which operates within the EC and its 17 sector groups will be involved in achieving these goals. Optimized functioning of SMEs and PROs in the innovation ecosystem is extremely important and technology transfer (TT) will play a key role here.

This paper presents the interactions between sector groups and industrial ecosystems on the example of the BioChemTech sector group as it is important to understand them in order to act in line with the new EU strategy. A database of EEN profiles, namely all profiles marked for dissemination in the BioChemTech group were analysed and the technology, market and client outreach based on real business and technological offers and requests is thus presented in this paper. The BioChemTech sector group has the most direct applications in Health (30%), Digital Industries (10%), Agri-Food (9%), and Renewables (4%) and many indirect synergies with the same industrial systems in the areas of Industrial Products, Genetic Engineering/Molecular Biology and Consumer-Related Products. The sector group has already established contacts with clients in the field of Digital industries (5%) and Renewables (5%), which will need to be maintained, reinforced and upgraded in cooperation with other sector groups to ensure effective digitalization and sustainability of companies.

The results reveal a unique opportunity for TT offices (TTOs), as the future demand for digital and environmental solutions should increase in companies. TTOs should catch this wave and thus overcome the usuall bottleneck of disproportionately large share of technology supply compared to technology demand as presented in this paper.

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KEYWORDS

European Industrial Strategy, Enterprise Europe Network, Technology Transfer, Industrial ecosystems, Sector groups, BioChemTech, biotechnology, chemistry

1 INTRODUCTION

The EU Industrial Strategy of EC from March 2020 focuses mainly on the dual transition to a green and digital economy [1] aiming to increase the competitiveness of EU industry and enhancing the Europe's open strategic autonomy.

The EU industrial strategy defines 14 industrial ecosystems (Figure 1). The primary aim of the new industrial strategy is to increase the innovativeness of SMEs within these industrial ecosystems. According to the Single Market Programme (SMP COSME) the research and TT are considered as a core expertise to ensure efficient support for SMEs by providing support to industry-academia cooperation including the provision of technology expertise and technology infrastructure services to facilitate lab testing, validation and demonstration [2].

Figure 1: Industrial ecosystems according to European Industrial Strategy [1].

EEN, which is operating under the EC has established 17 Sector Groups - the groups of network partners, who commit to work together in order to meet the specific needs of their clients operating in a particular sector [3]. The following sectors are covered by the groups: Aeronautics, Space and Defence, Agrofood, BioChemTech, Creative Industries, Environment, Healthcare, ICT Industries and Services, Intelligent Energy, Maritime Industry and Services, Materials, Mobility, Nano and micro technologies, Retail, Sustainable Construction, Textile and Fashion, Tourism and Cultural Heritage and Woman Entrepreneurship [3].

It is difficult to directly link the mentioned sectors to industrial ecosystems shown at Figure 1. For example, biotechnology and chemistry and many others are not listed as relevant industrial ecosystems. The reasons for the thematic mismatches between industrial ecosystems and sector groups vary. Some sector groups are based on the political agenda or are covering different services. However, the majority of sector groups is based on technology areas as defined by ATI - Advanced Technologies for Industry (former KET - Key Enabling Technologies) [3] meaning that the sector groups were established to transfer the advanced technologies from relatively narrow scientific fields to a relatively wide spectrum of industrial ecosystems.

Determination of how the technological sectors are related to industrial ecosystems is important to ensure the optimal functioning of SMEs and PROs in the innovation ecosystem according to the EU industrial strategy [1]. The information should benefit to Jozef Stefan Institute (JSI) as a PRO and ATI Technology Centre [3] as well as the partners of Slovenian EEN consortium [2] and Consortium for Technology Transfer from PROs to economy (KTT) [4] coordinated by JSI. The EEN and KTT community is indeed acting on various relations: SME-SME, PRO-PRO, PRO-SME and SME-PRO

In this paper, we describe an example of solving the above issue from the perspective of technology, market and client coverage in case of BioChemTech sector. We further discuss the opportunities for TTOs brought by the new EU industrial strategy and how TTOs can use the given situation to consolidate their role and importance in the innovation ecosystem.

2 METHODOLOGY

The profiles published on the EEN website (https://een.ec.europa.eu/partners) were exported using the following filters: profile date: "from 1 June 2020 to 20 May 2021"; partners: relevant sector groups: "BioChemTech". The obtained 199 results were exported into the Microsoft Excel worksheet (registration and login to EEN intranet is required to easily export the profiles). The technology, market and NACE codes with corresponding descriptions were further analysed (each profile has a maximum of five technology, market and NACE codes). The incidences of different individual codes were calculated. The most relevant sector groups or industrial ecosystems were attributed to the sets of most frequent codes occurring within 199 profiles and graphically displayed at Figure 2, Figure 3, and Figure 4. The "Others" group within individual sub-areas of Figures 1 – 4 represents the sum of various different codes that each individually covered less than 1% of the overall BioChemTech area. The number of business and technology profiles presented at Figure 5 is based on the same set of exported data. Analyses were performed in May 2021.

3 RESULTS AND DISCUSSION

3.1 Technology outreach

BioChemTech sector mainly covers the technological field of biological sciences (39%) and industrial technologies (26%) mainly in the fields of biotechnology, chemistry and materials, which is not surprising (Figure 2). Within biotechnology and chemistry, there are some cross-cutting areas with other sectors. The largest overlaps are in the areas of healthcare (19% of profiles), agri-food (10% of profiles), environmental protection (8% of profiles) and ICT (8% of profiles). Smaller overlaps are also in the field of micro and nanotechnologies (2% of profiles) and advanced materials (7%) including textile materials (Figure 2).

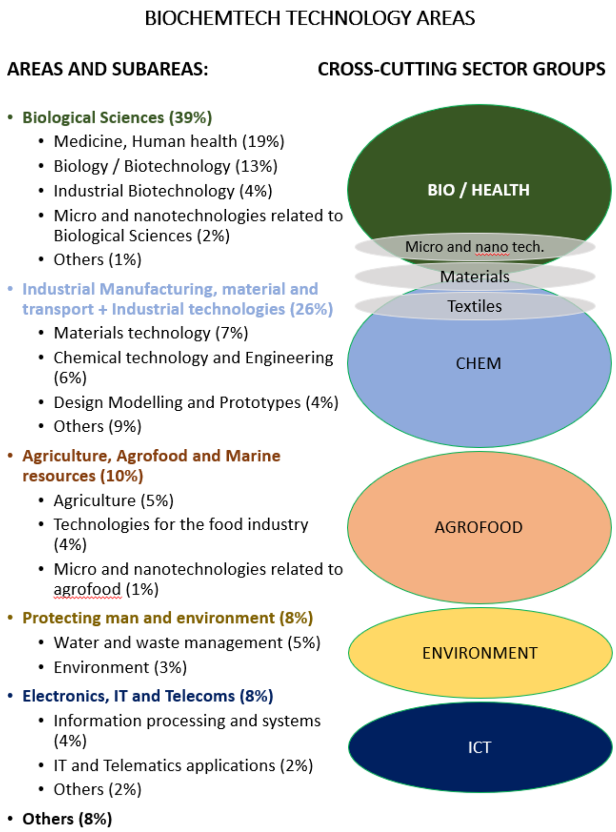

Figure 2: The incidence of EEN technology code descriptions and the representation of other cross-cutting sectors covering the same technology areas.

The field of Biotechnology is therefore interdisciplinary, which partly answers the question of why biotechnology and chemistry are classified as individual industrial ecosystems in new EU Industrial Strategy. Sectors such as biotechnology, nanomaterials, advanced materials etc. were established on the basis of ATIs, which are interdisciplinary by their nature and applicable in multiple industrial ecosystems simultaneously.

3.2 Market outreach

This interdisciplinarity can also be observed in Figure 3 representing the main markets of BioChemTech sector. Medical and Healthcare and Industrial products account for more than one half of the market, while other applications belong to various other industrial ecosystems, from Agri-food to Renewables and Digital Industries. Interestingly, there are a number of products in the ICT field intended for biotechnological applications and their development takes place hand in hand together with the ICT and BioChemTech experts as the knowledge has to be exchanged between these distinct groups of experts in order to build properly functioning medical/health/chemistry related computer applications. The said expert knowledge is intertwined in the fields of bioinformatics, assisted living facilities, electronic laboratory books, software for clinical study analyses, dietary needs, automation of laboratories, equipment management software etc.

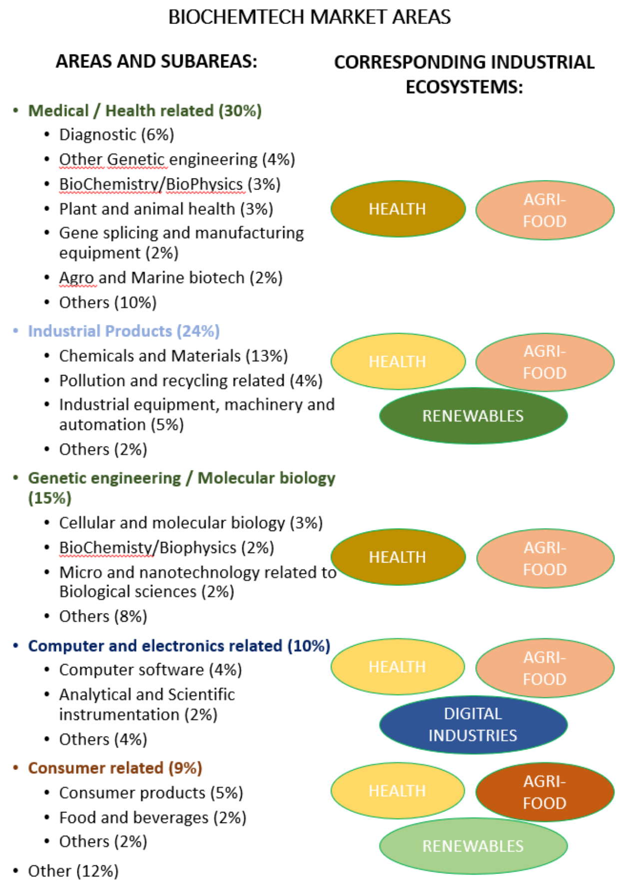

Figure 3: The incidence of EEN market code descriptions and the representation of corresponding industrial ecosystems.

It makes sense to maintain the established synergies with various industrial ecosystems, especially Healthcare and Agri-food in the upcoming years. However, from a strategic point of view, it is necessary to strengthen the integration with the Renewables and Digital industries in line with the new EU Industrial Strategy, which focuses most on digitalisation and sustainability of all industrial ecosystems [1]. For the mentioned integration, the BioChemTech sector group already seems to have established connections with the clients of the industrial ecosystems Digital industries (5% of clients from profiles) and Renewables (5% of clients from profiles), which only need to be strengthened.

3.3 Client outreach

Manufacturers of pharmaceutics, food and chemical products represent the largest share, 35% of clients of the BioChemTech sector group, while the representatives of Professional, scientific and technical activities represent only a slightly smaller share, 27% of clients (Figure 4). Almost equal representation of industrial partners and PROs should be considered as an unique opportunity for TT linking the technology demand of companies with technological supply of PROs, which is in line with the expectations of the latest Single Market Programme [2].

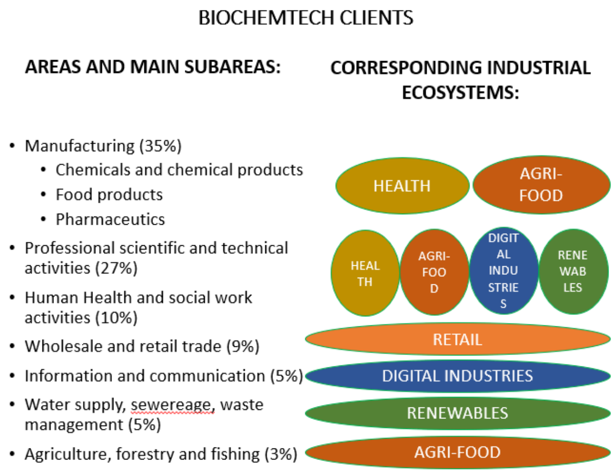

Figure 4: The incidence of NACE code descriptions and the representation of corresponding industrial ecosystems.

3.4 Opportunities for Technology Transfer

Figure 5 shows that there is a disproportionately large number of technology and business offers as compared to the number of requests. It is precisely this disparity that represents a bottleneck disabling the establishment of business and technological cooperation through matchmaking of supply and demand in commercial databases.

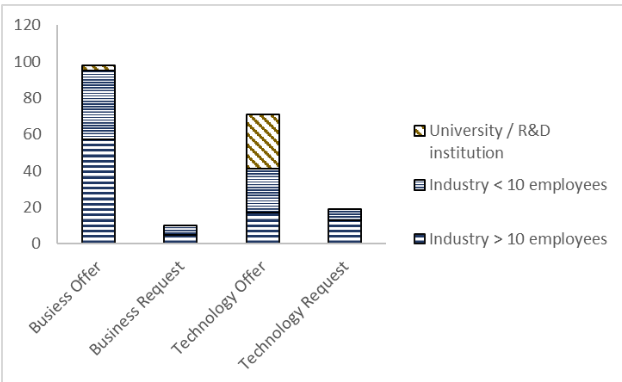

Figure 5: Number of profiles based on the profile type, organization type and number of employees in industry.

The technology offer of companies is higher as compared to the PROs at least in the BioChemTech sector. However, 58% of industrial clients in the segment are Micro Companies having less than 10 employees (Figure 5) and they are mostly start-ups and spin-offs (data not shown). Therefore, the knowledge included within the high number of technology profiles is coming predominantly from PROs. Analogously, the high number of business offers is coming from companies due to their desire to promote their products. The authors of this paper cannot find a good explanation for the low proportion of technology requests, except that they see it as a great window of opportunity for TTOs.

TTOs should play a key role in solving this problem by increasing the amount of technological requests gained from the companies. Direct marketing activities that lead to well identified topics of research with the companies by TTOs should be considered as a tool to bridge the above described lack of technological demand. For example, the direct marketing activities of Center of Technology Transfer and Innovation (CTT) at JSI include direct contacting of companies, promotion of technologies at brokerage events and other events, and physical visiting of companies: In the years 2017-2020 CTT visited 112 companies and identified 418 topics for cooperation with JSI. As a result of direct marketing CTT contributed to 35 license and 67 research and development agreements in years 2017-2020.

A relatively small proportion of the identified themes that lead to concrete agreements is best explained by well-known model of technology transfer funnel [6]. However, the TT funnel should not be taken as an excuse for not having successful commercialization cases at TTOs, but rather as an incentive to increase the quantity as well as the quality of company visits and identified topics [6].

On the other hand, in the future, the need for digitalization and sustainability is likely to arise in companies, which should have a positive impact on technology demand for digital and environmental solutions and thus positively influence the imbalance of technology supply and demand. TTOs, as experts in industrial ecosystems and technology sectors, should be able to help companies and PROs to establish collaboration and help especially SMEs to obtain national and EU funding.

4 CONCLUSIONS

Advanced Technologies for Industry (ATIs) areas are strongly intertwined (Figure 2) and have applications in several different markets (Figure 3) and consequently appear in several industrial ecosystems simultaneously (Figure 4) as shown on the case of BioChemTech sector.

The emphasis on digitalization, sustainability and environmental protection can only be established through active cross-sectoral integration, with the transfer of technologies from Digital Industries and Renewables related areas to other industrial ecosystems and the TTOs should play a crucial role, which is in line with EU Industrial Strategy [1] and the latest EU Single Market Programme [2].

Low technological demand (Figure 5) represents a bottleneck for successful TT and this paper suggests two ways of approaching this problem for the TTOs in the upcoming years:
(i) active seeking of the technological demand from companies at both national and international level and matchmaking the demand of companies with the offer of PROs;
(ii) introducing the digitalisation and sustainability to every company, which should in itself increase the technological demand of companies lacking of appropriate skills in the field of digitization and environmental protection.

The current situation is therefore a unique opportunity for TTOs that should be more adequately trained for:
(i) active searching and identifying the topics and research problems for further development and optimization of production processes and services in companies;
(ii) establishing research and development collaborations between the companies and PROs based on the interest of companies;
(iii) seeking for finance in the framework of national and EU projects for digitalization and sustainability.

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Knowledge generation in citizen science project using on-line tools: CitieS-Health Ljubljana Pilot

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ABSTRACT

In this contribution, we describe the development of a tool for data visualization and treatment designed for the participants involved in the citizen science (CS) activities in Ljubljana, Slovenia, as part of the CitieS-Health H2020 project dealing with environmental epidemiology. The tool, a web application that enables volunteers to autonomously collect, edit and analyse the data, was designed to encourage their involvement in discovering and generating new knowledge, together with professional researchers and according to the principles of co-creation. Some preliminary lessons about the tool applicability and usability, including potential intellectual property aspects, are discussed.

KEYWORDS

Citizen science, co-creation, knowledge generation

1 INTRODUCTION

In recent years, CS is on the rise and there is a growing body of literature on various aspects of CS, its role and increasing importance in scientific research [1]. There is no single definition of CS as taxonomy depends on the type and level of involvement of participants, but in general citizen science defines the practice where non-professionals take part in the scientific research process. Such an approach brings many new opportunities, such as generation of new knowledge and understanding, but it also brings several challenges. Therefore, the European Citizen Science Association (ECSA) prepared a common set of ten core principles to consider in the CS projects, one of them emphasising the need to take into consideration legal and ethical issues surrounding copyright, intellectual property, data-sharing agreements, confidentiality, attribution and the environmental impact of any activities [2].

Intellectually property (IP) rights of participants in CS projects depend on the type of their involvement and contribution. To this end, Scassa and Chung [3] outlined typology of CS projects based upon IP issues and classified participant's contribution into following four broad categories: (i) classification or transcription of data; (ii) data gathering; (iii) participation as a research subject; and/or (iv) the solving of problems, sharing of ideas, or manipulation of data. The fourth category is of special interest from the IP point of view, as it demands bigger intellectual engagement from participants [3]. This is usually the case in the so-called co-created CS projects where citizens are invited to take part in all the phases of research activities [4].

Many potentials of environmental citizen science are recognised by scientific community, among others generation of new knowledge and facilitation of (in-depth) learning at the individual level [5]. However, it is necessary to take into account that volunteers in CS projects have a very different prior knowledge, as well as socio-economic background and education, and are usually inexperienced in analysing and processing the data gathered by themselves. Their motivation to participate can also vary [6]. Thus, appropriate specific tools tailored to the capability of the individual user are needed to empower and facilitate their integration into the process of knowledge generation. In this paper, we present some preliminary results and describe an example of creating a web application designed for the volunteers to independently process their own data gathered in Ljubljana, Slovenia, under the CitieS-Health H2020 project on noise exposure and health.

2 METHODS

2.1 CitieS-Health Project and Ljubljana Pilot Activities

Activities reported in this contribution were conducted within the frame of the Cities-Health, EU Horizon 2020 programme funded project on CS in environmental epidemiology (https://citieshealth.eu/). In Ljubljana pilot, citizens took part in co-designing citizen science study that addressed noise pollution and health. Altogether, 49 volunteers aged 10-67 participated in the study from November 2020 to June 2021. They were recruited during meetings and various engagement and empowerment activities organised with local NGOs, schools, private companies and based on contacts established in previous similar projects. Following the CitieS-Health methodological framework [7] that is based on co-creation with citizens in four phases of the project – initial identification of concerns and interests of citizens, followed by co-design of data collection protocols, data collection and analysing, and action - the following overarching research question was formulated: How do the quality of the living environment (with an emphasis on noise) and living habits affect the (mental) health and well-being of individuals? To this end, volunteers performed measurements and gathered information on various aspects of their living environment (noise levels, characteristics and perception of their surroundings, sleep quality and cognitive performance) using smartphone applications and physical activity trackers (Figure 1). Apart from the sleep questionnaire, they were prompted to do all the activities twice per day (morning and afternoon), and each individual collected the data for a minimum of seven days. Overall, 75 aggregated variables were collected, and over 1000 observations made, which resulted in over 50000 records/observations all-together.

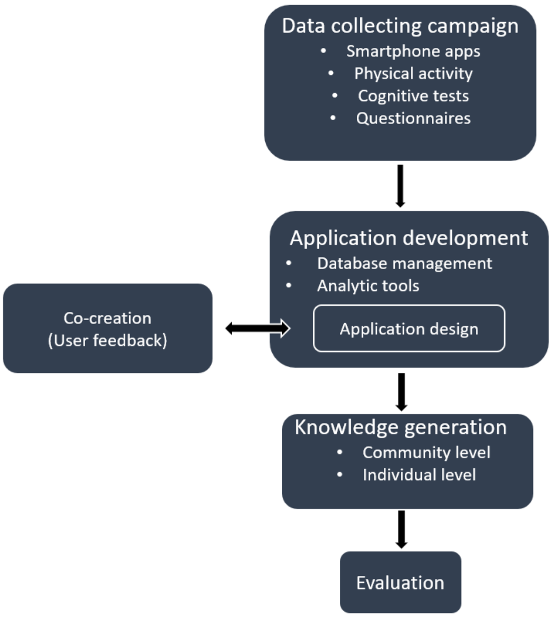

Figure 1: Schematic outline of the Ljubljana pilot

2.2 Challenges of Information Processing

As participants were collecting the data about themselves and their living environment, it was expected that they each get a personalized report on the data collected. On the other hand, participant's proactive contribution in all phases of the project, including data analysis and processing, is one of the key aspects of co-created CS projects such as CitieS-Health. However, the scale and variability of the data collected can present a challenge (60-75 variables depending on the user). Moreover, in discussion with participants in the planning and execution phase, it became clear that participants have very different interests and unalike perception on data processing. Therefore, a uniform report comprising all the topics and all the parameters might come across as too excessive and incomprehensible, at the risk of losing the desired information and consequently reducing the interest of volunteers in active participation. Moreover, as known form previous similar efforts [8], it has to be assumed that the reader is a layperson, and therefore information provided must be brief enough and concise, as too much information can create distraction. An alternative would be to send raw data to the participants, who would have to learn to use different data processing tools on their own, or the latter would have to be taken care of by researchers, which can be time consuming and not necessarily effective.

To overcome the aforementioned challenges, a web-based application was created for volunteers in Ljubljana pilot, which enables independent editing, visualization and analysis of data by participants, and thus their proactive involvement in discovering and generating of new knowledge.

2.3 Development of Web-based Application

2.3.1 Technical details. The application was developed using the R programming language, a free software environment for statistical computing and graphics, specifically the Shiny package. This environment allowed development of the application with relatively low effort and without using other languages (as the package translates the R code into HTML, CSS and JavaScript). Even though R applications are server side and are typically slow, this was not an obstacle, as the user count was sufficiently low. For reasons of data protection and privacy, the application along with the underlying databases was installed on internal institute's server. The application cleans, prepares and loads the data, and users only have access to their own data through password authentication. In this way, no data pre-treatment is needed from the participants' side, and they can proceed to immediate data processing.

2.3.2 Structure of the application. The application comprises the following four general sections: (i) the intro page, containing the overall instructions and overview of the application; (ii) data overview page, containing the overall activity summary, data tables, descriptions and graphs of individual variables, and their sleep quality assessment; (iii) data with spatial context, containing georeferenced information regarding movement patterns of the individual and noise measurements, overlaid with general maps of air and noise pollution; (iv) analysis tools, containing interactive plots allowing visualization and analyses of combinations of chosen variables. The latter comprises a boxplot/violin plot section, a scatterplot section, a radar chart section and a 3D plot section.

Following the principles of user-centred design, application was tested by three participants with varying degrees of knowledge. Their feedback and suggested improvements along with a smaller test group trial (15) helped us improve the usability of the application.

3 RESULTS

3.1 Functionality of the Web-application

In general, application enables three types of functionalities: Access to the raw data along with basic descriptive statistics, general data on the patterns of movement in space and sleeping habits, pre-processed by researchers, and specific tools for independent data processing (Figure 2). In this way, step-by-step approach is used, adding increased level of analytical complexity and dimensionality.

The main idea was to make the app straightforward and effortless for the users with no prior statistical knowledge. That's why it was designed with as few elements as possible to prevent cluttering and burdening the participants with too complex functions. Hence, some functionalities only became visible when relevant (example: the button to switch the confidence intervals on and off only becomes visible when the regression line is turned on). Moreover, the app was designed in a way that initial help sections are elementary and easily accessible (usually by hovering over a question mark or a mini tab besides the plots), with the option of deeper explanations on external links. Similar, as there were many variables to choose from, the feature of choosing between the main pre-selected variables (5 variables per argument) or all of them (between 60 and 75) was added.

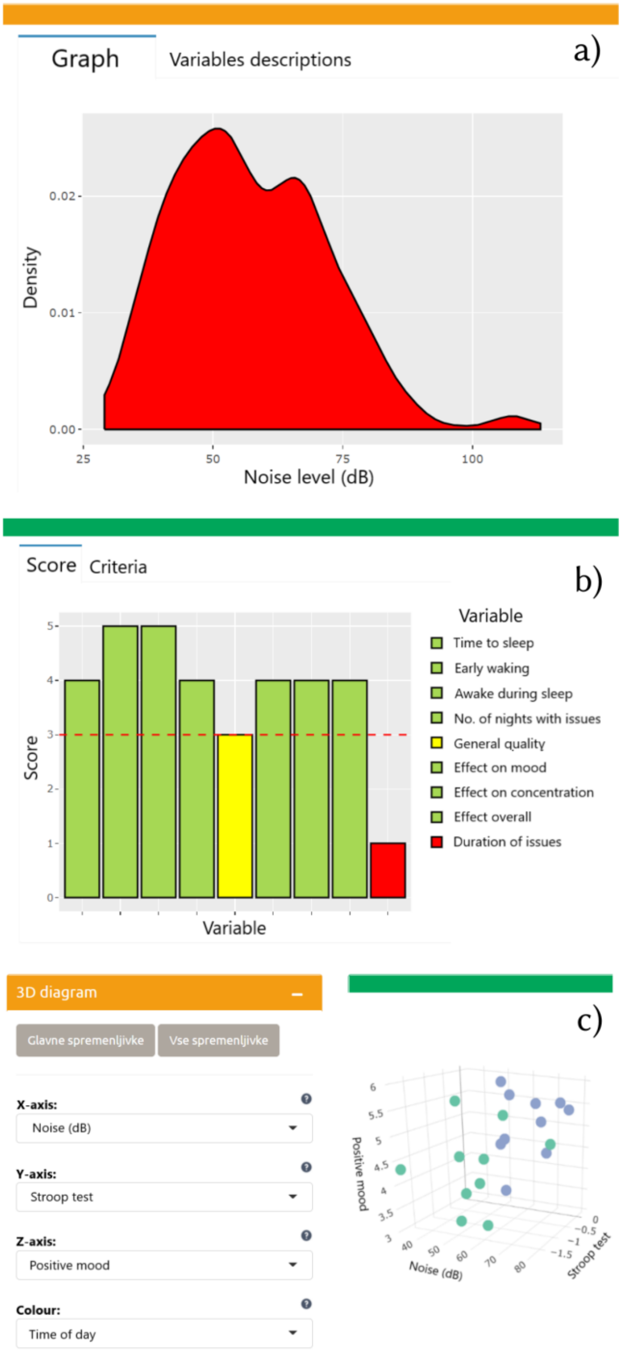

Figure 2: Examples of three types of functionalities: a) basic descriptive statistics b) general data pre-processed by researchers on general patterns of sleeping habits, c) tools for independent data processing

The primary advantage of this approach is that the users have the freedom to explore their own data, tailored according to their skills and interests. Initial descriptive statistics, general behavioural patterns and explanations are included to nudge the users in some directions, however the decision on which topics or variables they would focus is up to them. This approach offers more user-friendly experience than traditional paper reports, as it simplifies the experience and makes it more understandable for laypeople while it is not losing the professional and educational aspect.

3.2 User-experience Feedback

The results presented in this paper are preliminary in nature, as a more detailed analysis of the user experience will be evaluated in detail in the final phase of the project. However, based on the interactions with the volunteers involved so far, two general observations can be made. Lay volunteers show interest primarily in their own data and the level of their own exposure to environmental stressors, and are mostly interested in exposure to noise in the light of living habits, data on physical activity, and especially the quality of sleep. On the other hand, volunteers who have more experience with research, either within their profession or in general, recognize the added value of such tools. Among other things, it was proposed to expand the use of such an application for the continuous collection of a wider set of data in the living environment for the purposes of assessing the state of the environment, also as an aid to the work of inspection services and decision-makers.

4 CONCLUSION

The tool developed for the specific needs of the specific citizen science project described in this paper proves to be a very promising solution with the possibility of expanding its applications. Namely, it enables the interactive inclusion of lay people in data analysis, which gives them a personalized experience, maintains their engagement, and at the same time, in addition to creating new knowledge for the common good, users gain insight into their own living habits and quality of life. Its full potential however still needs to be explored. For this purpose, an evaluation will take place in the final phase of the project, where among others aspects of intellectual property, specifically if and to what extent participants perceive these aspects, as well as the possibilities of using newly acquired knowledge as a result of cooperation between researchers and volunteers acquired in the respective activities, will be analysed.

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Overview of National Sources of Finance and Supports Available to Spin-Out Companies from Public Research Organizations *

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ABSTRACT

At Slovenian public research organizations numerous advanced technologies and know-how are generated, a lot of which have great commercial potential. One of the possible ways to bring these innovations to the market is by selling or licensing them to spin-out* companies established by the researchers, employed within the parent public research organization. However, the path to commercialization for the spin-outs can take a long time, mainly due to a lack of financial resources and the legal impossibility for the public research organization to participate in spin-off companies. Especially spin-out companies from the deep-tech fields require not only specific technical and business expertise, but also high capital investment. On the national level, there are available public sources of funding that can help companies in the initial phase. In general, these means are adequate for start-ups with no needs for special equipment, expensive materials, and highly qualified human resources, and so don't meet the financial needs of a deep-tech company.

In this paper, an overview of the existing financial initiatives, helps and sources of funds, which can be used to support spin-outs are given and some improvements are proposed that would make it easier for young spin-out to get off the ground and thus enable more effective transfer of deep-tech inventions and knowledge to the economy.

KEYWORDS

IP transfer, spin-out company, commercialization, financial initiatives, help, funds.

POVZETEK

Na slovenskih javnih raziskovalnih organizacijah nastajajo številne napredne tehnologije in znanje, ki imajo velik tržni potencial. Eden od možnih načinov komercializacije potencialnih inovacij je prodaja ali licenciranje spin-out**podjetjem, ki jih ustanovijo raziskovalci, zaposleni v matični javni raziskovalni organizaciji. Pot do komercializacije spin-out podjetja je dolga, predvsem zaradi pomanjkanja finančnih sredstev ter zakonsko onemogočenega sodelovanje javnih raziskovalnih organizacij pri ustanavljanju odcepljenih podjetij. Zlasti spin-out podjetja s področij globoke tehnologije zahtevajo poleg posebnega tehničnega in poslovnega znanja tudi visoke kapitalske naložbe. Na nacionalni ravni so na voljo javni viri financiranja, ki lahko pomagajo podjetjem v začetni fazi. Na splošno so ta sredstva primerna za zagonska podjetja brez potreb po posebni opremi, dragih materialih in visokokvalificiranih človeških virih, zato ne zadovoljujejo finančnih potreb odcepljenih podjetij s področja globoke tehnologije.

V tem prispevku je podan pregled obstoječih finančnih virov, uporabnih za podporo spin-out podjetjem. Predlagane so nekatere izboljšave, ki bi mladim spin-out podjetjem olajšale zagon in tako omogočile učinkovitejši prenos izumov in znanja s področja globoke tehnologije v gospodarstvo.

KLJUČNE BESEDE

Prenos IP, odcepljeno podjetje, komercializacija, finančna orodja.

1 INTRODUCTION

Knowledge and technology established at public research organizations in Slovenia are commonly transferred to the economy through the sale of the intellectual property rights, by licensing the technology to an existing company, or by setting up a new spin-out company. A spin-out is a new company established specifically to further develop and commercialize technology arising from the public research organization. The relationship between a spin-out company and its parent public research organization is in most cases based on a licensing relationship. The spin-out company is 100% owned by investors, of which at least one is a researcher in a working relationship with the parent public research organization.[1] Such an organization ensures the best possible and successful transfer of knowledge and close cooperation in the future.

Like all of the young companies, i.e. start-ups, the initial founding of a spin-out comes from the equity funding from founders also known as the 3F model (family, friends, and founders). A key difference between spin-outs and start-ups is the path to commercialization, which is much longer for spin-outs. A deep-tech spin-out usually aims to commercialize a complex product that acquires a long development and scale-up to manufacturing. The more complex the product, the more resources and time are required to bring it to the market. Before a young spin-out can generate sufficient revenues on the market and become attractive to outside investors, it has to live on various sources of funding, mainly public funding, which is commonly aligned with the needs of start-up companies and already established companies, but less suitable for deep-tech spin-outs. Commercialization of deep-tech technologies requires

* A company linked to the parent organization based on licensing relationships (the company is wholly owned by investors, at least one of whom is a researcher in an employment relationship at the parental organization).[1]**Napaka! Vira sklicevanja ni bilo mogoče najti.**

** Podjetje, povezano z matično organizacijo na podlagi licenčnih razmerij (podjetje je v celoti v lasti vlagateljev, od katerih je vsaj eden raziskovalec v delovnem razmerju v matični organizaciji).[1]

besides highly skilled personnel, the resources for expensive materials and specialized equipment. An excellent example of financial support to commercialize deep-tech technologies are the calls supported by the European Innovation Council (EIC), e.g. programmes Pathfinder, Transition, and Accelerator.[2] These calls allow the applicant, e.g. a spin-out company, to develop according to the innovative idea, to develop the appropriate marketing model, to elaborate and scale the new product up to pilot production and to find first customers. Coaching and specific meetings are organized to connect directly with the companies that are the potential end-users of the product or service to be developed. In this way, the pilot product can be transferred to a suitable industrial environment at an early stage of development, and based on the received feedback adapted and optimized. It should be noted that EIC calls are overcrowded with applicants and the success rate is very low, so very few spin-outs get this chance. It is clear that most action should be taken at national level first. A good national funding mechanism would be welcome to create a supportive environment also for spin-out companies in the deep-tech fields that bring particular innovation and specialized knowledge.

2 PUBLIC SOURCES OF FUNDING

For newly establishes Slovenian companies there are few means of funding especially through the Slovenian Enterprise Fund, which, together with SID Bank and with the support of the Ministry of Economic Development and Technology, offers a wide range of financial incentives and assistance. In the following subchapters, we summarized and reviewed the available public funding's in the terms of support for a spin-out company. Only the support important for spin-out companies is discussed, although there is additional support available for established businesses.[3]

2.1 Grants

The aim of support of grants is primarily for research and development activities that are in line with the national and/or EU programme and policy priorities. The grants enable some coverage of costs for human resources and certain investment activities. Support in form of grants can also be called by larger EU initiatives and independent bodies, such as EIT Climate KIC [4], EIT Digital [5], EIT Food [6], EIT Raw Materials [7] other EITs, Bio-based Industries (BBI) [8], etc.[3] The aim of the European Institute for Innovation and Technology (EIT) is to increase Europe's innovation capacity by nurturing entrepreneurial talent and supporting new ideas. To make this possible, the EIT sets up various Knowledge and Innovation Community, (KICs) specialized in different challenges, such as climate, digitalization, food, raw materials, energy, etc. One of their activities is also grants for start-ups. They offer business-oriented acceleration programmes and aim to prepare a company for greater growth in the region and make it investment-ready. Usually, numerous entrepreneurial training courses are offered to boost the business. These services are highly appreciated and help the new business to secure the best possible path. However, a lean spin-out, especially from the cutting-edge technology sector, usually does not have free human resources that can be used only for these tasks. Most deep-tech spin-outs see the biggest gap in raising the technology level of their innovative product, especially above TRL5 where the technology needs to be demonstrated and developed into the real product. Most deep tech inventions require a long and costly development to raise the TRL and make all the necessary adjustments and scaling. Very few options are available to finance these needs and the grants described are not very suitable although they are welcome.

2.2 Subsidies, loans, guarantees, and equity

These funds are derived from EU financial assistance to support EU policies and programmes in form of all types of loans to companies to invest in research and innovation. It also provides guarantees to help recipients get loans from banks and other lenders and on better terms. In Slovenia, these funds are mainly managed by Slovenian Enterprise Fund (SEF) and SID Banka.[3]

2.2.1. SEF Programme »YOUNG ENTERPRISES«

In the scope of a newly formed spin-out company, the Slovenian Enterprise Fund (SEF) offers the product Programme »YOUNG ENTERPRISES« for companies younger than 5 years. The purpose of the programme is to provide the initial financial support for entrepreneurial ideas and/or for already established young companies that have a guaranteed market and demonstrate the potential increase in added value per employee. The programme is primarily aimed at companies with a high share of their own knowledge, innovation, and the potential of creating products or services with high added value. It enables a comprehensive financial support adapted to development phases for young companies with initial support solely through public funds and subsequent public-private financing. There are few supports available in regard to the company's stage of development among which the most adequate for new spin-out is the start-up Incentives for innovative start-ups "SEF TWIN". It purposes the support of start-up companies with a potential for rapid growth and that develop innovative products, processes, and services with high added value for a broader market.[9]

The "YOUNG ENTERPRISES" programme is highly welcomed and appreciated by start-ups with innovative ideas that do not require much effort to reach the required TRL. Such examples include various IT -based services and interesting products that are high risk but can be developed to the development stage with relatively little funding. In contrast, cutting-edge technology areas typically require much larger investments in equipment, materials, and various human resources with specialized technical knowledge and skills. The time required for growth is usually much longer. It is very likely that most of these companies would not be able to sustain the financial incentives of the programme because of the time and resources required to grow rapidly to the stage where venture capital could be available.

In many cases, eligible costs serve almost exclusively IT -based start-ups and allow for the purchase of computers and related equipment, but not materials, such as chemicals, or special equipment needed to develop the new products. Nor can they fund the rental of laboratory space, which is urgently needed for the development of cutting-edge technology inventions. For this reason, the programme mainly includes SMEs with interesting but technologically relatively simple products, but not many spin-outs from research institutes and university operating in the deep-tech field of innovation. [10]

Another instrument implemented by the SEF are the substantive support programmes in form of vouchers such as Small Value Incentives, Content support for young innovative companies, and Abroad training for high-tech companies.[9] The support enables the financing of e.g. intellectual property protection, certificates of quality, internationalization costs, networking and information, fast-growth accelerator programmes. For example, the Patent, design, trademark vouchers are meant to cover the costs of preparing the application dossier and/or maintaining and/or extending legal protection for the intellectual property at national, European and international patent offices, including the costs of the patent attorney, official fees and translation costs. The available means are between 500,00 and 5.000,00 € for applications without substantive examination and between 500,00 and 9.999,99 € for applications with substantive examination. Based on practical experience this amount is enough to cover the cost from application till grand at individual national offices, such as the SIPO, UK IPO or at the European Patent Office (EPO).[10]

2.2.2. SID Bank Fund of Funds

The SID Bank Fund of Funds was set up in 2017 by the Ministry of Economic Development and Technology and SID Bank and is intended for the use of European cohesion funds. These funds are aimed at the financing of sustainable economic growth and, development, investments in innovation and current operations through debt financing in four areas: research, development and innovation, small and medium-sized enterprises, energy efficiency, and urban development. The Fund of Funds includes many repayable forms of financing, which are extremely welcome at later stages of development, i.e. at higher TRLs, especially after reaching TRL9. At this stage, a deep-tech SME is fully confident in its successful technology and knows exactly what investment is required to develop pilot production into real production and grow the business beyond early adopters and byers. The instruments managed by the SID Bank which can be of interest to spin-out companies are the (i) Loans to finance research, development, and innovation (RDI) (enable to cover the cost of development, improvement or launch of a new or improved product, process, or service, etc.) and (ii) Micro loans for SMEs (SME micro) (applicable to cover the costs of business process, investments in property, plant, and equipment). These instruments draw funding from the European Cohesion Policy funds and funds from financial intermediaries. However, for earlier TRL stages, the Fund of Funds is most likely too risky, especially for deep tech.[11]

2.3 Awards

Lower financial support is possible to be obtained through innovation prizes such as the Rector's Award for the Best Innovation at the University of Ljubljana [12], EIT Jumpstarter [13], EIT Awards [14], BASF Innovation Hub [15], etc. Such awards are important to raise awareness of the novelty and publicize the spin-out company, but too early notes could also mean too much of a push in a particular direction that could become a side track.

2.4 Benefits

The national Corporate Income Tax Act (ZDDPO-2) enables spin-out companies benefits in form of tax deductions which are possible to claim corporate income tax (CIT) tax deductions for 100% investment in research and development, investment in in-house R&D activities and for the purchase of R&D services, investment in equipment and intangible assets at 40 % of the amount invested.[16] It should be noted that these benefits do not include the investments made with the help of the projects, not even the part in which the company has to participate. This part ranges from 30% to 50% or even higher, depending on the financing arrangements of the instrument. This can be a large amount, especially for large investments in specialized equipment likely required by the deep-tech.

2.5 Non-financial forms of public aid

Non-financial forms of state aid are available through support environments and networks across Slovenia. They offer assistance mainly as services for potential entrepreneurs, and SMEs, such as technical assistance, advice, mentoring, guidance, workshops and training, competence building, opening up new business opportunities and exchanges of good practice.[3]

3 WHAT IS MISSING

3.1 Venture capital fund along the lines of the EIC

Support should be developed along the lines of the European Innovation Council (EIC), which is an example of good practice that should be transferred to Slovenia.

The steps needed to set up such a support would first and foremost require an appropriate legal basis, which is currently lacking - this could change with the new Research and Innovation Act, we are expecting soon. Furthermore, it is necessary to ensure coordinated action and support from funders - Slovenian Research Agency (ARRS), Public Agency for Entrepreneurship, Internationalization, Foreign Investments and Technology (SPIRIT), Slovenian Enterprise Fund (SEF), and other existing or future funders of such projects. In this way, coordinated and continuous funding of successful projects on the area of higher TRLs could be ensured, without interruptions in the (co-)financing of the development of a specific technology.

3.2 Innovation projects at national research agency – the new financial instrument to balance the basic science funds

To develop innovation at the scale required, especially for deep-edge technology, we need a new funding instrument. This instrument is best located at ARRS, which currently with the new law needs to upgrade its funding of science with innovation funding.

Beneficiary projects should be funded at a realistic cost of 100,000.00 € per year upwards (similar to the ERC Proof of Concept grants, which offer a lump sum of 150,000.00 € for a period of 18 months) [17], comparable to the projects and funding levels of typical basic research projects at ARRS. The Agency also finances the so-called larger research projects with higher funding. The allocation of funds for innovation projects should consider the real costs of the project and not a fixed amount which is current praxis for research projects. In view of the final added value that could be generated by the company with such support, the proposed sum is actually low. The number of innovation projects selected should be in line with the number of projects awarded for basic science at national level.

The envisaged financial support should finance promising research that has already been funded as a basic research project by the ARRS and as such should have priority for funding. This would achieve greater funding coherence and justify the rationality of funding basic research and ensure higher added value of funding that if serving just excellent science. Additionally, it would create systematic and continuous financial support in Slovenia from idea to market entry, especially in the field of deep-tech. This is a basic requirement for entering the innovation-based community and could bridge the gap between basic science and the start-up opportunities already available in Slovenia.

3.3 Other possibilities

In order to improve all opportunities to make our original deep-tech knowledge available to the economy, especially that generated by spin-out companies as a result of the pre-funding of basic research, we recommend that the other financial initiatives adopt some changes. To this end, the SEF programme "YOUNG ENTERPRISES" could make appropriate changes to support SMEs with more complex needs. It should also be thoroughly discussed whether the corporate tax deductions for investments in in-house R&D activities and for the purchase of R&D services and equipment during an R&D project are also possible for the part that the company has to co-invest through its own participation.

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Note: Researcher who wish to establish a spin-out company can acquire more information at the Technology Transfer Office of the parental research organization.

Application of 3D printing, reverse engineering and metrology

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ABSTRACT

Examples of transfer of knowledge in the field of 3D printing, reverse engineering, and metrology will be presented in this paper. The first chapter contains the description of the concept of the Learning Factory, within which knowledge is created and transferred to the economic entities in the environment. Technologies of 3D printing, reverse engineering, and metrology are subsequently described and various examples of development projects for the local industry are presented. A conclusion regarding the realized activities is given at the end.

KEYWORDS

3D print, reverse engineering, metrology, Learning Factory, transfer of knowledge

1 INTRODUCTION

The Learning Factory at the Faculty of Mechanical Engineering, Computing and Electrical engineering (FSRE) has the basic goal of enabling students to experience many problems that will be present in the production facilities where they will soon be operating. At the same time, the Factory also provides engineers from local companies with the opportunity to get acquainted with new technologies that were not present at the time they were studying.

The set goals are achieved through several projects: “Reconnecting universities and enterprises to unleash regional innovation and entrepreneurial activity” (Kno wHUB) and “Increasing competitiveness of micro, small and medium-sized enterprises through digitalization” (IC SMED). The main goal of the KnowHUB project is to build HUBs as a link between higher education institutions, the business environment and the wider community. The main goal of the IC SMED project is to increase the competitiveness of micro, small and medium enterprises with the help of digitalization. Through these projects, conditions have been established to help and support local businesses in the areas of 3D printing, reverse engineering, and metrology. Students, assistants, and engineers from local companies are introduced to 3D printing, 3D scanners and 3D scanning through practical examples. Also, they can actively participate in the development and adjustment of materials for the implementation of training and laboratory exercises, as well as in the organization of training, laboratory exercises and exercises on real examples. The practical work of printing and scanning objects is done in the premises of the Learning Factory.

[*]Article Title Footnote needs to be captured as Title Note

[†]Author Footnote to be captured as Author Note

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2 3D PRINT, REVERSE ENGINEERING AND METROLOGY

2.1 Rapid prototyping - 3D print

Several 3D printers were procured at FSRE through the project.

• Stratatys F 270 is an industrial type of F123 series printer with FDM technology. It uses materials for model/support: PLA, ABS-M30, ASA, TPU, 92A/QSR.

• MakerBot Method X Carbon Fiber Edition uses carbon fiber reinforced material, ABS, ASA, SR30, PLA, PVA.

• Zortrax M200 Plus uses LPD/FFF printing technology. It uses dedicated M series material.

• Ultimaker 2+ is a small 3D printer that is programmed within the Cura software package. The software is easy to use and allows you to move objects, load multiple objects for printing, and change resolutions and other settings.

2.2 Reverse engineering in general

Modern manufacturing companies that want to maintain and improve competitiveness in the global market are forced to systematically update existing and find new ways to reduce operating costs in all aspects of their operations.

The process of transforming an idea into a functional product consists of a series of steps that in some cases can be iterated several times. Such a setting implies a significant expenditure of time and financial resources during the product development process, without a guarantee of a positive outcome of the entire process. These reasons were sufficient to try to find ways and methods of shortening the time of product development and spending financial resources related to the product development process in everyday engineering practice. One of the ways of reducing the time and cost of the new product development process is reverse engineering.

In a narrower sense, reverse engineering can be defined as the process of duplicating an existing component, assembly, or product, without the aid of a drawing, technical documentation, or computer model (Figure 1). In the context of the aforementioned, the technique of reverse engineering can be applied to analyze and study the internal working parts of the machine, for example, to compare the current device with the performed analyzes in order to obtain suggestions for improvement.

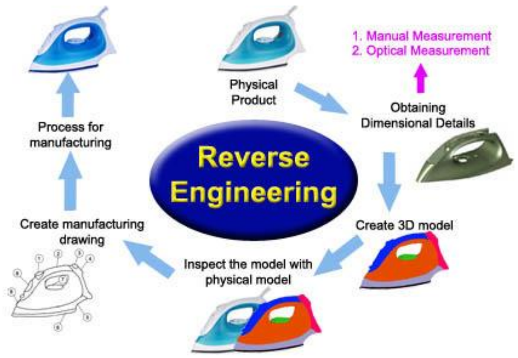

Figure 1. Reverse engineering process [1]

Unlike "classical" engineering design that starts from the abstract - the idea implies its elaboration through conceptual and then detailed CAD design, design based on the principles of reverse engineering begins with a physical object which is then translated into a CAD model, possibly adapted or refined and in the end manufactured by one of the CNC, that is, RP technologies [2].

2.2.1 Reverse Engineering and Metrology at FSRE In the "Learning Factory" at the Faculty of Mechanical Engineering, Computing and Electrical Engineering, within the KnowHUB project, several tasks related to the topic of reverse engineering were performed. 3D digitization, for example, scanning of workpieces is performed using the scanner GOM ATOS Compact Scan 8M. Processing is done within the GOM Inspect Suite 2020 software package, and CAD model generation is done using the reverse engineering tool Geomagic for SolidWorks.

2.2.1.1 GOM ATOS Compact Scan. A new class of compact 3D scanners for 3D metrology and control (Figure 2). Light, compact construction of the trigger probe opens new areas of application and provides adaptability for three-dimensional measurement of components such as cast and injection molded parts, cores and models, interiors, prototypes, and similar. Adopts blue light technology, combines scanning and measurement, adjustable measuring range, complete and portable measuring system, compact trigger probe with integrated control unit, etc.

Figure 2. 3D scanner within the FSRE Learning Factory

2.2.1.2 GOM Inspect Suite. GOM Inspect Suite is a comprehensive software package for simple or complex measured tasks during the entire quality control process - from 3D product scanning, polygon network editing, CAD model import, GD&T analysis, statistical trend analysis, digital editing, etc. (Figure 3)

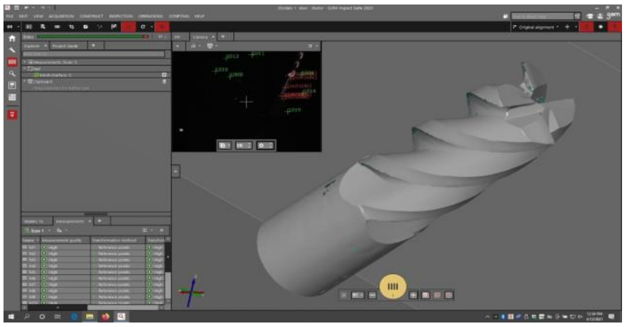

Figure 3. The appearance of the workspace inside the GOM scanning module

2.2.1.3 Geomagic for SolidWorks. Represents a set of software tools for reverse engineering that provides advanced capabilities for point clouds and polygon networks to become usable in the product construction and redesign process. Data can be imported or scanned directly into SolidWorks. Supports all major scanners and portable CMMs as well as importing standard point cloud and network formats.

2.3 Metrology in general

Metrology is a scientific discipline that deals with measurement in all its theoretical and practical forms. Basic metrology deals with the scientific assumptions of measurement, technical metrology covers the procedures and methods of measurement, and legal metrology covers the applications prescribed by law. Metrology includes all theoretical and practical aspects of measurement, deals with methods of measuring physical quantities, realization, and maintenance of standards of physical quantities, development and production of measuring instruments, and analysis of measurement results. Metrology has been developed to the level of applied science.

2.4 Integration of rapid prototyping and reverse engineering processes

With the help of the characteristics of the process of rapid prototyping and reverse engineering, the possibilities provided by their combination and adequate application provide numerous advantages that are primarily reflected in the ability to reduce time and reduce costs of product development/redesign, and in certain conditions in the production of tools and ready-to-use products. The integration of these approaches ensures the transition of the problem of transformation, that is, the translation of a virtual product from a digital form stored in the appropriate CAD software into a real tangible form-object and vice versa (Figure 4). Namely, reverse engineering ensures the generation of 3D CAD models based on a real object, and the model is transformed into a suitable real prototype/product relatively quickly and without significant human involvement by applying the process of rapid prototyping.

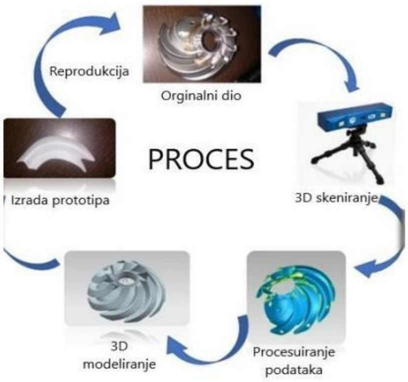

Figure 4. Integration process [3]

3 APPLICATION OF 3D PRINT, REVERSE ENGINEERING AND METROLOGY

Various examples of the application of 3D printing, reverse engineering, and metrology will be presented in this chapter.

3.1 Reverse engineering applied on metal joints for FSRE

The task aims to generate a CAD model (original geometry or redesign) of metal couplings with the intention of small series production (3D printing technology) for the needs of the "Learning Factory" if the prototype satisfies during testing (Figure 5).

All aforementioned elements were made with 3D printing technology after scanning and processing (Figure 6).

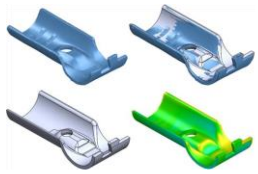

Figure 5. Reverse engineering on G-1S connector (polygonized mesh - scanned piece and CAD model - CAD model - deviation display)

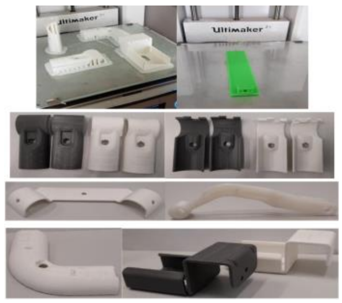

Figure 6. Scanned elements made with 3D printing technology

3.2 Reverse engineering on the example of a pulley for the local company "ZEC"

This task aimed to use reverse engineering to obtain the geometry of the pulley profile using a CAD model to make an equal part since the original part is frayed (Figure 7).

Figure 7. Scanned pulley, 3D model of the pulley and deviation display

3.3 Reverse engineering on the example of a part of a plastic injection tool for a local company "Weltplast"

The task aims to generate a 3D model of a part of a plastic injection tool since the original part is frayed (Figure 8).

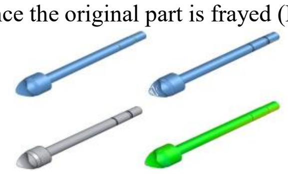

Figure 8. Reverse engineering on a part of a plastic injection tool

3.4 Reverse engineering on the example of dental spoons for the local company "MA-COM"

This task aims to create a CAD model (and technical documentation) of dental spoons for taking dental impressions (Figure 9).

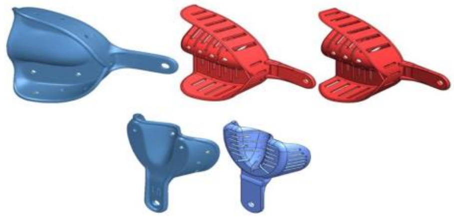

Figure 9. Scanned spoons U1 and U4 and redesign of the spoon

3.5 Reverse engineering applied on a lever for the company "SIK"

The task aims to create a new lever with 3D printing technology using the process of reverse engineering (Figure 10).

Figure 10. Reverse engineering on a lever

3.6 Reverse engineering applied to the pool shutter

The task aims to create documentation based on a damaged shutter and then create a new part by reverse engineering and 3D printing.

In this specific case:

- No spare parts on the market
- No shutter drawing
- No tools for making shutters

Shutter requirements:

- Must be made with 3D printing
- The material must be elastic due to the installation requirements
- The material must be resistant to sunlight

A drawing of the shutter in SolidWorks and a prototype of the shutter obtained by 3D printing are shown in Figure 11.

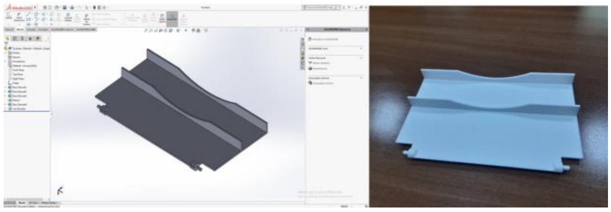

Figure 11. Drawing of the shutter on the pool and a prototype of the shutter made by 3D printing

3.7 Metrology applied on a milling cutter for the company "Škutor"

In the FSRE Learning Factory, several tasks related to the topic of metrology were performed.

The objects that have to be measured were first subjected to a scanning process performed using a GOM ATOS Compact Scan 8M scanner. The measurement process itself is performed within the GOM Inspect Suite 2020 software package within the measurement module [4].

The task aims to determine the dimensions of cutters with a diameter of Ø20 and Ø12 and to prepare accompanying documentation ((Figure 12).

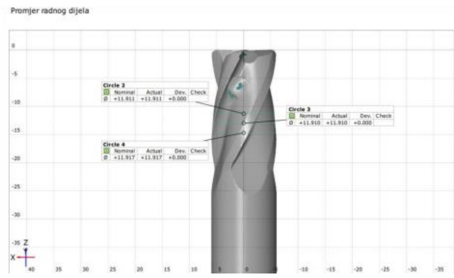

Figure 12. Display of the measurement report page

4 CONCLUSION

The technology of rapid prototyping with 3D printing in combination with a 3D scanner and appropriate software using reverse engineering can significantly speed up the path to the finished product, which is extremely important for relevant companies.

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Towards the Market: Novel Antimicrobial Material

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ABSTRACT

The Jožef Stefan Institute has developed novel antimicrobial nanogold composite and patented it (EP2863751 B1). In comparison with widely used silver, the material is less toxic to human and environment and has better antibacterial properties. Good antiviral effect has also been shown. In the period 10/2020-04/2021 the technology for applying this material on textile has been developed within KET4CleanProduction project. This was an important step towards higher TRLs. Before entering the market, the novel material must be tested according to Biocidal Product Regulation (EU No 528/2012). This includes toxicity and efficacy testing and submission of the dossier to European Chemical Agency. In order to successfully enter the market, suitable industrial partner which will scale up the production of the material and commercialize it is needed. Horizon Europe calls represent interesting financial tool to support this endeavour to reach higher TRLs.

KEYWORDS

technology transfer, antimicrobial material, gold, proof of concept study, technology readiness level

POVZETEK

Institut "Jožef Stefan" je razvil nov protimikrobni kompozit na osnovi zlata in ga patentiral (EP2863751 B1). V primerjavi s široko uporabljenim srebrom je material manj strupen za ljudi in okolje ter ima boljše protibakterijske lastnosti. Dokazan je bil tudi dober protivirusni učinek. V obdobju 10/2020-04/2021 je bila v okviru projekta KET4CleanProduction razvita tehnologija za nanašanje tega materiala na tekstil. To je bil pomemben korak k višjim stopnjam TRL. Pred vstopom na trg je treba novi material preskusiti v skladu z Uredbo o biocidnih proizvodih (EU št. 528/2012). To vključuje testiranje toksičnosti in učinkovitosti ter predložitev dokumentacije Evropski agenciji za kemikalije. Za uspešen vstop na trg je potreben ustrezen industrijski partner, ki bo povečal proizvodnjo materiala in z njem vstopil na trg. Razpisi programa Horizon Europe predstavljajo zanimivo finančno orodje, ki podpirajo tako prizadevanje za doseganje višjih stopenj TRL.

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KLJUČNE BESEDE

prenos tehnologije, antimikrobni material, zlato, študija preverjanja koncepta, stopnja tehnološke zrelosti

1 INTRODUCTION

In year 2012 DDr. Marija Vukomanović published her second PhD thesis with title 'Sonochemical synthesis and characterization of hydroxyapatite/metal-based composite materials for biomedical applications' which represented the work performed at the Advanced Materials Department, Jožef Stefan Institute [1]. Furthermore, the research group identified an invention that was made within this work – a novel antimicrobial material and its production method. Together with the Institute's Center for Technology Transfer and Innovation technology and market potential was evaluated. In the same year, a Slovenian patent application was filed. Due to high potential of the technology a PCT application was filed next year and in the beginning of 2015 an entry in European phase was made. In the period 2015-2018 European patent office examined the patent application and expressed their opinion about patentability. Necessary modifications of the claims were made and the European patent EP2863751B1 was granted in 2018 and no opposition has been filed afterwards [2].

2 ANTIMICROBIAL MATERIALS

Novel trends in developing antimicrobial technology are associated with the use of multifunctional nanosystems. The challenges for the use of nanotechnology are focused into: (i) nanoparticles loaded with antimicrobial substance(s) able to control their release and (ii) "nanoantibiotics" – nanoparticles with antimicrobial nature. The main drawback of the first strategy is dependence of the released substance on the properties of the carrier that provides conditions potentially favourable for bacterial resistance. The second strategy is based on the development of novel antibacterial nanoparticles and it has been applied for many different materials including silver, copper-, titanium-, zinc-, cerium- oxides, doped hydroxyapatite, carbon nanotubes, NO-releasing nanoparticles, fullerenes and clay nanoparticles. Among all of the listed materials, silver is the most economic and most effective in action against various bacterial stains. However, as for the silver, the majority of listed materials are leaching and they release active component (particularly reactive oxygen species) which provides action against bacteria. The mechanism is highly non-selective and has the very similar contribution to the death of bacterial cells as to the death of mammalian cells. Even composites with bioactive component (like apatite) do not mitigate toxic effect of silver and selectivity indexes remain quite low [3].

Contact- based antimicrobials, designed to perform antimicrobial action without leaching any active substance, are exceptional solution for above described problem. Mainly designed as functionalized polymers, contact-based antimicrobials usually contain high density of charged functional groups (i.e. quaternary ammonium compounds, alkyl pyridiniums, or quaternary phosphonium). They use multiple charges to attach and interact with bacterial membranes providing their disassembly. As observed in antimicrobial peptides and polymers, the main limitation of these systems is low chemical stability, pronounced susceptibility to enzymatic degradation and conformational changes induced by environmental stimuli. These are very good targets for potential inactivation mechanism that will lead to losing their antimicrobial potential.

Innovative contact-based antimicrobials, based on functionalized gold, invented by our group at the Advanced Materials Department, Jozef Stefan Institute, is a step ahead in comparison to the common contact-based antimicrobials and very promising alternative (Figure 1) [4]. They use surface-associated guanidinium groups to physically disintegrate bacterial cells. Bactericidal effect is enabled in a range of gram + and - bacterial strains and is associated to the surface potential of bacterial membranes. Due to bioinert gold and natural-sourced functionalizing agents, concentrations toxic to human and animal cells are up to 20 times higher than biocidal, confirming high selectivity. In addition, since they are functionalized using direct bonding of charged, small molecules to the surface on nanoparticles (rather than formation of long polymeric chains) they keep their stability under different environmental stimuli, including presence of enzymes. With better stability and safety, the novel kind of contact-based antimicrobials is overcoming general difficulties with common contact-based antimicrobials and significantly decreases possibility for inactivation.

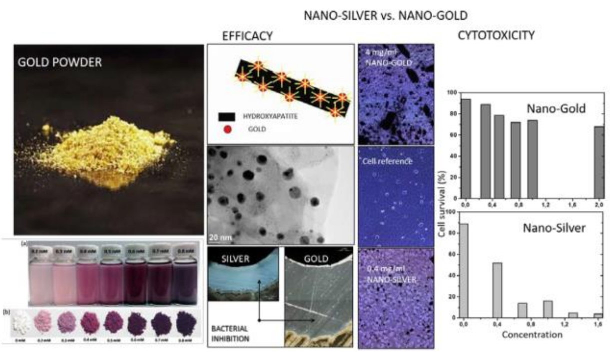

Figure 1: Current state of the invention: gold powder its efficacy and cytotoxicity in direct comparison to nano-silver.

3 TOWARDS HIGHER TRLS

3.1 Initial steps in finding R&D partners

After filing the priority Slovenian patent application for the novel antimicrobial material first attempts to establish connections with relevant industry partners have been made. These efforts have been enhanced by the Center for Technology Transfer and Innovation (CTT) after the European patent was granted.

CTT has used several channels and media to promote the invention and find suitable partners to reach higher TRLs. The initial step was to publish technology offer in Enterprise Europe Network, which is the largest brokerage network for companies (SMEs and others), research institutes and universities. It brings together 3,000 experts from more than 600 member organizations from Europe and beyond [5]. The technology offer is published for maximum two years and has to include information about the technology, owner organization, advantages and innovation, information about partner sought, cooperation type and keywords. Enterprise Europe Network includes also topic specific groups, called Sector Groups. The invention was presented and promoted in SG Materials in which we also have a member.

In 2018 the innovation was presented at the International Exhibition of Inventions ARCA, Zagreb Croatia with the help of partners from the Slovenian Consortium of Technology Transfer (Figure 2). A silver medal was awarded for this innovation [6]. This contributed to general promotion of the invention.

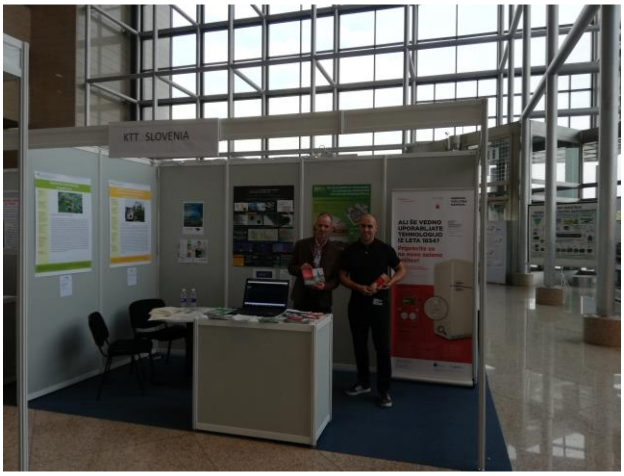

Figure 2: Presentation of inventions at the International Exhibition of Inventions ARCA, Zagreb, Croatia.

As antimicrobial materials can be applied in many different fields (cosmetics, medical devices, plasters, filters, paints, dentistry, textile etc.) it was hard to decide and look for a partner from specific industry so we decided to make a broad search of partners for different applications. We contacted producers of implants and other medical devices, filters, toothpastes, medical plasters, plastics, seats, which represented the entities nearer to end user in the value chain of antimicrobial materials. This resulted in scarce response. Additionally, we contacted also companies that produce active antimicrobial component and companies that produce antimicrobial mixtures – masterbatches. Sometimes these two activities are performed by the same company. We received an important feedback from UK masterbatch producer about the relevance of Regulation (EU) No 528/2012 also named Biocidal Products Regulation – BPR [7]. They told us that if we want to enter European market with novel antimicrobial component, we have to perform the necessary toxicity and efficacy tests. They estimated costs for a new BPR product registration to > 1 million €.

3.2 EU Biocidal Product Regulation

Although the regulations often limit the entry of new technologies on the market due to its high costs it is important to confirm the safety and efficiency of the technologies in order to provide long term benefit for the society.

Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products was accepted by the European Parliament and Council on 22 May 2012 and is successor of Directive 98/8/EC. BPR concerns biocidal products, which are used for protection of people, animals, materials or products against pathogen organisms like bacteria, viruses or fungi and comprise active component. The aim of this regulation is to improve the market of biocidal products in EU and provide high level of safety for humans and environment.

For each biocidal product or its active component, it is necessary to acquire permission, before it can be placed on market. The active components can be available on the market in some occasions also during the procedure of their registration. The regulation aims to simplify and unify the procedure for EU member states. It also aims to maximize the sharing of available data and minimize the amount of tests on animals.

Novel biocidal active components and biocidal products are submitted to European Chemical Agency – ECHA and national authorities (i.e. Chemicals Office in Slovenia). The data is managed and available on the Register for Biocidal Products (R4BP 3). Another IT tool, IUCLID, is used for preparing the applications.

According to Annex II of BPR the tests performed for registration of any new active substance should comply with the relevant requirements of protection of laboratory animals, set out in Directive 2010/63/EU of the European Parliament and the Council of 22 September 2010 on the protection of animals used for scientific purposes and in the case of ecotoxicological and toxicological tests, good laboratory practice, set out in Directive 2004/10/EC of the European Parliament and of the Council of 11 February 2004 on the harmonization of laws, regulations and administrative provisions relating to the application of the principles of good laboratory practice and the verification of their application for tests on chemical substances or other international standards recognized as being equivalent by the EU Commission or the ECHA. Tests on physic-chemical properties and safety-relevant substance data should be performed at least according to international standards.

Due to high standards needed for the tests, these are very expensive. The tests are performed stepwise and in dialog with ECHA. Some tests are then performed only if the results of first set of tests are not satisfactory or ECHA decided they are necessary. The amount of tests also rises for nanomaterials, which might involve additional risk.

As the procedure to prepare and submit the data, needed for registration of novel active component is very demanding and extensive, companies often employ consultants to manage this procedure. For this reason, we also contacted such consultant companies to see, how we can use their support. They informed us is that the first step is to perform Data Gap Analysis, where existing data is reviewed and a list of necessary further tests to be performed is made. Preparation of this document costs 10.000-30.000 €. We received different information for the costs of toxicity and efficacy tests according to suitable standards, which varied between 0,5 and 3 million €. The ECHA fee for application of novel active substance is 120.000 €, whereas there are additional fees for registration of biocidal products, which is additional procedure performed at ECHA and national agencies of countries, where the biocidal product is to be placed on market. Management, registration procedure and communication with ECHA, which is done by consultant companies costs 150.000-480.000 €. Due to high costs, companies that want to place novel biocidal products also form a consortium and jointly finance this procedure. Only the applicant that submitted results of tests can make reference to this data. If another company wishes to place such product on the market and hasn't performed any procedure at ECHA or national offices, they have to purchase a license to make reference to already submitted data. This creates a specific situation on the market, similar to patent system.

3.3 Proof of Concept study on textile

In the frame of Interreg project KETGATE CTT and partners organized brokerage event for SMEs and research organizations from Central Europe [8]. Due to COVID-19 pandemic it took place online in May 2020. 124 participants attended short 1:1 meetings. We had a meeting with Hungarian textile producer, which uses silver to prepare antimicrobial clothes. We introduced them our invention and they were interested to investigate the possibility to apply our material on their textile products. Due to relatively low TRL (at that time TRL4) and high risk associated with the material, we had to find a financing program for this kind of cooperation. The call KET4CleanProduction offered Proof of Concept study for SMEs which wanted to use Key Enabling Technologies, developed at the research organizations. The KET4CleanProduction was a Horizon Europe project with its own fund of 2 million € for the call, that was open in period 2018-2020 and granted projects received 50.000 € of lump sum. In the KET4CleanProduction network we also identified suitable partner for this Proof of Concept – a Portuguese textile institute – and the project was granted [9].

In the period 10/2020-04/2021 the project to apply the Au/apatite nanoparticles on textile took place. The nanoparticles were synthesized and sent for further application – deposition on textile. For the functionalization of the cotton textile, one of the suitable method was found the most efficient one in terms of yield of the functionalization, leading to higher amounts of nanoparticles bonded to the textile substrate. Textiles (cotton) obtained after single washing were confirmed to have bacteriostatic effect in *P. aeruginosa*, as Gram negative strain, and strong bactericidal effect in Gram negative *E. coli* and Gram positive *S. epidermidis* and *B. subtillis* (Figure 3). Antimicrobial effect was detected on contact with textiles; it followed contact-based mechanism of Au/apatite nanoparticles and confirmed their very stable bonding to the cotton textile. The gold-based nanoparticles also showed high antiviral activity, even at low concentrations.

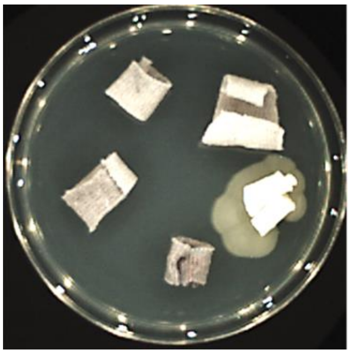

Figure 3. Antibacterial test on Au/apatite nanoparticles bound to textile.

3.4 Horizon Europe project

The KET4CleanProduction project represented strong support to reach higher TRLs. It proved that the novel antimicrobial can be applied on end product and still keeps its excellent antimicrobial function. This project paved further way towards entry of the novel material on the market. We identified next three tasks that needed to be performed in the following steps:

- Testing the toxicity and efficacy (antibacterial, antiviral, etc.) of the composite nanogold material and preparation of the documentation according to the Biocidal Product Regulation (EU 528/2012)
- Development and optimization the technology for textile application and for other relevant applications
- Scaling up the nanogold composite production process

In order to reach planed goals, we had to (i) find suitable partners and (ii) get a funding on the scale of few million €. When the end of previous period for EU financing was approaching, new set of large R&D funding package for 2021-2027 - Horizon Europe - was announced. We identified suitable call for our plan: HORIZON-CL4-2021-RESILIENCE-01-20: Antimicrobial, Antiviral, and Antifungal Nanocoatings (RIA) [10]. Activities within the project are expected to start at TRL 3 and achieve TRL 6 by the end of the project. The budget of the call is 23 million € and it is expected to fund 4-5 projects. The deadline is in the end of September 2021. This call is directly related to the well-being of citizens in the context of COVID-19 virus pandemic. It aims to minimise the risk of spread of infections from harmful pathogens arising from everyday human activities; and create a healthier living and working environment and offer holistic solutions to people with health issues. The research should focus on sustainable synthesis of nanocoatings/nanocomposites with effectiveness against a range of pathogens.

We decided to keep the consortium created in KET4CleanProduction and add new required partners. We contacted different antimicrobial active component producers and received higher interest, presumably due to demonstrator on textile and a plan regarding the Biocidal Product Regulation. We also contacted different companies – producers of high traffic objects, where antimicrobial materials need to be applied. Currently 10 partners are forming consortium which is about to be finalized and project plan submitted.

The project is expected to have an important impact on prevention of spreading of already known and novel pathogens (bacteria, viruses, fungi, etc.) by limiting their transmission through different surfaces. In the first place, the project will provide demonstrators on face masks, hospital linen, protective clothes, textile handles for public transport, pull handles for doors or textile sheath for pull handles, paper for everyday use, banknotes, passport, plastic covers for door handles, working surfaces in healthcare sector (i.e. hospitals) and areas where food is prepared. Furthermore, it will explore the opportunity to include it in the antimicrobial masterbatches, which can be used for wide variety of end products. The demonstrators will pave the way to other possible usage of novel antibacterial material based on gold as the demonstrators of the project will include various materials like cotton; different polymers such as polyester, polypropylene, polyamide; cellulose; mineral composite; metals etc. This will enable the opportunity to relatively easily apply it also on other products in the hospitals, long-term care facilities, public transport, public offices, restaurants and bars, sport facilities, shopping centres, cinemas and theatres as well as other places frequently visited by general public. The efficiency of the novel material among wide range of pathogens including bacteria, fungi, viruses and yeast will be evaluated. Special emphasis will be given to virus SARS-CoV-2 including its latest variants.

The longterm vision is that a French manufacturer of composite materials will sign license agreement with JSI, start to produce the novel gold composite on industrial level, register it at the ECHA and enter the market with it. Producers of different antimicrobial products, members of the consortium shall be first clients and further promotion will be made to successfully increase the sales share.

ACKNOWLEDGMENTS / ZAHVALA

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ABSTRACT

The paper informs on current state and future prospects of technology transfer in Belarus. It outlines legislation in the field of technology transfer; key features of the research and development system; system and instruments of technology transfer; structure and mission of the Republican Centre for Technology Transfer, the Business Cooperation Centre “Enterprise Europe Network Belarus” and its services provided to innovation activity agents. Finally, the recommendations are given to improve legislation in the field of technology transfer in Belarus.

KEYWORDS

Technology transfer (TT), legislation, public research organizations, intellectual property rights (IPR), spin-off, R&D contracts

1 INTRODUCTION

Belarus is a country with 9,5 million inhabitants, 451 public R&D organizations (PROs) and 25600 research personnel. The structure of research personnel remains practically unchanged: researchers – 65,2%, technicians – 6,5%, support personnel – 28,3% [1, 2].

Belarus is a small, open, upper-middle income economy. The country is not well endowed with natural resources. It largely relies on imported energy and raw materials and has a historical specialization in processing. The main activities of Belarusian industrial sector are engineering (agricultural technology and specialized heavy vehicles), potash fertilizers, and refining (which relies on oil supplies from Russia). These sectors depend heavily on external demand. Trade openness is among highest in the region, with a ratio of merchandise exports to GDP of 48% in 2020 (52% in 2019) [2].

Belarus is ranked 64th in the Global Innovation Index 2020 [3], that is eight places up from the 2019 and 22 places higher than in 2018. Belarus has demonstrated progress in a number of indicators reflecting the practical results of innovations in the production sector. Belarus highest rankings were in Human Capital and Research (37th place), Infrastructure (46th place), and Knowledge and Technological Output (58th place). The achieved results are due to the constant improvement of legislation in the field of technology transfer (TT).

2 THE LEGISLATIVE CONTEXT

The purpose of the legislation and policies of the Republic of Belarus in the field of TT is to facilitate the transfer of technologies developed with government funding in order to ensure sustainable growth of national economy and to increase competitiveness of local products [4].

Currently, Belarus has more than 50 regulatory legal acts related to TT.

The analysis of Belarusian legislation shows that it regulates the following relationships in the field of TT:

1. Public funding of fundamental and applied research
2. Transfer of developed technologies to state enterprises and organizations
3. Transfer of developed technologies to enterprises and organizations with a mixed form of ownership, small business, and foreign firms
4. Dissemination of information in the field of TT
5. Establishment of organizations related to TT (technology transfer centers, science and technology parks, venture capital organizations)
6. Ownership of inventions and remuneration for using the inventions.

In recent years the government expenditure on R&D in Belarus was at 0,45% of GDP [2]. In the next five years Belarusian economy and science are faced with the task of reaching R&D financing of 1% of GDP.

While allocating public funds for applied research to contactor the state enterprise is simultaneously assigned to commercialize anticipated research results. If, for some reason, the state enterprise is not using the developed technology or product, the contractor is obliged to pay back the allocated funds to the state budget.

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Every year Belarusian PROs create over 400 new products and technologies for commercialization at state enterprises [1, 2]. The plan for this year is to introduce about 470 new technologies and products.

After Belarus gained independence in 1991, the first normative act regulating the acquisition of property rights on the results of scientific and technical activities and the disposal of those rights was the Presidential Decree No. 432. According to it, property rights resulted from research subsidized (in whole or in part) by public funds were obtained by the state. The IP right holders could be a government customer and (or) a research contractor – PRO. Legal practice showed that de facto, the state retained ownership of IP rights and consequently research contractors were not interested to commercialize them.

In 2013, the Presidential Decree No. 59 approved new Regulation on the commercialization of the results of scientific and technical activities created at the expense of state funds, which expanded opportunities for research contractors to obtain rights on results of R&D activities. Still, in spite of the amendments made to Decree No. 59 in 2018, the legal procedures to obtain IP rights remain overly complex and unwieldy. Research contractors do not have “the right to risk”, due to the requirement to pay back funds in case of failure to commercialize the developed technology of product. Since the state retains the IP rights the transfer of technologies developed with government funding to private enterprises and foreign companies is carried out not through the sale or licensing of IPR, but under commercial agreements with technical assistance, research and technical cooperation agreements, and joint venture agreements. For the same reason the Belarusian PROs don’t create spin-offs.

The Belarusian law on patents for inventions, utility models and industrial designs was amended several times [5]. This law regulates the property and associated personal moral relations arising in connection with the creation, legal protection and use of inventions, utility models, and industrial designs. The legislation is in harmony with international treaties and, in principle, it enables the protection of intellectual property objects of domestic and foreign entities. In addition, some government decrees have set the legal framework for the sharing of royalties and other IPR incomes between inventors and employers [1]. According to legislation, remuneration is paid in the amount and on terms specified in agreements between the employee and the employer – the minimum level of remuneration shall be determined by the Council of Ministers of the Republic of Belarus [6].

Legislation doesn’t limit maximum remuneration to authors (co-authors) for the created objects of industrial property rights. If the employer decides to keep an invention as a secret know-how, then the reward for the creation of objects of industrial property rights to authors, co-authors and individuals should be paid as a lump sum within three months of employer’s decision. Businesses may combine both options: keep some inventions secret and patent the other abroad (e.g. innovative export products). The inventor should be compensated equally regardless of the option.

The dissemination of information in the field of TT is regulated by the Law of the Republic of Belarus No. 250-Z “On scientific and technical information” dated 05.05.1999, and the Law of the Republic of Belarus No. 170-Z “On state secrets” dated 19.06.2010 [7, 8].

The establishment of organizations related to TT regulates the Presidential Decree No. 1 “On approval of the Regulations on the procedure for creating subjects of innovation infrastructure and amendments and additions to the Decree of the President of the Republic of Belarus dated September 30, 2002, No. 495” dated 03.01.2007 [9]. According to it, the center for technology transfer (CTT) is an organization with an average number of employees up to 100 persons, tasked to ensure the transfer of innovations from the sphere of their creation to the sphere of practical use. A scientific organization with a separate TT subdivision with at least 7 employees can also be recognized as CTT, and use all privileges and advantages granted to CTT by law. In Belarus CTTs are not funded from the state budget.

3 THE REPUBLICAN CENTRE FOR TECHNOLOGY TRANSFER

The Republican Centre for Technology Transfer (RCTT) was established in 2003, under the aegis of the State Committee on Science and Technology of the Republic of Belarus, the National Academy of Sciences of Belarus, the United Nations Development Programme and the United Nations Industrial Development Organization [10].

RCTT’s primary goal is to facilitate transfer of technologies developed in Belarus and abroad for sustained growth of the country’s economy and increase the competitiveness of Belarusian industry and agriculture, provide advice to CTTs in the country.

Tasks set for RCTT:
- create and maintain information databases meant for serving clients in the technology transfer sector;
- provide RCTT clients with access to foreign technology transfer networks;
- assist innovation activity agents in development and promotion of their innovation and investment projects;
- train specialists in research- and innovation-related entrepreneurship;
- establish RCTT offices across the country, to create a unified national network of technology transfer centers;
- promote international technical and scientific cooperation and exchange of experts.

RCTT is a consortium with the headquarters in Minsk. It’s made up of:
- 5 regional offices and 30 branch offices at research organizations, institutes, universities, enterprises in Brest, Vitsebsk, Homel, Hrodna, Lida, Minsk, Mahileu, Novapolatsk and other cities and towns across Belarus;
- 91 foreign partners in 23 countries: Armenia (3), Azerbaijan (2), China (25), Denmark (1), Great Britain (2), Germany (4), Georgia (1), India (1), Iran (1), Italy (1), Lithuania (1),

Moldova (1), the Republic of Korea (4), Poland (3), Kazakhstan (6), Russia (19), the USA (2), Sweden (1), the Republic of South Africa (1), Uzbekistan (2), the Czech Republic (2), Ukraine (7), Vietnam (2).
- 2 overseas field offices.

RCTT staff is a certified member of 12 technology transfer networks, in particular, Russian Technology Transfer Network (since 2004), yet2.com (since 2005), AUTM (since 2012), Enterprise Europe Network (since 2015) and others.

RCTT offers its services to innovation activity agents in Belarus as well as foreign companies and investors.

RCTT has a web-portal (https://ictt.by), with several subject sections and databases such as: "Virtual exhibition of the NAS of Belarus"; "Catalogue of innovation offers by organizations of the NAS of Belarus"; "New partnership opportunities", to present in real-time offers and requests from RCTT, EEN, and AUTM networks; "Catalogs"; "Manuals"; "Investment and venture funds"; "Crowdfunding"; "IP auctions"; "IP insurance"; "Legislation" covering the laws and regulations applicable to innovation activity in Belarus and foreign countries; "Technoparks of Belarus", and others.

RCTT provide services to more than 250 Belarusian state organizations, private enterprises and individuals. The National Academy of Sciences, Belarusian State University, Belarusian National Technical University are among the centre's clients. With the support from RCTT in 2003–2020 more than 6200 Belarusian specialists have been trained and instructed in various fields of technology transfer at 510 local and international workshops, seminars and exhibitions.

RCTT was involved in implementation of more than 30 international projects related to improving the competencies of researchers and representatives of small and medium-sized businesses funded by UNDP, UNIDO, FP7, Baltic Sea Region Programme, CEI, Latvia, Lithuania and Belarus Cross Border Cooperation Programme, The Swedish Institute, Chinese Government and others.

Since 2015 RCTT is a coordinator of the project "Creation of the Business Cooperation Centre "Enterprise Europe Network Belarus" (BCC "EEN Belarus")". The aim of the project is to encourage the provision of services to support cross-border business cooperation, technology transfer, and research collaboration on the basis of mutual benefit via the Enterprise Europe Network.

4 FURTHER DEVELOPMENT

The 18 years of RCTT work experience show that to improve commercialization of technologies developed with government funding in Belarus, it is necessary to develop and adopt:

1. a law similar to Bayh-Dole Act;
2. legislative acts that will allow the contractor to restrict access to research results and inventions if public disclosure could damage commercial interests;
3. legislative acts requiring inclusion into job description of employees of all state organizations engaged in R&D the obligation to engage in TT, and the administration of organizations to take into account TT activities when assessing the work of employees;
4. legislative acts stimulating the transfer of technologies developed with government funding to small businesses ("gratuitous" transfer);
5. legislative acts stimulating the creation and funding of TT organizations (departments); and
6. introduce the technology transfer course into the curricula of higher educational institutions.

5 CONCLUSIONS

This paper provides an overview of the current state of technology transfer in Belarus. It highlights several legal issues that need to be addressed in the future to make technology transfer more efficient.

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DODATEK / APPENDIX

ITTC 14

14th International Technology Transfer Conference

LET'S INNOVATE THE FUTURE

INTRODUCTION AND AIM OF THE CONFERENCE

Conference topic: how to survive the valley of death?

How to enable investors in early stage deep tech ventures: buying a lottery ticket vs building the jackpot?

How to integrate the PoC funding in the national and regional innovation ecosystem?

What is the role of TTOs, PROs, governments and industry in the setting up a successful PoC funding scheme?

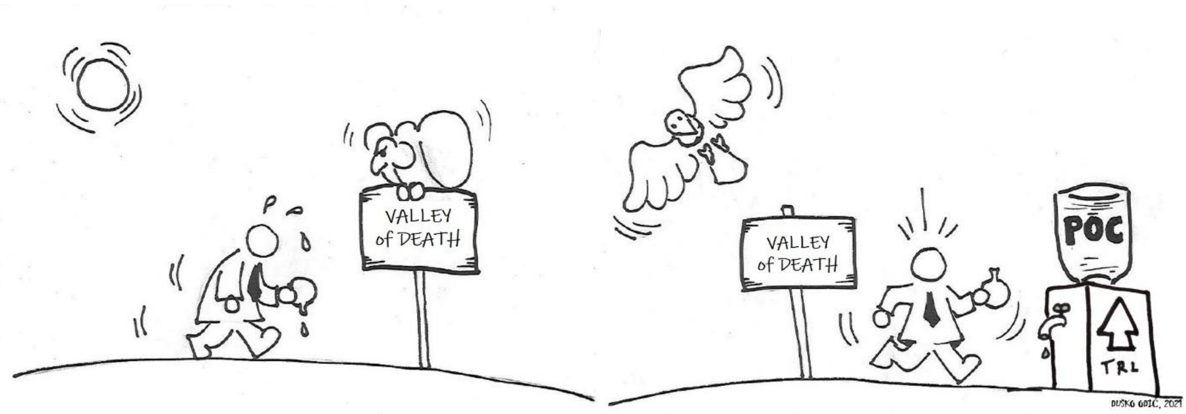

Illustration: Dusko Odić. 2021.

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 2600 participants, including investors, inventors, researchers, students, technology commercialization and intellectual property experts, start-up funders, industrial development experts etc. We have successfully organized twelve competitions to award the teams 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 2021

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.

Scientific papers on TT and IPR

Experts on TT, IPR, researchers that cooperate with industry and others have been invited to submit their scientific papers. The accepted papers have been presented by the authors. This year's topics were: Key factors for successful technology transfer from different points of view (researchers, knowledge transfer experts, enterprises); Key inventions and their protection for the greater good; Market perspective through different TRL phases; Financing different TRL phases; Setting-up internal Proof-of-Concept funds at public research organisations; Lowering the Proof-of-Concept risks; Shortening the time-to-market for different technological fields; Spin-out vs spin-off; Key trends in IP protection and TT for mid TRL phases; Examples of IP protection in Artificial Intelligence; The role of patents in Artificial Intelligence; Activating the IP protection and TT players in the SEE region; National IP protection: a profit or a hindrance; Governmental support vs institutional support of IP protection and TT; IP and internal secret know-how: who prefers what and why; Other, chosen by the contributor

School section

A parallel section “Connecting the education system with academia: Presentations of selected research topics from the Jožef Stefan Institute and proposals for cooperation” took place. The section was aimed at primary and high school teachers where selected research topics from the Jožef Stefan Institute (JSI) and proposals for cooperation were presented.

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, development banks), 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 14th 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 (IS2021), 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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Niko Schlamberger, President of Slovenian Society INFORMATIKA

Doc. Dr. Tamara Besednjak Valič, Faculty of Information Studies in Novo Mesto

Prof. Alexandru Marin, University POLITEHNICA of Bucharest

for their contribution to the scientific programme and review of the scientific contributions and selection for publication in this Conference proceedings.

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Dr. Jon Wulff Petersen from Plougmann Vingtoft

Matthias Keckl from Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič from Slovene Enterprise Fund

Gregor Klemenčič from Deep Innovations

for their evaluation of written technology commercialization proposals and selection of winning teams, authors of inventive technologies with the best potential for commercialization of the technologies, developed at Public Research Organizations.

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for their evaluation and selection of the awardees of the WIPO IP ENTERPRISE TROPHY and WIPO MEDAL FOR INVENTORS.

INTRODUCTION TO THE ITTC CONFERENCE AS A WHOLE

Value creation should be at the heart of valorization activities and denotes a process where stakeholders' benefits are articulated, created, and captured throughout the valorization process. Value in this sense is, however, not static or absolute. Value is relative and usually changes with the stakeholders addressed. Hence, value creation implies, wherever it is meaningful and possible, that the benefits for a stakeholder must be higher than the efforts, risks and resources needed to obtain the promised benefits.

Turning any publicly financed knowledge, i.e. intellectual property in its broadest sense to socio-economic benefits calls for a much wider scope of activities than just industrial rights management. The Center for Technology Transfer and Innovation at Jožef Stefan, if anyone, has always been very much aware of this. Thus, we have set in motion in the past ten years of our existence, based on the dowry of additional 15 years of a Technology transfer office of Jožef Stefan Institute, many different changes. These changes have influenced the Institute and the society around us. We have created processes that any Slovenian public research organization would be able to use. We have created an internal ecosystem of activities and interactions with essential innovation actors, allowing us to research, assess, understand, co-create, offer, and fine-tune the academia-industry-society helix on the most bottom-up, most influential level. We are proud of that.

Now we must go on. We created a proof of concept of activities – of what the ecosystem in our environment could look like in a scalable way. Others should take the essential elements (codes of practices we have so prudently developed through the past 10 years of our existence) and use them to their liking and the capacities of their institutions. There are differences among actors in the ecosystem. But once these differences have been understood, there are just similarities that can be harvested in the quest for better valorization results.

We are all unique. And we are all very similar. Acknowledging this means not fighting better from us but building on their experience. "*Yeah, everybody wants change. Don't nobody wanna change though. (NF)"* We need to creatively and constructively take part in knowledge valorization for a better future, even if it means it is our turn to change.

Day 1

OVERVIEW OF THE PROGRAMME

7 October 2021 (hybrid teleconference, virtual and live)

MAIN SESSION

08.30 – 09.00	**Registration**
09.00 – 09.15	**Welcome address** (in Slovene language) Prof. Dr. Mitja Slavinec, State Secretary, Ministry of Education, Science and Sport Simon Zajc, State Secretary, Ministry of Economic Development and Technology Prof. Dr. Boštjan Zalar, director, Jožef Stefan Institute
09.15 – 10.30	**Round table: Future of Knowledge Transfer in Slovenia and EU** (in Slovene language) Prof. Dr. Gregor Majdič, University of Ljubljana Prof. Dr. Boštjan Zalar, Jožef Stefan Institute Prof. Dr. Maja Ravnikar, National Institute of Biology Prof. Dr. Klavdija Kutnar, University of Primorska Prof. Dr. Matej Makarovič, Faculty of information studies in Novo mesto Prof. Dr. Urban Bren, University of Maribor Prof. Dr. Robert Repnik, Slovenian Research Agency Gregor Klemenčič, Deep Innovations Gregor Umek, mag., Ministry of Economic Development and Technology mag. Damjana Karlo, Ministry of Education, Science and Sport
10.30 – 12.00	**Pitch competition: Best innovation with commercial potential**
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 – 15.30	**Keynote speech: PoC funding of research spin-offs** Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH **Keynote speech: CEETT Platform – Central Eastern European Technology Transfer Platform** Natalija Stošicki, Director, Investments and EU Programmes Department, SID Bank / SID – Slovenska izvozna in razvojna banka **Paper presentations: scientific papers on technology transfer and intellectual property**

15:30 – 16.50	**Opportunities arising from publicly funded research projects / presentations of successful scientific projects** **Award announcement: WIPO Medal for Inventors**
16.50-17:00	Closing

PARALLEL SESSION I

10:00 – 13:20	**Research2Business meetings (R2B meetings)**

PARALLEL SESSION II

13:20 – 15:20	**Connecting high-school education system with academia: Presentations of selected research topics from Jožef Stefan Institute and proposals for cooperation** Povezovanje šolskega sistema z akademsko sfero: Predstavitve izbranih raziskovalnih tem Instituta "Jožef Stefan" in predlogi za sodelovanje <u>Agenda (in Slovene language)</u> 13:20-13:25 Uvodni pozdrav 13:25-13:40 Predstavitev možnosti sodelovanja Instituta »Jožef Stefan« z šolstvom, CTT - Obiski instituta »Jožef Stefan« med šolskim letom - Dan odprtih vrat in Teden odprtih vrat na IJS - Izobraževanja, usposabljanja in predavanja za učitelje in profesorje - Mentorstva pri raziskovalnih nalogah dijakov - Aktivnosti promocije znanosti in raziskovalnega dela - različne evropske - projekte in iniciative ter druge aktivnosti (Znanost z in za družbo / Science - with and for society) 13:40-14:20 Predstavitev odsekov s področja kemije, biokemije, materialov in okolja - Odsek za znanosti o okolju, O2 - Odsek za biokemijo, molekularno in strukturno biologijo, B1 - Odsek za fizikalno in organsko kemijo, K3 - Odsek za Sintezo materialov, K8 14:20-14:30 Predstavitev odsekov s področja fizike - Odsek za tehnologijo površin, F4 14:30-15:00 Predstavitev odsekov s področja elektronike in informacijske tehnologije

	- Odsek za umetno inteligenco, E3 - Laboratorij za odprte sisteme in mreže, E5 15:00-15:20 Morebitna dodatna vprašanja za raziskovalce 15:20 Zaključek

WELCOME ADDRESSES

From 9:00 to 09:15

Honourable Speakers:

Prof. Dr. Mitja Slavinec, State Secretary

Ministry of Education, Science and Sport

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Govorca veseli in se zahvaljuje organizatorju konference, Centru za prenos tehnologij in inovacij na Institutu »Jožef Stefan«, da ima uvodni nagovor na zelo pomembnem srečanju.

Na izvedbeni ravni, kjer znanje nastaja, sodelovanje dobro poteka. Sodelovanje je odlično na univerzah in institutih, prav tako je okrepljeno sodelovanje med izobraževanjem in raziskovanjem na institucionalni osnovi, kar dokazuje tudi udeležba na današnjem dogodku, saj so prisotni predstavniki univerz in raziskovalnih institutov.

Na drugi strani se zna gospodarstvo tudi relativno hitro povezati, ker jim to narekuje njihova gospodarska pobuda. Največ lahko naredimo na tem, kako ta znanja in raziskave čimprej prenesti v gospodarstvo.

Pri raziskovanju je možno zaznati najmanj dve ravni. Pri bazičnih raziskavah je Slovenija na nekaterih področjih v svetovnem vrhu. Manj uspešni smo pri prenosu in implementaciji aplikativnih raziskav v celotni družbi in gospodarstvu.

Država je od leta 2017 dalje s 6 mio EUR podprla pravo pot za prenos tehnologij, ki se odvija s pomočjo pisarn za prenos tehnologij. MIZŠ namerava to podporo še okrepiti in okrepiti sodelovanje z MGRT. Nujno je sodelovanje z MGRT, ker MIZŠ podpira nizke TRL-je in MGRT višje. Vendar srednji TRL-ji še vedno »ostajajo v zraku«.

K sodelovanju je potrebno poleg MGRT povabiti še Gospodarsko zbornico Slovenije, ki ima povezovalno vlogo in dostop do gospodarstva. S sodelovanjem vseh deležnikov bo Slovenija postajala družba, kjer se bo več delalo z glavo in manj z rokami.

Simon Zajc, State Secretary,

Ministry of Economic Development and Technology

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Živimo v nenavadnih časih, ko je COVID-19 razkril pomanjkljivosti in šibke točke slovenskega gospodarstva in nabavnih verig. Slovenski gospodarski model mora biti z uvedbo inovacij v gospodarstvo odpornejši za prehod v zeleno družbo.

V Evropski skupnosti se vsi usmerjamo v zeleni, digitalni prehod. Prehod je mogoče narediti samo na krilih inovacij, ki so ključni dejavnik uspeha podjetij, konkurenčnosti nacionalnih držav in Evropske skupnosti kot celote ter družbe, ki je usmerjena k okolju prijaznem načinu življenja.

Načrt za okrevanje in odpornost (NOO), ki bo podlaga za koriščenje razpoložljivih sredstev iz Sklada za okrevanje in odpornost (RRF), nam ponuja veliko priložnosti za okrevanje.

V Slovenski industrijski strategiji 2021-2030, ki jo je pripravilo Ministrstvo za gospodarski razvoj in tehnologijo, so začrtali zelen, digitalen in ustvarjalen razvoj industrije in gospodarstva do leta 2030.

Na drugi strani je na evropski lestvici upadla slovenska inovacijska uspešnost v primerjavami z drugimi državami EU. Slovenija ne sodi več med močne, ampak zmerne inovatorje, ker je imela padec uspešnosti v obdobju 2018 – 2020. Velik izziv predstavlja zagotovitev stabilnih vzpodbud države za znanost. Na drugi strani moramo v naslednjih desetih letih zagotoviti tako podjetniške naložbe v raziskave in inovacije kot naložbe na raziskovalnem nivoju.

Pri tem ne moremo računati samo na evropska sredstva, ampak tudi na našo premišljenost pri dodeljevanju nacionalnih sredstev za ključne finančne instrumente, ki bi jih morali izvajati vsako leto brez vmesnih premorov.

Ministrstvo za gospodarski razvoj in tehnologijo bo okrepilo vlogo SPIRIT-a na področju inovacij in tehnologij ter pri podpori povezovanju med industrijo in javnimi raziskovalnimi organizacijami.

Ministrstvo bo še naprej spodbujalo prenos znanj in tehnologij na trg z vzpostavljenimi strateškimi, razvojnimi in inovacijskimi partnerstvi, ki po začetnih težavah delujejo vedno bolje prav zaradi vzpostavljenih povezav s številnimi podjetji, društvi in raziskovalnimi organizacijami.

Pomembno je, da se bodo vsi deležniki v Sloveniji prizadevali za prenos inovacij na trg – iz bazičnega razvoja v tržne aplikacije.

Prof. Dr. Boštjan Zalar, director,

Jožef Stefan Institute

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Govorec je v uvodnem in pozdravnem nagovoru izpostavil Center za prenos tehnologij in inovacij (CTT), vodjo centra dr. Špelo Stres, njene sodelavke in sodelavce, ki so organizirali že 14. Mednarodno konferenco o prenosu tehnologij. Na teh konferencah sodelavke in sodelavci CTT z učinkovitim prenosom tehnologij v prakso še posebej krepijo sodelovanje med znanstveno sceno in gospodarstvom.

Pisarne za prenos tehnologij naj bodo ključne v procesu prenosa tehnologi ter pri sodelovanju z deležniki, ki so dobro vpeti v inovacijskem sistemu. Najpomembnejša vprašanja, ki bi jih bilo potrebno nasloviti, so:

- Vzpostavljanje sklada za preverbo koncepta na nacionalni in na institucionalnih ravneh
- Problematika ustanavljanja odcepljenih podjetij
- Odnosi med raziskovalno in tehnološko infrastrukturo ter centri odličnosti
- Večji družbeni vpliv javnih raziskovalnih organizacij in univerz ter njihovo boljše povezovanje z družbo
- Vloga odprte znanosti v povezavi z intelektualno lastnino
- Vpliv razdrobljenosti raziskovalnega sistema v Republiki Sloveniji ter ocenjevanja učinkovitosti sistema in vpliva na kakovost delovanja pisarn za prenos tehnologij
- Sodelovanje med SRIP-i in pisarnami za prenos tehnologij

Na današnji konferenci so prisotni skupaj s pisarnami za prenos tehnologij vsi, ki soustvarjajo inovacijski sitem v Sloveniji.

Na zaključku pozdravnega nagovora se je govorec zahvalil sodelavkam in sodelavcem Centra za prenos tehnologij in inovacij za organizacijo današnje okrogle mize in za že 14. dogodek po vrsti.

ROUND TABLE: THE FUTURE OF KNOWLEDGE TRANSFER IN SLOVENIA AND EU

From 09:15 to 10:30 (in Slovene language)

Moderators:

Dr. Špela Stres, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Dr. Vojka Žunič, National Institute of Chemistry, KnowledgeTransfer Office

Round table speakers:

Prof. Dr. Gregor Majdič, University of Ljubljana

Prof. Dr. Boštjan Zalar, Jožef Stefan Institute

Prof. Dr. Maja Ravnikar, National Institute of Biology

Prof. Dr. Klavdija Kutnar, University of Primorska

Prof. Dr. Matej Makarovič, Faculty of information studies in Novo mesto

Prof. Dr. Urban Bren, University of Maribor

Prof. Dr. Robert Repnik, Slovenian Research Agency

Gregor Klemenčič, Deep Innovations

Gregor Umek, mag., Ministry of Economic Development and Technology

Mag. Damjana Karlo, Ministry of Education, Science and Sport

Povzetek okrogle mize / Abstract of the Round table

Okroglo miza sta odprli moderatorki dr. Špela Stres, MBA, LLM, Vodja Centra za prenos tehnologij in inovacij na Institutu ''Jožef Stefan'', in dr. Vojka Žunič, Vodja pisarne za prenos znanja na Kemijskem inštitutu.

Uvodni nagovor moderatorke dr. Špele Stres:
Podatki o inovacijah in internacionalizaciji kažejo, da je potrebno omogočiti skladno in na mejnikih temelječe financiranje inovacij ter podpreti internacionalizacijo. Naš cilj je, da izboljšamo politike za celostno nemoteno preoblikovanje rezultatov raziskav v ekonomsko in družbeno vrednost.

Moderatorka dr. Vojka Žunič je predstavila udeležence okrogle mize:

- prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
- prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
- prof. dr. Maja Ravnikar, direktorica Nacionalnega inštituta za biologijo
- prof. dr. Klavdija Kutnar, rektorica Univerze na Primorskem
- prof. dr. Matej Makarovič, dekan Fakultete za informacijske študije v Novem mestu
- prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru

- prof. dr. Robert Repnik, direktor Javne agencije za raziskovalno dejavnost Republike Slovenije
- mag. Gregor Umek, vodja Sektorja za industrijo, spodbujanje inovativnosti in tehnologije v Direktoratu za internacionalizacijo, podjetništvo in tehnologije (Ministrstvo za gospodarski razvoj in tehnologijo)
- mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
- Gregor Klemenčič, Deepinovations (Nizozemska)

1. Gregor Klemenčič, sr. principal innovation researcher for e-health data driven solutions za Philips Research (Medical systems) na Nizozemskem in soustanovitelj ter solastnik mednarodnega podjetja Deep Innovations B.V

Gospod Klemenčič je predstavil svoj pogled na inovacijski sistem v naslednjih točkah:

- Innovation to market – I2M
- Research to application – R2A
- Value proposition creation – VPC
- The game of rules – IPR
- Earning models

Curiosity is a personal characteristic of a researcher or entrepreneur. A researcher is looking for an inspiration, learning from white papers and colleagues. Researcher combines different sources of information. It looks like a child play for clever people.

Creation is also creation of products and services and how to apply. This is a game for elderly researchers.

Researchers have to understand the buyer and not try to sell unique selling points and not even unique buying reasons. Researchers have to find out why buyers become hungry for new innovation applications.

We have fundamental, applied and complementary research. Researchers have to try as fast as they can to combine information from different sources domains. It's a lot of hard work and play as well. If you play, you may do a mistake. Researchers have to learn fast and make NOT TO DO list to ignore or mitigate the risk.

Provocative design is another applied approach in the innovation system. Researchers design new solution or concept and they test them with people without asking them what they want.

Mixed research teams with different skills from different research areas with non-standard combination of knowledge will bring applications out of the box.

New school doesn't believe much in IP as the old one. Also, how to make money with innovations is different from the old school. New school prefers to organize focused micro meetings, attract micro investors and apply IP stacking or block chain to trace effort input as output values.

Iztočnica okrogle mize – dr. Špela Stres:
Winston Churchill je rekel, Personally I'm always ready to learn, although I do not always like being taught. Del napredka v človeški zgodovini je povezan s posebno sposobnostjo ljudi, da smo se sposobni učiti. Zato bomo danes uporabili svoje znanje in naslovili nekaj ključnih tematik, ki bodo opredeljevale vsebino področja prenosa znanja in njegove valorizacije v prihodnosti.

2. Prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
Vprašanje: Problematika ovir z ustanavljanjem odcepljenih podjetij. Glede na vaše izkušnje tudi iz podjetniškega sveta, če bomo z novim Zakonom o znanstveni razvojni in inovacijski dejavnosti lahko JROji postajali solastniki odcepljenih podjetij, je to pametno, ker bodo institucije v bolj zgodnjih fazah lahko upravljale z inovacijami v podjetniških vodah ali dodaten zaplet, v katerem bodo JRO upočasnjevali razvoj mladih podjetij proti trgu?
Ali se vam zdi, da smo zreli za ta korak?

Prof. dr. Gregor Majdič:
Tak sistem je vzpostavljen v številnih zahodnih državah, dobro deluje ter prinaša velike koristi za akademsko sfero in gospodarstvo, če ta proces pravilno izvajamo.

Če se bodo javne raziskovalne organizacije, ki so običajno velike in nekoliko bolj okorne kot so majhna podjetja na trgu, preveč vmešavale v samo delovanje podjetij na trgu, ko bodo le-ta naskakovala nove trge in se internacionalizirala, to zna biti ovira.

Če pa bodo raziskovalne organizacije preko pisarn za prenos tehnologij to upoštevale in pustile malim podjetjem samostojnost, hkrati pa sodelovale pri potrebni pomoči, pa je to zagotovo lahko velika prednost in nova dodana vrednost, ki bo omogočila takšnim podjetjem, da bodo lažje prišla na trg in lažje izhajala iz akademskih institucij ter prenašala znanje v gospodarstvo v Sloveniji in v mednarodnem prostoru.

3. Prof. dr. Maja Ravnikar, direktorica Nacionalnega inštituta za biologijo
Vprašanje: Vzpostavljanje sklada Proof-of-Concept. Na NIB ste prav v letošnjem letu uspešno ustanovili novo visokotehnološko podjetje. V letu 2021 so SID banka, HBOR in EIF podpisali pogodbo za prvi PoC sklad v regiji. Na posamičnih institucijah, IJS (od leta 1998), UL (od leta 2020) in UM (od leta 2020) - PoC skladi delujejo že nekaj časa in podpirajo raziskovalce na njihovi poti proti trgu. Kako se do tega opredeljuje NIB? Je 40 mio EUR v skladu PoC za dve državi preveč za regijo, ki je šele na začetku svoje poti povezovanja z gospodarstvom ali pa celo premajhen vložek za regijo, ki mora nujno ustvariti množico gazel, da se bo vrnila med inovacijsko uspešne države?

Prof. dr. Maja Ravnikar:
Na NIB smo pred desetimi leti ustanovili prvi spin-out Biosistemika. Pri tem je podjetju zelo pomagal mehanizem projektov VALOR. PoC skladi bodo omogočali javnim raziskovalnim organizacijam, da pridejo v svojih raziskavah na srednje TRL-je, ker takšnega financiranja v tem trenutku v Sloveniji ni.

V letošnjem letu smo na NIB za novoustanovljeno podjetje pridobili močne investitorje, ki so lahko takoj investirali samo v opremo več kot milijon evrov in odkupili intelektualno lastnino, vendar to ni običajno stanje pri ustanavljanju spin-out podjetij.

Če bodo sredstva PoC sklada primerno odrejena, bo to velik korak naprej, ker akademska sfera in javne raziskovalne organizacije nimajo dovolj potrebnih sredstev za premagovanje »doline smrti«.

ARRS financira tako bazične kot aplikativne projekte, ki pa se ocenjujejo več ali manj kot bazični. Projekti izkazujejo svojo aplikativnost z zainteresiranostjo podjetij za takšno vrsto raziskav. Takih financiranih projektov je v Sloveniji bistveno premalo.

4. Mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
Vprašanje: Kako vidite problematiko ustanavljanja odcepljenih podjetij na MIZŠ? Kako vidite možnosti pomoči zasebnim podjetjem v solastništvu JRO, v luči državnih pomoči? Vemo, da bi na nekaterih področjih (biotehnologija, medicina, nanomateriali, itd) morali biti začetni vložki v bodoče gazele precej veliki, tudi milijonski.

Mag. Damjana Karlo:
Z novim Zakonom o znanstvenoraziskovalni in inovacijski dejavnosti (ZZRID) je predvidena možnost za ustanovitev odcepljenih podjetij. To in celotno področje inoviranja je tipično medresorsko vprašanje predvsem med MIZŠ in MGRT.

Najprej so potrebne reforme institucij in obeh ministrstev ter kadrovske in vsebinske krepitve tako ministrstev kot njihovih izvajalskih agencij – ARRS in SPIRIT, ki smo se jih lotili v okviru Načrta za okrevanje in odpornost.

Prenizko javno financiranje je vplivalo tudi na padec uspešnosti Slovenije v kazalnikih Evropskega inovacijskega indeksa. Slovenija mora priti do 1% javnega financiranja za raziskovalno-razvojne dejavnosti iz različnih virov, ki so sedaj na razpolago v Načrtu za okrevanje in odpornost ter v okviru evropskih kohezijskih sredstev za naslednjih 10 let, ki jim morajo slediti tudi sredstva iz nacionalnega proračuna.

MIZŠ iz evropskih kohezijskih sredstev financira povezovanje gospodarstva z raziskovalno sfero ter s tem razvojno-raziskovalne projekte na TRL lestvici od 3 do 6, ki se jim s financiranjem priključi tudi MGRT na višjih ravneh tehnološke pripravljenosti.

Zagotovljeni so formalni pogoji za ustanovitev odcepljenih podjetij, za katera so potrebni tudi veliki finančni vložki. MIZŠ teh vložkov v odcepljena podjetja ne more financirati iz opravljanja javne službe. Prav tako je potrebno poleg vzpostavitve finančnih instrumentov pritegniti tudi partnerje, ki imajo veliko raziskovalne opreme in znanja.

5. Prof. dr. Robert Repnik, direktor Javne agencije za raziskovalno dejavnost Republike Slovenije
Vprašanje: ARRS določa v Pravilnikih (Pravila za oblikovanje cen za uporabo raziskovalne opreme, obveščanje in poročanje o uporabi raziskovalne opreme) način določanja cen in upravljanja z raziskovalno in tehnološko infrastrukturo v Sloveniji. Kakšne priložnosti še vidimo med podjetji in JRO ter centri odličnosti, ki imajo infrastrukturo, ki bo jo lahko potrebovala podjetja? Kako podjetjem dovolj na glas povedati, da imamo opremo, ki jo potrebujejo, a je pri nas še niso našli?

Prof. dr. Robert Repnik:
Srednji del TRL-jev je v Sloveniji resen problem. Nižji TRL-ji (predvsem TRL 1-2, pogojno TRL 3) spadajo v področje znanosti, ki jih pokrivata MIZŠ in ARRS v skladu s smernicami resornega ministrstva.

Na drugi strani podporo pri premostitvi srednjih TRL-jev nudijo MGRT, SPIRIT, Slovenski podjetniški sklad in tudi Gospodarska zbornica Slovenije.

Za rešitev problematike srednjih TRL-jev je ključno zavedanje deležnikov in njihovo soglasje, da je problem srednjih TRL-jev v Sloveniji resen in je zato potrebno premostiti dolino smrti.

Za uspešno premostitev je potrebno sprejeti skupno odločitev, da je to nujno ter zagotoviti institucionalno podprtost in pokritost premostitvenega procesa.

Prav tako morajo skupno nastopiti vsi, ki pokrivajo posamezne skupine TRL-jev. Nižje TRL-je pokrivajo znanstveniki, višje pa gospodarstvo, medtem ko je »srednja množica« prazna.

Ljudje, ki delujejo na teh področjih in stojijo za temi skupinami TRL-jev, morajo začutiti svojo osebno motivacijo, da uspešno izkazujejo svoje talente skozi rezultate.

Govorec je prepričan, da obstajajo še nekateri talenti, ki jih je potrebno aktivirati za vstop na področje srednjih TRL-jev. Pri tem sta možna dva pristopa, in sicer, da ustvarimo skupino ljudi, ki bi delala na področju srednjih TRL-jev, ali pa motiviramo obe skupini raziskovalcev, da aktivirajo svoje lastne talente in začnejo delovati tudi na področju srednjih TRL-jev.

Raziskovalna oprema je drugi segment, ki odgovarja in naslavlja težavo srednjih TRL-jev. En del je že vzpostavljen, ker se skozi ARRS plačujejo investicije v nakup raziskovalne opreme na javnih raziskovalnih organizacijah. Taka oprema na javnih raziskovalnih organizacijah že obstaja, vendar podjetja premalo poznajo možnosti, kako do nje dostopati.

V Evropi obstajajo primeri dobre prakse, ki pa jih ni mogoče enostavno preslikati v naše okolje, da bi delovali. V Sloveniji bi morali najprej dobro pregledati seznam opreme, preveriti, če je ustrezno vpisana in ažurirana. Potem bi lahko seznam opreme promovirali pri gospodarskih družbah, da podjetja spoznajo, kakšne možnosti obstajajo.

6. Prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru
Vprašanje: Kaj sploh je povezovanje z družbo? S stališča univerze, katere raziskovalno delo obsega velik delež naravoslovno tehničnih vsebin? Gre bolj za članke in sodelovanje na konferencah, za neformalne razgovore in občasno naključno pomoč tistim podjetjem, ki so bolje informirana in se bolje znajdejo pri dostopanju do JRO, ali pa bi se morali potruditi vzpostaviti enoten sistem, v katerem bi vsako, še tako majhno, če le dovolj aktivno in radovedno podjetje prišlo v stik s pravim raziskovalcem, pa tudi dobilo dostop do ustrezne infrastrukture za izvedbo meritev za potrebe podjetja?

Prof. dr. Urban Bren:
Univerza v Mariboru izhaja iz gospodarske pobude. Na dolgi tradiciji sodelovanja z gospodarstvom gradimo naprej. Včasih je bilo tako sodelovanje naključno in stihijsko na podlagi osebnih poznanstev. Danes pa projekta KTT1 in KTT2 vzpostavljata institucionalno in

formalizirano raven sodelovanja. Na ta način lahko univerze in javne raziskovalne organizacije delujejo kot enotna vstopna točka (one-stop-shop) za sodelovanje z industrijo.

V vzhodni kohezijski regiji smo zelo razpršeni. Tako ima Univerza v Mariboru svoje institucije še v Krškem, Brežicah, Velenju, Celju, Hočah in pri Murski Soboti. Na ta način se znanje bliža uporabnikom v regije, kar je pomembno za enakomeren razvoj države. Prav tak »one-stop-shop« pristop preko kohezijskih regionalnih središč lahko opolnomoči Slovenijo in jo naredi mnogo odpornejšo.

Pomembno pa se je zavedati, da prenos znanja ne vključuje zgolj tehnologij za gospodarstvo, ampak tudi prenos v negospodarstvo, v javne institucije in občine.

7. Prof. dr. Klavdija Kutnar, rektorica Univerze na Primorskem in prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
Vprašanje: **Vloga Centrov odličnosti.** Leta 2009 je bilo s strani MIZŠ ustanovljenih 7 Centrov odličnosti, ki so spremenili slovensko raziskovalno pokrajino in jo razgibali, predvsem tudi glede ponujanja dostopa do raziskovalne infrastrukture.

IJS ima veliko izkušenj s centri odličnosti, saj je že ob ustanovitvi deloval kot ustanovitelj v treh različnih, na različnih področjih, pomemben del sodelovanja z industrijo poteka tudi danes z njihovo pomočjo.

Univerza na Primorskem, kot soustanovitelji zasebnega raziskovalnega zavoda Innorenew, katerega soustanovitelj je tudi nemški Fraunhofer WKI, se dobro zaveda pomembnosti povezave med temeljnim in uporabnim raziskovanjem, kot pravne oblike, ki omogoča tudi sodelovanje slovenskih in mednarodnih deležnikov.

Kako vidite razvoj področja centrov odličnosti v Sloveniji v prihodnje? Si želimo nove CO in zakaj ali zakaj ne? Kaj to pomeni za nadaljnje drobljenje raziskovalnega prostora v Sloveniji? Kako skozi Centre odličnosti s pomočjo javnih raziskovalnih organizacij urediti odnos glede raziskovalne in tehnološke infrastrukture ter ponujanje le-te podjetjem, saj vemo, da je vsaj del opreme nepopolno izkoriščen, podjetja imajo potrebo po rabi, vendar do realizacije zaradi zapletenosti sistema ne pride? Kako vidite centre odličnosti na lestvici nivoja tehnološke pripravljenosti TRL? In kako so s centri odličnosti ter raziskovalno infrastrukturo, ki prehaja v tehnološko infrastrukturo, povezane pisarne za prenos tehnologij kot most med njimi?

Prof. dr. Klavdija Kutnar:
Univerza na Primorskem (UP) je nastala na drugačen način kot Univerza v Mariboru. UP je imela predvsem družboslovno in humanistično usmeritev, hkrati pa izjemno željo za sodelovanje z gospodarstvom v lokalnem okolju. Sodelovanje je bilo oteženo, ker ni bilo razvoja na naravoslovno-tehničnem področju. V naslednjih osemnajstih letih so vzpostavili odlična in tudi nekatera vrhunska nišna naravoslovna področja. Pri tehnologiji pa je bilo težje, ker so v ozadju zelo veliki finančni stroški. Zato so iskali rešitve za okrepitev področja tehnike in tehnologij.

V tem konceptu so s pomočjo evropskih sredstev s še osmimi drugimi institucijami ustanovili Center odličnosti.

Center odličnosti Innorenew ne drobi raziskovalnega prostora, ampak krepi znanstveno odličnost in povezovanje različnih institucij. Preko Centra odličnosti so združili različne kompetence in znanja, da so naredili preboj v znanstveni odličnosti. Vsi partnerji so vstopili s strateško odločitvijo. Zato Center odličnosti ni konkurenca, ampak partner, ki so mu podelili polno avtonomijo.

V UP želijo, da bi prišli do tako močnih pisarn za prenos tehnologij kot jih ima njihov odlični partner Fraunhofer. Le-ta deluje na način, da zaposleni strokovni sodelavci najprej presodijo vsak znanstveni članek, če ima potencial za preboj in prenos v industrijo. Potem se odločijo, ali gredo v patentiranje in zaščito intelektualne lastnine, ali v odprto znanost.

V Sloveniji se razlikujejo cilji javnih raziskovalnih institucij, ki stremijo k odprti znanosti in podjetij, ki zasledujejo druge cilje. Zato imajo pisarne za prenos tehnologij pomembno vlogo, da povežejo gospodarstvo z raziskovalno sfero.

Raziskovalci UP, ki so najaktivnejši v povezovanju z gospodarstvom, imajo največ težav z ohranitvijo svoje raziskovalne pozicije na univerzi, ker takšnega sodelovanja ne morejo uveljavljati v habilitacijskih merilih. Zato si na UP prizadevajo, da bi dali več točk v habilitacijskih postopkih dodani vrednosti prenosa znanja v gospodarstvo.

Komentar moderatorke dr. Špele Stres:
Profesionalizacija dela v pisarnah za prenos tehnologij bi bila pravi korak v smeri, da bi se tovrstno podporo lahko nudilo.

Prof. dr. Boštjan Zalar:
Govorec meni, da Centri odličnosti sodijo na tisti del lestvice nivoja tehnološke pripravljenosti TRL, kjer govorimo o dolini smrti. Centri odličnosti bi lahko bili zelo učinkoviti na tem področju.

Raziskovalci imajo dokaj deljena mnenja o uspešnosti Centrov odličnosti, ki so bili ustanovljeni v drugem valu v letih 2008 in 2009 in so žal sovpadali s svetovno gospodarsko in finančno krizo. Centri so bili mišljeni kot injekcija v raziskovalno opremo, ki bi bila na uporabo podjetjem. Vendar se je prav v tem obdobju dogajalo podfinanciranje osnovne znanosti. Namesto, da bi država za takšne iniciative našla dodaten denar, je del denarja prenesla iz enega sektorja v drugega.

Centri odličnosti so potrebni, saj se lahko preko njih podpre in mednarodno uveljavi prioritizirano področje znanosti, npr. digitalno transformacijo, kvantne tehnologije in umetno inteligenco, kjer Slovenija kot majhna država naredi preboj v svetovnem merilu.

Pomembno vlogo pri tem ima na IJS pisarna za prenos tehnologij, ki je vez med akademijo in gospodarstvom, predvsem s pravno in sistemsko podporo, z ovrednotenjem učinka in doprinosa raziskovalčevega izuma k dodani vrednosti.

V Sloveniji bo potrebno na pisarne za prenos tehnologij gledati kot na nekaj nujnega, saj sploh niso umeščene v današnjim sistem financiranja. Delo v pisarnah za prenos tehnologij je specifično, ker potrebuje visoko izobražen kader. Od odločevalcev se pričakuje, da bodo na boljši način uredili delo in financiranje pisarn za prenos tehnologij kot del javno raziskovalnih organizacij.

8. Prof. dr. Matej Makarovič, dekan Fakultete za informacijske študije v Novem mestu
Vprašanje: **IKT.** Glede na to, da je ena od temeljnih usmeritev dela Fakultete za informacijske študije prav informatika kot področje raziskav in da je velik del na delo raziskovalcev vezanih inovacij po svoji naravi software. Stanja na področju zaščite programske opreme v Evropski Uniji oz. v Evropi še vedno ne moremo obravnavati kot povsem pravno urejenega, niti kot pravno neurejenega. Področje zato narekuje številne priložnosti za nadaljnje delo. Kako vidite smernice za obravnavo programske opreme, da bi izboljšali stanje s katerim se znanstveniki na področju računalništva soočajo predvsem pa nagrajevanju iz izumov, povezanih s programsko opremo v slovenskem inovacijskem prostoru?

Prof. dr. Matej Makarovič:
V času digitalne transformacije je paradoksalno, da je področje patentov in nagrajevanja inovacij na področju programske opreme do neke mere nedorečeno.

Kadar je inovacija samo na področju programske opreme in ne vključuje strojne razsežnosti, ne omogoča klasičnega polnega preskusa patenta oziroma njegovega tehničnega doprinosa. S tem so raziskovalci, ki inovirajo samo na področju programske opreme, v neenakopravnem položaju, saj se postavlja neka arbitrarna meja pri patentiranju.

To vprašanje bi morali reševati na nivoju Evropske unije. V Sloveniji bi lahko na nacionalnem nivoju uredili npr. nagrajevanje, ki ni samo denarno. Raziskovalce - informatike pritegnejo tudi dobri odnosi, priznanja in možnosti napredovanja.

Z razmislekom glede kriterijev habilitacije in točk, ki se izračunavajo na osnovi SICRIS baze, je možno urediti nagrajevanje inovacij na programski opremi, ki nima strojne dimenzije. Tehnični preskusi patentov namreč prinesejo veliko več točk. To bi lahko bilo priporočilo za ARRS in NAKIS, da se ta dimenzija pri kriterijih za projekte in habilitacije bolj upošteva.

9. Prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
Vprašanje: Eden od prijaviteljev European Digital Innovation Hub (e-DIH) je tudi Fakulteta za elektrotehniko UL. S prehodom inovacij na digitalno področje je programska oprema postala pomemben del sodobnih izumov in stvaritev, hkrati pa predstavlja izjemno pomemben del intelektualne lastnine – tako v slovenskem kot evropskem prostoru. Obenem je prav to področje v praksi najmanj urejeno tudi glede ustanavljanja odcepljenih podjetij, poleg tega pa podjetja v Sloveniji ne dobijo dovolj podpore pri procesih digitalizacije. Kako vidite možnosti, da se to v praksi izboljša in kako so v te napore vpeti vzporedno ali v sodelovanju tako TTO kot DIHi in kje vidite sinergije med njimi?

Prof. dr. Gregor Majdič:
Vsekakor bi tu morale biti povezave in vzporednice. Nenazadnje gre za veliko vzporednic. Pri digitalni transformaciji govorimo od dveh stvareh.

En del so podjetja, ki izvajajo in tržijo digitalne inovacije, na drugi strani pa so pomemben del podjetja, ki proizvajajo druge produkte in pri svojem delovanju uporabljajo digitalna orodja.

Pri ustanavljanju novih podjetij, ki delajo na področju digitalizacije, imajo pisarne za prenos tehnologij klasično vlogo. Pri pomoči pri digitalizaciji drugih podjetij bi pisarne za prenos znanja prav tako lahko imele podobno podporno vlogo kot jo imajo pri drugih vidikih ustanavljanja nekega podjetja, npr. s pomočjo pri birokratskih in finančnih vprašanjih. Tudi pisarne za prenos znanja bi se lahko posvetile digitalizaciji tako, da bi v svoje delovanje vključile digitalizacijo, pomoč podjetjem, našle načine, kako tudi z digitalizacijo pomagati podjetjem, ko se ustanavljajo, prihajajo na trg ter iščejo nove poti za internacionalizacijo in scale-up ter kako pri tem čimbolj izkoristiti digitalizacijo.

Govorec lahko na podlagi lastnega primera, kot znanstvenik na področju znanosti o življenju, ki se ne spozna na digitalizacijo, vidi veliko pomoč pisarn za prenos znanja pri tem.

10. Prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru
Vprašanje: **Ob tem ne smemo pozabiti, da je eden od prijaviteljeDIH tudi UM.** Naslednje vprašanje pa je **povezano z Open Science.** Univerza v Mariboru se v okviru vzpostavljanja odprte znanosti kot pomemben akter na slovenskem parketu glede naslavljanja vsebin Open Science, še posebej v kontekstu Ustanovitve Slovenske skupnosti odprte znanosti. Kakšna je v**loga TTOjev v upravljanju z IL in hkratnemu spodbujanju raziskovalcev h konceptu odprte znanosti.** European Open Science Community že od leta 2013 vzpostavlja sistem za hranjenje in ponovno uporabo podatkov iz raziskav, ki jih financira država. Če vemo, da je skozi celoten H2020 OpenScience postajal pojem za dostopanje do podatkov, ali smo v večini raziskovalnih skupin danes vsebinsko pripravljeni na dele projektov, kjer je potrebno opisati pretekle data-sete, njihovo validacijo ter prakse open science? Open science sicer ni v nasprotju z zaščito IL, vendar pa oboje sledi nekim pravilom, ki jih je potrebno upoštevati, da se doseže maksimalen vpliv raziskav, kako so z zagotavljanjem vpliva povezani TTOji in če v Sloveniji niso, zakaj ne? Kako vidimo razvoj vseh teh področij v Sloveniji in ali jih vidimo povezano?

Prof. dr. Urban Bren:
Univerza v Mariboru ima resnično številne repozitorije odprte znanosti, ki jih uporabljajo tudi druge institucije.

Vsekakor se odprta znanost sliši odlično na papirju. Odprta znanost je financirana iz javnih sredstev, zato so tudi izsledki javno dostopni. V tem mozaiku pa smo pozabili na založbe, ki večinoma niso javne, zasledujejo tržni princip in zahtevajo plačilo za objavo prispevkov znanstvenikov.

Znanstveniki tako sami plačujemo za odprte članke. Na drugi strani pa mnogo založb zahteva članarino ali direktno plačilo na spletni strani za prebiranje člankov.

Posledično se lahko zgodi, da znanstvenik ne bo mogel objavljati, ali pa bo zelo težko objavljal, če ne bo imel raziskovalnega projekta, s katerim si bo kupil odprtost svojih člankov. ARRS sicer najboljše članke v posamezni kategoriji naslavlja preko njenega razpisa.

Še večji strah in problem pa je v primerih, ko je s tem povezano podjetje, ki ga skrbi, da ne bi izgubilo svoje intelektualne lastnine.

Javnost podatkov, ki jih moramo zasledovati v skladu s strategijo odprte znanosti, predstavlja večji izziv od javnosti objav. Lahko se zgodi, da bo kdo drug na znanstvenikovih odprtih podatkih napisal članek. Še večji izziv pa bi nastal za podjetje, ki sodeluje z javnim zavodom in bi na ta način delilo svoje podatke s konkurenco.

11. Mag. Gregor Umek, vodja Sektorja za industrijo, spodbujanje inovativnosti in tehnologije v Direktoratu za internacionalizacijo, podjetništvo in tehnologije (Ministrstvo za gospodarski razvoj in tehnologijo)
Vprašanje: **Reforma inovacijskega sistema.** V okviru Načrta za okrevanje in odpornost je predvidena tudi reforma na področju RRI. Deležniki inovacijskega okolja v Sloveniji pogosto med seboj niso dovolj povezani. Kako na MGRT razmišljate o možnostih izboljšanja povezav in koherentnosti delovanja inovacijskega okolja?
Kako bi po vašem mnenju lahko dosegli boljše sodelovanje JROjev in gospodarstva ter politike v Sloveniji, tudi z namenom izboljšanja procesov prenosa tehnologij iz JRO v gospodarstvo?

Mag. Gregor Umek:
Reforma RRI znotraj Načrta za okrevanje in odpornost je ključna in predvideva sprejem novega Zakona o znanstvenoraziskovalni in inovacijski dejavnosti (ZZRID). Prav tako je ključna vpeljava novega modela upravljanja in povezovanja deležnikov inovacijskega sistema predvsem preko razvojnega sveta. MGRT je s strani ministrstva, ki naslavlja gospodarstvo, predvidel vključitev direktorjev SPIRIT-a in Slovenskega podjetniškega sklada ter predstavnike SRIP-ov v razvojni svet, ki naj bi na strateški ravni usklajeval politiko.

V programskem svetu sodelujejo MGRT, MIZŠ, Ministrstvo za kmetijstvo in SVRK s svojimi izvajalskimi agencijami, ki implementirajo ukrepe. Trenutno je v pripravi postopek za evalviranje in standardizacijo ukrepov.

Zato sta ključni okrepitvi ARRS-ja in SPIRIT-a, v katerem je predvidena zaposlitev 15 novih ljudi. Področje inovacij bi se upravljalo v okviru Agencije SPIRIT na trodelnem sloju na način, da bi se vse finančne spodbude izvajale preko Agencije, kar je boljše z vidika upravljanja, prav tako podjetja vse dobijo na enem mestu. Tudi vsa mednarodna dejavnost bi se izvajala v sklopu Agencije SPIRIT, kar bi dalo slovenskim inovacijam prepoznavnost na mednarodni ravni. Prav tako bi se v Agenciji upravljali in koordinirali vsi deležniki.

Pri reformi RRI je zelo pomembno, da MGRT v okviru obstoječih razpisov za spodbujanje raziskav in razvoja ter demo pilotov, uvaja v skladu z Načrtom za okrevanje in odpornost načelo, da vsi ukrepi, ki bodo znotraj teh razpisov, ne smejo škodovati okolju. Kar 40% meril mora biti vezano na trajnost in zeleni prehod, kar je ključno tudi v naši industrijski strategiji, v kateri moramo doseči zeleni prehod.

Prav inovacije lahko pripomorejo k zelenemu prehodu, kar je govorec ilustriral na primeru Steklarne Hrastnik, ki je s pomočjo pilotov naredila inovacijo na steklarski peči s ciljem ničelne ogljičnosti.

Pri reformi RRI je ključno stabilno financiranje. Ker imamo pomanjkanje integralnih sredstev, nastanejo vrzeli med več finančnimi kohezijskimi perspektivami, v katerih podjetja ne morejo dve leti dostopati do sredstev.

Ključno je, da se tudi z novim Zakonom o znanstvenoraziskovalni in inovacijski dejavnosti MGRT zavezuje k 1,25% javnemu financiranju, ker morajo imeti podjetja stalen dostop do teh sredstev.

Prav tako je ključno povezovanje vseh ukrepov MGTR-ja in MIZŠ-a za podporo/ financiranje lestvice nivojev tehnološke pripravljenosti, da lahko tudi podjetja na eni točki dostopajo do vseh ukrepov.

MGRT konkretno sodeluje z Gospodarsko zbornice Slovenije pri Načrtu za okrevanje in odpornost, ki lahko da odziv s terena, kaj dejansko podjetja potrebujejo in kje so izzivi, ki jih mora nasloviti MGRT.

Če bomo v Sloveniji želeli financirati vse, kar je vključeno v Načrtu za okrevanje in odpornost, so ključne sheme državnih pomoči. Brez ustreznih shem ni možno financirati investicij pri demo pilotih in zelenega prehoda. Evropski komisiji je potrebno predlagati, da je nujna večja prilagodljivost države članice, ki je omejena s shemami državnih pomoči.

Podvprašanje:
Vloga strateško razvojno inovacijskih partnerstev (SRIP). Vzporedno z vzpostavitvijo Konzorcija za prenos tehnologij s strani MIZŠ se je na MGRT vzpostavil sistem S4 in SRIPi. Danes vidimo, da SRIPi in TTO opravljajo komplementarne storitve (SRIPi informiranje in mreženje podjetij tudi za namen vzpostavljanja tematik za razpisne sheme), TTO pa pri vzpostavljanju odnosov JRO-podjetja igrajo bolj operativno vlogo podpore posamičnim primerom sodelovanja pri vzpostavljanju vsakodnevnih, mukotrpnih gradenj odnosov med posamičnimi podjetji in JRO. SRIPi in TTO se torej prekrivajo v manjšem deležu svojih aktivnosti. Kako naj se vzpostavi aktivna povezava in sinergije med obojimi?

Mag. Gregor Umek:
SRIP-i in pisarne za prenos tehnologij so deležniki inovacijskega sistema, ki z različnim delovanjem povezujejo javne raziskovalne organizacije in gospodarstvo. Pisarne za prenos tehnologij želijo prenesti znanje iz JRO-jev v gospodarstvo. SRIP-i delujejo širše in krepijo razvojno-raziskovalno in inovacijsko dejavnost med gospodarstvom, JRO-ji in tudi drugimi deležniki na področju razvoja. Predvsem pa je vloga SRIP-ov, da povezujejo vse te deležnike v mednarodne verige vrednosti na področju internacionalizacije.

MGRT z MIZŠ in drugimi deležniki sodeluje pri projektu Evropske komisije z naslovom »Strengthening the innovation eco-system in Slovenia«. Ključno sporočilo projekta je, da morajo bolje povezati vse deležnike inovacijskega eko sistema, za kar bodo v Načrtu za okrevanje in odpornost predvidena konkretna finančna sredstva (3 mio EUR) za mreženja, organizacijo delavnic in opolnomočenje med vsemi deležniki. Na ta način lahko povežemo SRIP-e, pisarne za prenos tehnologij in vse deležnike.

12. Mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
Vprašanje: **Konzorciji za prenos tehnologij.** Če pogledamo skozi zadnjih 15 let, Leta 2008 je le redkokdo poznal določbe v Zakonu o izumih iz delovnega razmerja, ki opredeljujejo obvezo države, da financira TTOje za delo z raziskovalci, posebej. Leta 2013 je konzorcij za prenos tehnologij financiral MGRT za slabi dve leti. Rezultati niso bili navdušujoči, čeprav so bili zahtevani rezultati minimalni. Leta 2015 so najprej MGRT, nato pa še skupno SVRK in MIZŠ zavrnili možnost financiranja novega konzorcija za prenos tehnologij, od leta 2017 pa pod okriljem MIZŠ konzorcij uspešno deluje. Kako vidite razvoj področja v zadnjem desetletju na MIZŠ in kako vnaprej, ne toliko glede financiranja, ki je sicer pomembno za trajnostni razvoj področja. Temveč: kako vidite strateški razvoj področja prenosa znanja, njegovega pomena za Slovenijo, možnost in načine profesionalizacije aktivnosti in predvsem povezave z drugimi strateškimi instrumenti?

Mag. Damjana Karlo:
MIZŠ je ta izziv že naslovil iz preteklih izkušenj pri pripravi nove raziskovalne in inovacijske strategije Slovenije do leta 2030. V strategiji namenjajo še večjo težo sistemskemu urejanju področja prenosa znanja, da se okrepi sistemska podpora z integralnimi sredstvi, ki jih 20 JRO-jev pridobi za delovanje. Znotraj teh sredstev bo vsak JRO v skladu s svojo avtonomijo opredelil, koliko sredstev bo namenil področju prenosa tehnologij. MIZŠ želi, da se na vseh 20 JRO ustanovijo pisarne za prenos znanja.

MIZŠ namerava iz evropskih kohezijskih sredstev 2021-2027 nadgraditi obstoječi konzorcij KTT v približno enakem obsegu, ker so praktično že letos doseženi ali preseženi vsi kazalniki projekta, ki se zaključuje 30. junija naslednje leto.

MIZŠ si bo prizadeval, da ne bo prišlo do vrzeli v financiranju in načrtuje objavo javnega razpisa za nadgradnjo konzorcija KTT iz evropske kohezijske politike 2021-2027 takoj, ko bodo izpolnjeni vsi formalni pogoji na ravni države, kar bi lahko bilo od druge polovice leta 2022 dalje.

Komentar moderatorke dr. Špele Stres:
Obe ministrstvi (MGRT in MZIŠ) sta usklajeni v svojem delovanju, da preprečita vrzel v financiranju. Še posebej želi MIZŠ preprečiti vrzel pri financiranju konzorcija KTT. Vendar se projekt KTT zaključuje 30.6. naslednje leto, kar pa pomeni operativno težavo in nastanek vsaj minimalne vrzeli, če bodo razpisi objavljeni v drugi polovici leta 2022.

Kadri za prenos tehnologij, ki so se razvili in profesionalizirali v okviru konzorcija, so izjemnega pomena in bi jih pisarne za prenos tehnologij želele obdržati. Zato bi bilo potrebno vrzel v financiranju čimbolj skrajšati.

13. Prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
Vprašanje: **Razdrobljenost.** Kako razdrobljenost raziskovalne sfere (slišali smo, da govorimo o 20 JRO in nekaj desetih nejavnih, ki prav tako izvajajo raziskovalno dejavnost, predvsem iz evropskih sredtsev) v Sloveniji vpliva na kvaliteto storitev TTOjev na posamičnih organizacijah? Je smiselno in upravičeno pričakovati visokokvalitetne storitve za raziskovalce, od vzpostavljanja raziskovalne strategije in pridobivanja financiranja za vse faze TRL (kot npr. pri Fraunhoferju, kjer pregledujejo vse znanstvene članke raziskovalcev in se odločajo, ali gredo v odprto znanost ali patentiranje), do kapitalizacije na trgu? So take storitve celostno sploh zaželene, saj deloma posegajo v raziskovalno svobodo?

Prof. dr. Boštjan Zalar:
V dvomilijonski naciji ne moremo preslikati učinkovitih rešitev iz velikih nacij, ki so svoje sisteme že zgradile. Zato bomo vedno doživljali rahlo razdrobljenost raziskovalne sfere. Pri reševanju določenega tehnološkega problema se je potrebno ozreti tudi v tujino, ker ni nujno, da bomo v svojem ožjem okolju našli tehnološko rešitev.

Na drugi strani se dnevno postavlja vprašanje, od katere stopnje tehnološke pripravljenosti dalje potrebujemo podporo pisarn za prenos tehnologij. Postavlja se tudi dilema, ali je vse, kar delamo v znanosti (npr. merjenje mase črne snovi v vesolju), možno uvrstiti na lestvico TRL. V znanosti je še vedno en del, kjer bi morala biti lestvica znanja – na kateri stopnji znanja smo in ne na kateri stopnji tehnološke pripravljenosti.

V Sloveniji naj se zgledujemo po dobrih zgledih iz tujine. Evropa je ustanovila Evropski raziskovalni svet. V programu Obzorje Evropa imamo sedaj tudi novo institucijo - Evropski inovacijski svet, ki se ukvarja z vprašanjem, koliko daleč naj posega na lestvici TRL – ali že v osnovni znanosti, ali sploh ne.

ZAKLJUČKI

Gregor Klemenčič, Deepinovations (Nizozemska)
Kot zunanji opazovalec in nekdo z ogromno izkušnjami iz obeh strani, JRO in gospodarstva v inovacijskem sistemu, še posebej glede na to, da ste vanj umeščeni v bolj razvitem tujem okolju, ki se mu želi Slovenija s svojo inovacijsko dejavnostjo približati. Kako v luči današnjega pogovora gledate **na vlogo in pomen različnih deležnikov v inovacijskem okolju**? Kako močno lahko **politika, JRO in TTOji vplivajo na** zagotavljanje inovativnega mišljenja, internacionalizacije, prenosa znanja in izkoriščanja rezultatov? Prosim za zaključno misel.

Zaključna misel:
V njegovem raziskovalnem okolju razdrobljenost obstaja in ni problem, ker gre za razdrobljenost po temah (npr. informacijsko-komunikacijske tehnologije, biotehnologija). Tudi pisarne za prenos tehnologij so praviloma uspešne, še posebej, če se povezane z gospodarskimi zbornicami, drugimi raziskovalnimi organizacijami in komercialnimi firmami.

V pogledu od spodaj navzgor imajo znanstveniki s svojim zagonom, znanjem in interesi možnost, da se srečujejo z drugimi znanstveniki in start-upi. Na zelo uspešnih mikro srečanjih na določeno temo se znanstveniki povežejo in izmenjujejo znanje z drugimi raziskovalci, se povezujejo z malimi, srednjimi podjetji ter pridobijo tudi mikro financiranje.

Komentar moderatorke dr. Špele Stres:
Mikro srečanja so v tej luči vzpostavila B2R sestanke, ki se dogajajo on-line vzporedno s konferenco in iz katerih se lahko razvije dolgoročnejše sodelovanje.

Zaključne misli drugih udeležencev okrogle mize:

Mag. Damjana Karlo:
Znanje je potrebno ne samo ustvariti, ampak ga tudi prenesti v družbo - tako v gospodarstvo kot v širši sistem, zaščititi in pripeljati do inovacij ter na ta način izboljšati našo mednarodno konkurenčnost in izboljšati kakovost življenja.

Prof. dr. Robert Repnik:
Pristop, o katerem smo danes govorili, je pravilen. Vendar ga je potrebno kombinirati s pristopom od spodaj navzgor. Pri tem je potrebno upoštevati, kateri motivacijski elementi bi ljudi prepričali v to, da bi se začeli ukvarjati s srednjimi stopnjami tehnološke pripravljenosti. Prav tako se je potrebno osrediniti na področja, kjer je največ možnosti, potencialov in priložnosti in kjer ima Gospodarska zbornica pomembno vlogo.

Mag. Gregor Umek:
Najpomembnejše je povezovanje med vsemi deležniki, ki je tudi del reforme v Načrtu za okrevanje in odpornost. Povezovanje od spodaj navzgor je zelo pomembno in MGRT že

sodeluje z Gospodarsko zbornico in drugimi deležniki. MGRT mora pridobiti informacije s terena, se primerno odzvati in temu primerno voditi politiko.

Prof. dr. Matej Makarovič:
Ko govorimo o javnem financiranju in javnem raziskovanju, je predvsem pomembno, da služi tudi popravljanju »tržnih napak«, torej zagotavljanju tega, česar trg sam ne zagotavlja. Tipičen primer tega je področje trajnostnega razvoja.

Prof. dr. Maja Ravnikar:
Biti moramo aktivni na promociji znanosti, saj s tem osveščamo družbo in gospodarstvo, kaj je na voljo v Sloveniji. Poleg tega so zelo pomembne mehke veščine in izobraževanje raziskovalcev, kako pravilno pristopiti in se pogovarjati z gospodarstvom ter kako jim ponuditi tehnološke rešitve. Zato so nujno potrebne okrepitve pisarn za prenos tehnologij in znanja.

Prof. dr. Urban Bren:
V Sloveniji imamo dobro izdelan sistem financiranja temeljne znanosti. Aplikativna znanost šepa - kot da potrebujemo samo katalizatorje, potem pa bo prenos znanja stekel sam od sebe. Dejansko pa ta proces stalno potrebuje potisk energije in finančnih sredstev. Potem učinki prelivanja naredijo tak prenos znanja vzdržen in v dobrobit celotne skupnosti. Nekatera odlična orodja kot so mladi raziskovalci v gospodarstvu, mladi raziskovalci na začetku kariere in projekti TRL 3-6 so že razvita in jih je potrebno zgolj kontinuirano uporabljati.

Prof. dr. Gregor Majdič:
V Sloveniji imamo ogromno odlične znanosti, tako bazične kot aplikativne, čeprav sam nikakor nisem zagovornik takšne delitve na bazično in aplikativno znanost saj menim, da je znanost ena. Šepa pa nam pa prenos znanja, premalo znamo izkoristiti to znanje in ga prenesti na trg, da bi imelo tudi ekonomske učinke. Zato potrebujemo pisarne za prenos znanja, ki opravljajo zelo dobro vlogo in je njihov pomen potrebno še okrepiti. So pa v Sloveniji problem tudi kapitalske spodbude in pretakanje kapitala, saj nimamo pravih inštrumentov in vlagateljev v mlada zagonska podjetja. To je posebno velik problem na področju naravoslovja in deloma tehnike, saj so na teh področjih potrebni višji finančni vložki, ki se povrnejo v daljšem časovnem obdobju in zaradi tega je pogosto težko pridobiti zagonski kapital za podjetja s takšnih področij.

Prof. dr. Klavdija Kutnar:
Sporočilo današnje okrogle mize je, da je zelo pomembno povezovanje slovenskih raziskovalnih institucij. Prav partnerji iz drugih institucij so pomagali Univerzi na Primorskem, da so svojo dejavnost dvignili na višji nivo.

Prof. dr. Boštjan Zalar:
Prenehajmo se pogovarjati o temeljnosti in aplikativnosti, raznih lestvicah, saj linearne linije vse med sabo prepletejo.

Zaključna beseda: dr. Špela Stres

Če smo začeli s citatom Winstona Churchila o tem, da se moramo učiti celo življenje, naj tudi končamo na tak način. Vedno se bomo soočali z izzivi, in izzivi bodo vedno večji od nas. G. Churchil je glede našega odziva na izzive rekel Fear is a reaction courage is a decision. Z iskrenim upanjem, da bomo pri soočanju s prihodnostjo pogumni, se vam najlepše zahvaljujemo za vaše sodelovanje na tej izredno zanimivi okrogli mizi.

PITCH COMPETITION: BEST INNOVATION WITH COMMERCIAL POTENTIAL

From 10:30 to 12:00

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission:

Dr. Jon Wulff Petersen, Plougmann Vingtoft

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič, Slovene Enterprise Fund

Gregor Klemenčič, Deep Innovations

Presentation of six (6) selected business model proposals from public research organizations to the technology transfer experts.

Course of the competition

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

The 14th annual competition for the best innovation in 2021 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. Eligible authors are individuals, employed at PROs, which are developing innovative technologies and their teams into a viable business model. Possible business models are either licensing the technology to industrial partners or commercialization in a spin-out company. The teams have prepared description of their technology and the key discoveries that underpin the commercial activity (licensing or spin-out creation). An important part of description is the proposed business model and customer value proposition. The pitch presentations are following the guidelines, which were introduced by the Organizer of the Conference at the dedicated preparatory webinar and individual consultancy which was organized for the teams. At the webinar the researchers learned the main guidelines on how to prepare their pitch presentation. In a series of individual consultation and rehearsal of the pitch session 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: Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH, Gregor Klemenčič, Founder and co-owner, Deep Innovations B.V., Nina Urbanič, Adviser for equity investment monitoring, Slovene Enterprise Fund, and Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft.

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 Application with weight of 10 points, Value Chain with weight of 3 points, Market size and development costs with weight of 2 points, Competition with 1 point, the Team with 3 points, IPR and Regulatory with one point. All criteria together bring at the most 20 points for written application. 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 13th anniversary, motivated six innovative and entrepreneurial research teams to prepare their pitch and apply for competition. Members of the teams have participated in the preparatory workshop and rehearsal to develop their pitch and receive comments for improvements of their proposed business model. 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. Members of the teams are entirely or partly employed or study at the PROs, Jožef Stefan Institute, Jožef Stefan International Postgraduate School, University of Belgrade. Members of the teams are also the founders or employed at industrial partners, which are already involved in the technology and business model development.

Criteria	**Short description of the criteria**	**Max. points**
Application	Which problem is the technology solving? Has this been verified with end users? What is the Technology Readiness Level (TRL)? How many different applications can the technology be used for? Is there a well-defined end-user for this technology? Is there any barrier to the end-user adopting this solution? Is there a clear existing end user need for this solution? How well does this solution match the users' needs? When will this solution be ready for market? Will this solution have a social impact or bring other benefits to people?	10
Value chain	Where does the technology fit in? How well does the technology fit the existing value chain?	3
Market size and development costs	How is the market size in relation to the development costs? How large is the potential customer community for this product? 1000, 100K, 1M, 100M? How strong is the competition in this market? How receptive will the market be to your idea? What total market share do you expect to get in 5 years? How aligned are the market drivers to the proposed solution? What Is the perceived value by the end user? What is the perceived Strength level overall? What is the perceived Weakness level overall? What is the perceived Opportunity level overall? What is the perceived Threat level in your overall? Only limited development is required before an investor will commit. Funds are available to complete the development investor or other sources (e.g. PoC). The time to market Is shorter or comparable to the time scale for any competition. For VC's: The costs associated with taking the product to market is at least 25 times smaller than the value of the market.	2
Competition	What do the end users use today? Any other technology underway? Which is the expected competition level when you will hit the market How good is the present solution (not yours) in solving the problem? How good will any expected future solutions (not yours) be in solving the problem?	1

	How good will your solution be in solving the problem? How strong is your market differentiator?	
The team	Are the inventors, members of the team, dedicated to the idea? The researchers have unique skills, have experience with tech transfer, and are enthusiastic about following the project through The team has the technical, business, marketing, financing skills needed to understand and develop the idea into a marketable product?	3
IPR & Regulatory	Can the intellectual property of the technology be protected? How strong is the patent likely to be? How dense is the IPR landscape in this technology area in terms of pending and granted patents? How strong is the IPR competition? How complex is the regulatory system in this area Is the technology ready for investment?	1

Table 1: Criteria for evaluating the applications (source: Jon Wulff Petersen, TTO A/S, Denmark)

Abstracts of the competing teams and their technologies

Real-time fluorescence lifetime acquisition system – RfLAS

Authors/inventors: Andrej Seljak, Rok Dolenec, Rok Pestotnik, Matija Milanič, Peter Križan, Samo Korpar

PRO: Jožef Stefan Institute

Abstract:

The present pandemic has shown us how vulnerable we are, and challenged the human knowledge-based capacity to adapt very quickly. Biomedical engineering has produced one of the most outstanding up to date solution to avoid severe consequences due to Covid complications. One of the key tools used in biomedical engineering is measuring of the fluorescence response. This method is non-invasive, sample non-destructive, provides functional and structural information, biochemical parameters, oxygen concentration, pH, and other vital parameters, that enable the study of the interaction of proteins, and is sensitive enough to monitor cellular environment and metabolic states. Moreover, fluorescence is used in material sciences to characterize novel materials or screening drug production as examples. This key tool is made using complex electronic and optical elements, which makes market accessible devices very expensive.

We constructed a novel device, which compared to the current state of the art is about 10 times faster, provides extended capabilities, can be made the size to fit into a portable suitcase, and allows for very competitively pricing on the market, even considering initial small productions. This lands it perfect for start-ups and tech giants in the field, to access tools for future discovery. The technology is also scalable into a variety of different systems for different purposes. Our primary target are therefore biomedical and bioengineering companies, research institutes, universities, and companies requiring specific know how or OEM products.

We expect this technology to enter the biotech market, which alone is expected to hit 2.44T USD in 2028 [*]. This estimate is 3 times higher compared to pre Covid times (about 2 years ago). We present the newly developed device and its envisaged future.

*https://www.grandviewresearch.com/press-release/global-biotechnology-market

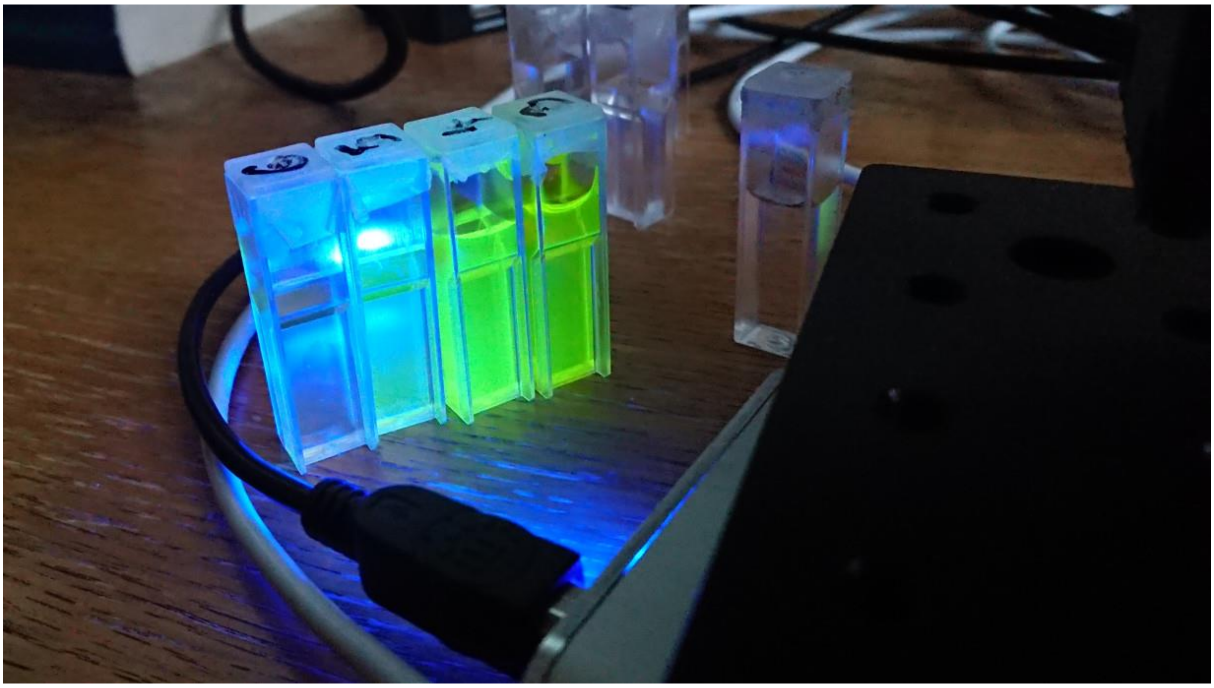

Figure 1: Fluorescence samples. Rok Dolenec. 2020.

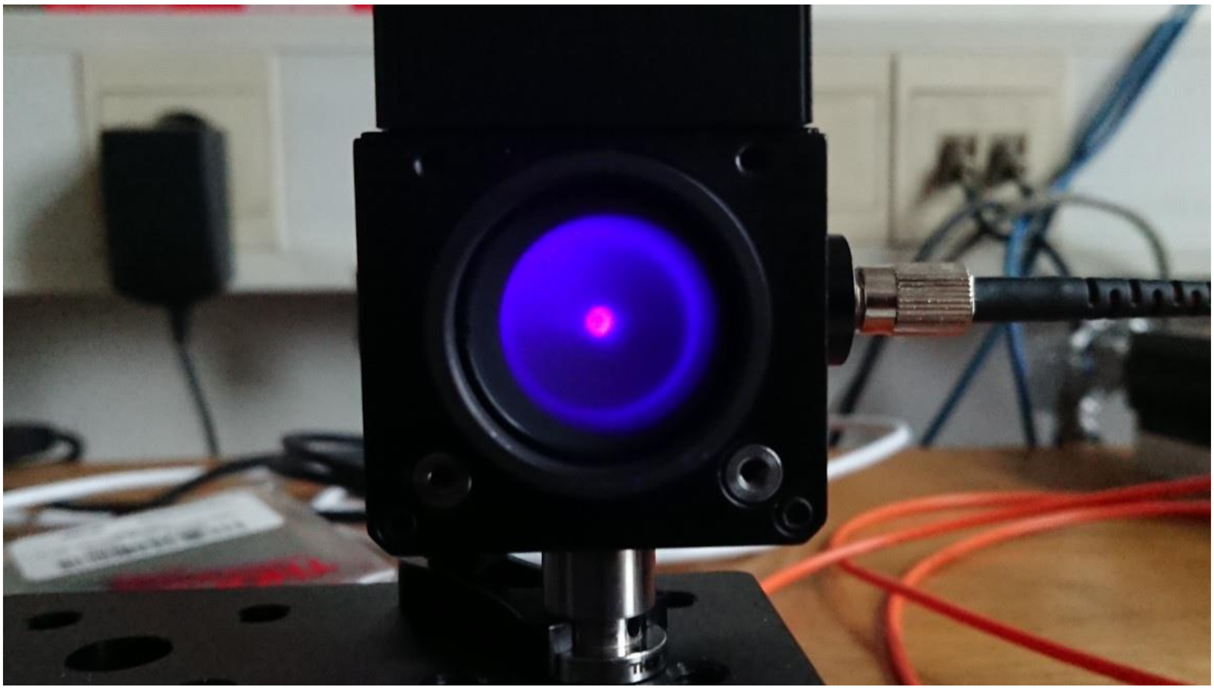

Figure 2: Cross view into sample space. Rok Dolenec. 2020.

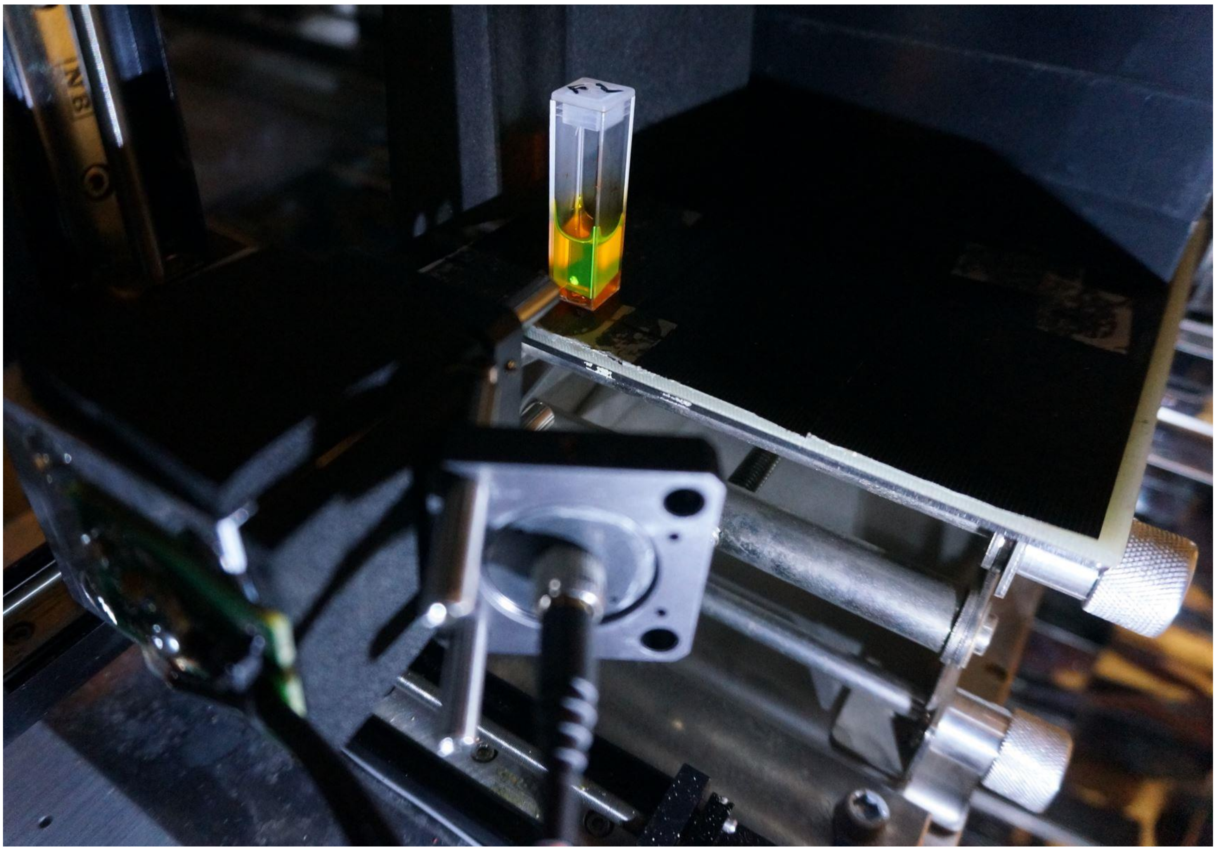

Figure 3: Device in operation. Rok Dolenec. 2020.

Tomappo OptiGarden – healthy, sustainable and nutritious vegetable garden planned in a few clicks

Authors/inventors: Bojan Blažica, Andrejaana Andova, Barbara Koroušić Seljak, Bogdan Filipič.

PRO: Jožef Stefan Institute

Industrial partner: Proventus, d.o.o.

Abstract:

Vegetable gardening is gaining popularity among the younger generation as growing your own local food and taking care of a healthy nutrition is increasingly trendy. Gardening is a rewarding and relaxing hobby, but can also be daunting as there is much knowledge to be considered when planning a healthy, nutritious garden. Considering gardening best practices such as crop-rotation and companion planning, data about vegetables and climate, yield estimation, nutritional contents and the needs and tastes of the gardener can be treated as an optimization problem and thus solved automatically with an algorithm with little effort by the user.

Automatic garden planning can be used to develop solutions in the home and garden market. From powering a mobile application for gardeners (B2C, approx. 5 million potential users in main EU markets, 44 million in the US) to advanced lead generation and e-marketing solutions addressing the need of garden centers and gardening brands to connect to a younger generation of gardeners and digitalize their operations both online and in-store.

A team of researchers with backgrounds in AI, optimisation, meteorology and human-computer interaction, who are keen gardeners themselves, is devoted to bring the benefits of gardening just a click away to all expert and aspiring gardeners. Teaming up with Proventus, the start-up developing the gardening platform Tomappo, ensures market uptake in both B2B and B2C segments and much needed business development experience.

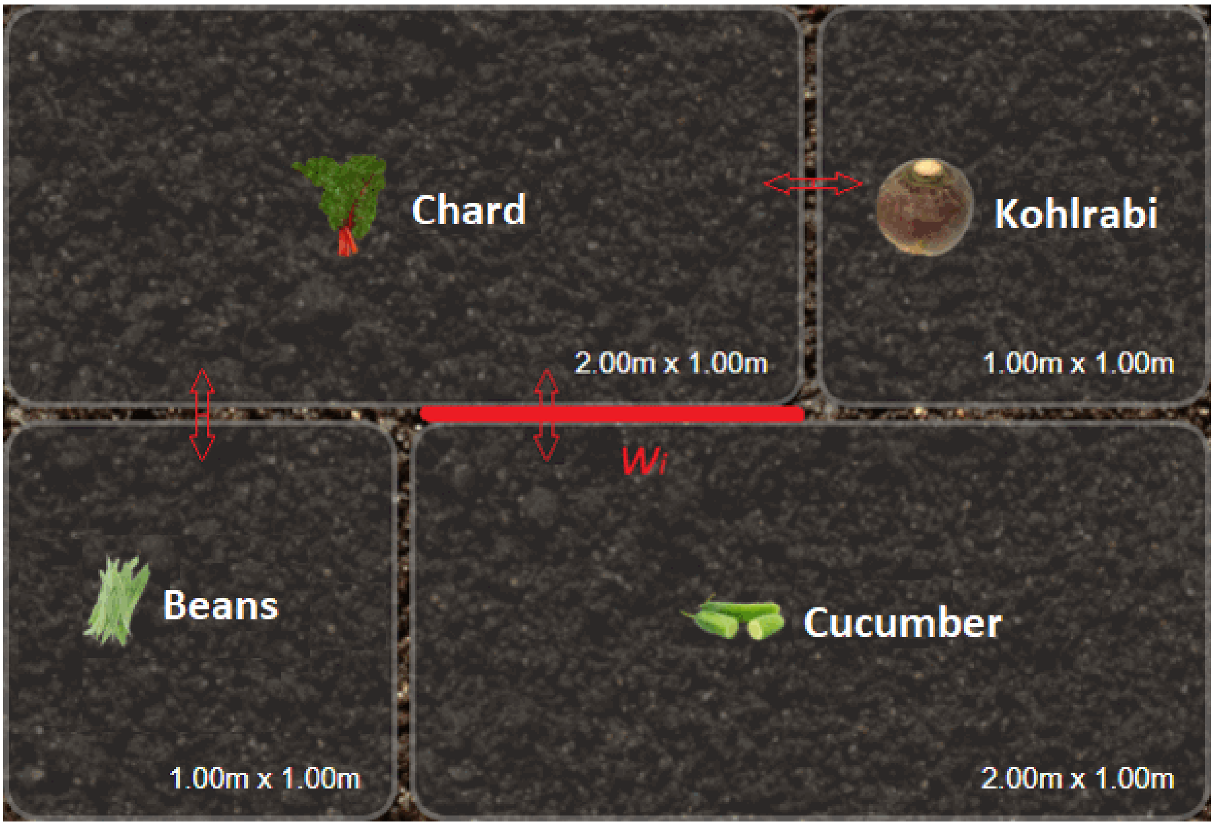

Figure 1: A segment of a vegetable garden illustrating the concepts to be considered in garden planning. Andrejaana Andova and Bogdan Filipič. 2021.

Figure 2: Testing the interactive kiosk in garden centre Kalia, Ljubljana. Bojan Blažica. 2021.

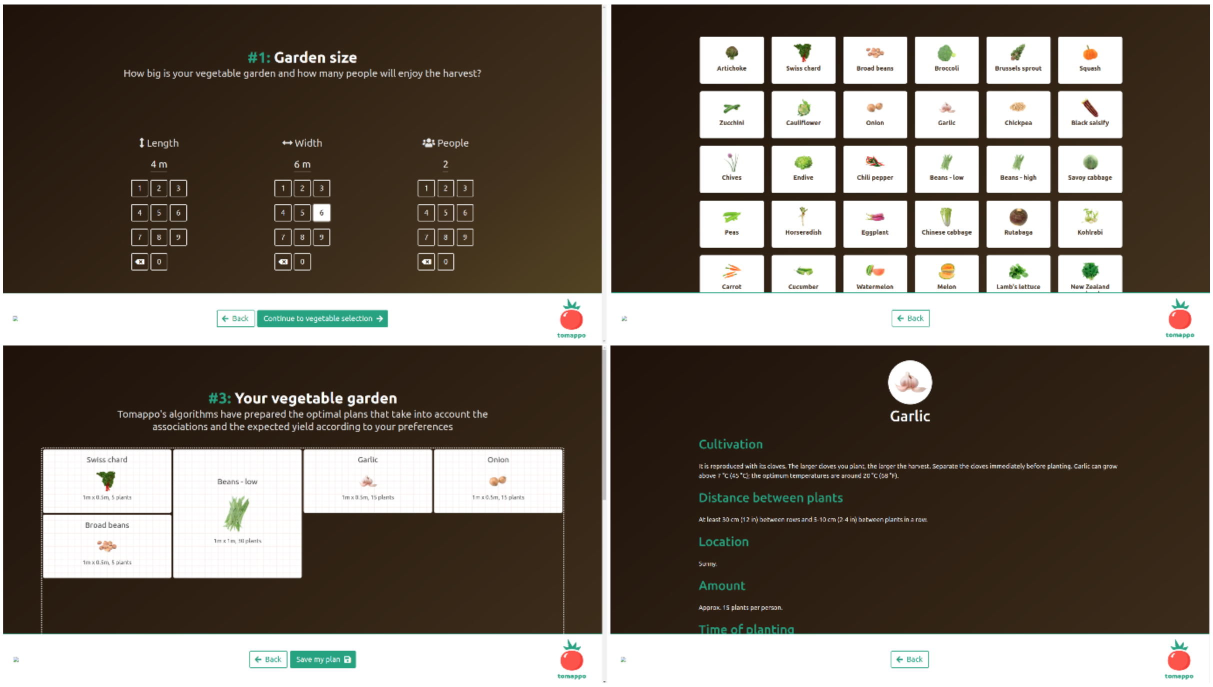

Figure 3: Automatic garden planning on interactive kiosk: input of basic parameters, selection of vegetables, display of different optimal layouts, info about vegetables. Bojan Blažica. 2021.

Novel surface finishing procedures for medical devices, especially vascular stents

Authors/inventors: Ita Junkar, Metka Benčina, Rok Zaplotnik, Matic Resnik

PRO: Jožef Stefan Institute

Abstract:

Cardiovascular diseases cause millions of deaths all over the world and present a serious health care burden. The minimally invasive way to treat diseased blood vessels is by insertion of expandable tubular stent. Currently three types of stents are available on the market; the bare metal stents (BMS), drug eluting stents (DES), and the bioabsorbable stents (BAS). According to Market Data Forecast the European Coronary stents market is estimated to grow to reach 3.64 billion by 2026. Vascular stents have already saved countless lives, but unfortunately their surface properties, which significantly affect biocompatibility, are still far from optimal and there is a huge demand to develop vascular stents with superior properties. The main issues are the stent induced thrombosis (blot clotting) and restenosis (narrowing of blood vessel wall), which are linked with health complications, high health care costs, high demand for medication, and revision surgeries, which can be even fatal for the patient. Numerous approaches have been proposed to improve coronary stent surface mainly by developing various types of coatings, however so far improvements have been only incremental. Our interdisciplinary team (chemical and mechanical engineers, plasma scientists, microbiologist) developed plasma-based approaches for surface modification of biomaterials, especially vascular stents. The novel approach is based on one step plasma treatment, which enables fabrication of multifunctional surface that; prevents platelet adhesion and smooth muscle cell proliferation, promotes proliferation of endothelial cells and reduces bacterial adhesion. By relatively fast and environmentally friendly treatment at optimized plasma conditions it is possible to fabricate nanostructured stent surface with specific surface chemistry, that are mechanically stable, anti-corrosive and can prevent undesired release of toxic ions like Ni in case of NiTi implants.

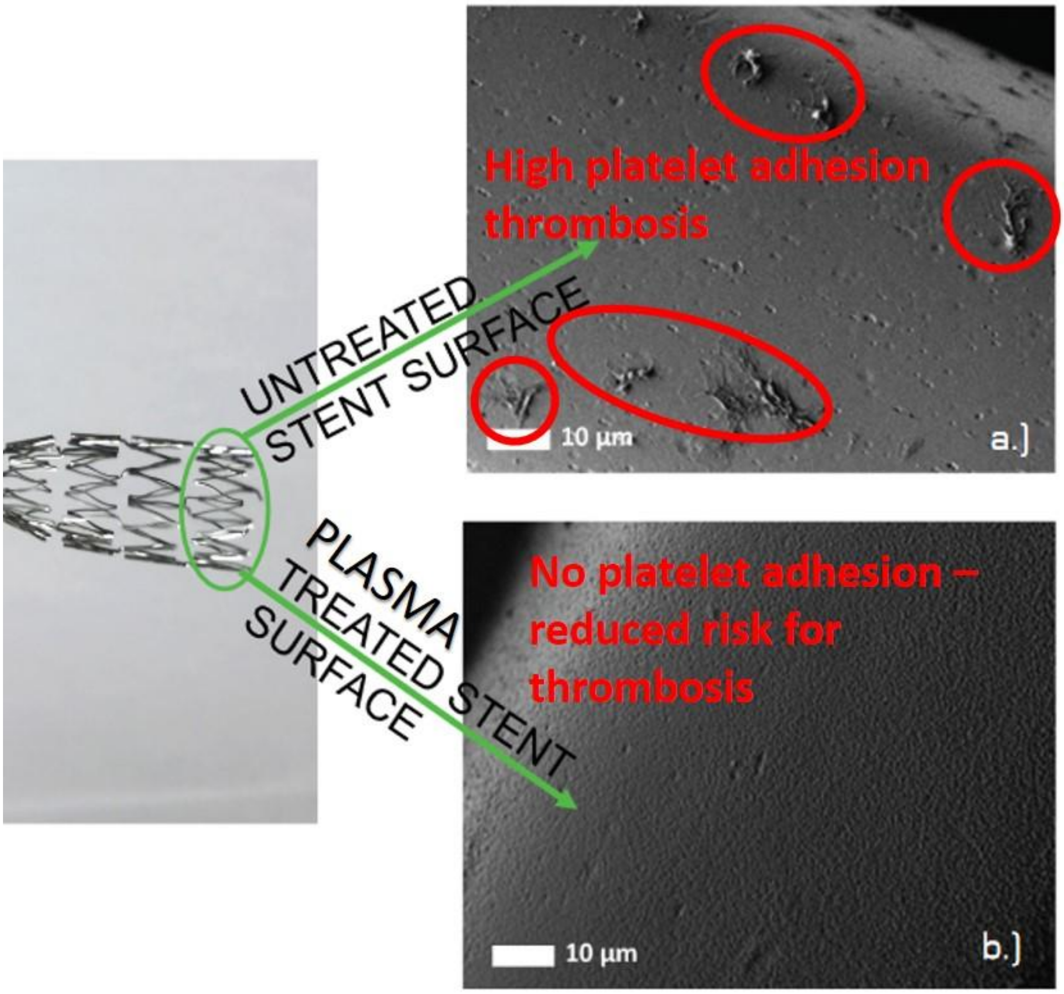

Figure 1: On the left-hand side bare metal vascular stent from NiTi alloy (Kindly donated by Rontis AG) is shown, while stent surface after incubation with whole blood is presented on the right-hand side. Interaction of platelets with the surface of commercial and plasma-treated vascular stent (images obtained from scanning electron microscopy) is shown. Ita Junkar. 2021.

Superhydrophobic coatings with dual action: corrosion and antibacterial/antiviral protection

Authors/inventors: Peter Rodič, Ana Kraš, Barbara Kapun, Chris Černe, Ingrid Milošev, Veronika Bračič

PROs: Jožef Stefan Institute

Abstract:

The innovation is the synthesis and preparation of superhydrophobic coating, which can be deposited on various metal surfaces. The superhydrophobic surface has two principal roles: (i) it repels the solution droplets from the surface and thus acts as corrosion protection since it prevents a corrosive solution to reach the underlying metal substrate and initiate the corrosion process, and (ii) it prevents, or diminishes, the attachment of pathogens (bacteria and viruses) or biofilm (microorganisms) to the surface and thus acts as antimicrobial/antiviral protection.

The development of superhydrophobic coating as corrosion protection responds to the need to extend the lifetime of devices/constructions made of metals. Superhydrophobic coating as antimicrobial protection is required in various critical applications such as hospitals and health care facilities, where microorganisms can be easily spread. Contaminated surfaces such as doorknobs, tables, and utensils used in hospitals/restaurants/hotels/apartment blocks can facilitate the viral transfer. Although surfaces can be sanitised with a variety of household cleaners, sterilising all the surfaces after each use is challenging to maintain. Further, by using disinfectants, the corrosion protection of the metals can be reduced because disinfectants solutions are usually chlorine- or alcohol-based and highly alkaline or acidic. Consequently, they are harsh for many metals such as copper, zinc, steel and aluminium. Therefore, the metal surfaces must be additionally protected against corrosion.

Our innovation can be applied in all the applications where the needs exist to preserve metal surfaces from corrosion and to protect them from the action of microorganisms. Compared to the competition, the main advantage of this coating synthesis is an easy and innovative preparation with desirable superhydrophobic properties.

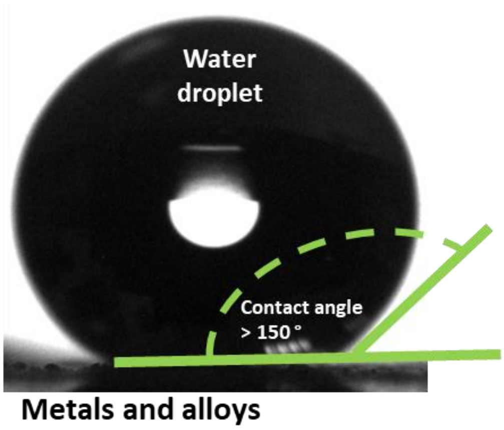

Figure 1: Water droplet on the superhydrophobic surface with contact angle above 150°

Cutting Tool Life Estimator

Authors/inventors: Anže Marinko, Jože Ravničan, Matjaž Gams

PRO: Jožef Stefan Institute, Jožef Stefan International Postgraduate School

Industrial partner: Unior, d.d.

Abstract:

In mechanical engineering, a lot of work is performed on lathes, where the cutting tools wear out over time. Replacing cutting tools is expensive and time consuming so it should be delayed if possible. On the other hand, costs and customer dissatisfaction may be caused by products not performing well if cutting tools are worn out. To avoid non-quality products, replacement of the cutting tool should be performed at optimal time.

Currently, most of cutting-tool replacement if performed by human operators using either human or specialized sensors for inputs. With our Cutting Tool Life Estimator (CTLE), the human operator relies on CTLE sensors detecting 3D accelerations, and the CTLE artificial intelligence (AI) proposing replacement when needed. The role of the human operator changes from the one getting input information and making subjective decision into a second-opinion generator and supervisor since the CTLE system objectively proposes a decision on its own. Compared to human-only decision making, the new approach enables use of more sensors and combining human with artificial intelligence, which in recent years progressed substantially in performing real-life problems based on complex input signals.

The use of CTLE therefore enables better timing of the replacement of the cutting tools. As a consequence, the production is cheaper and of better quality, thus providing an important advantage over competitors in the mature automotive, tool and other mechanical industries. In the future, the CTLE could become more independent, as the program would eventually learn more to predict the time of excessive tool wear and would propose changing the cutting tool at the closer-to-optimal time. Machine learning models in general improve over time when more data are provided.

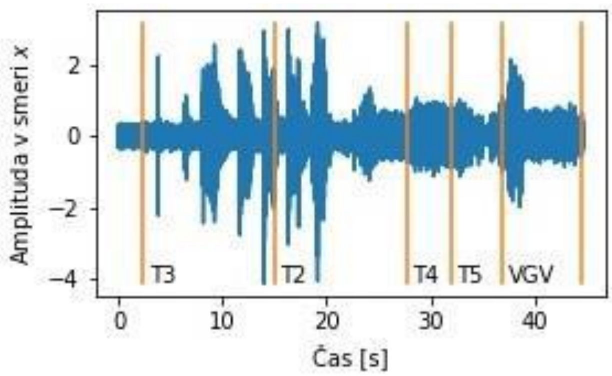

Figure 1: Amplitudes of vibrations in time of one machining cycle. Anže Marinko. 2021.

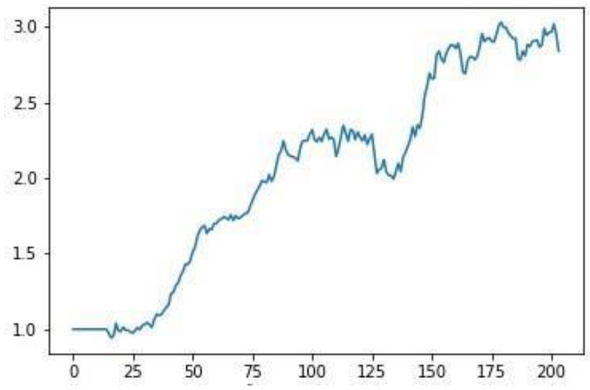

Figure 2: Estimated cutting tool wear during cycles until the cutting tool replacement. Anže Marinko. 2021.

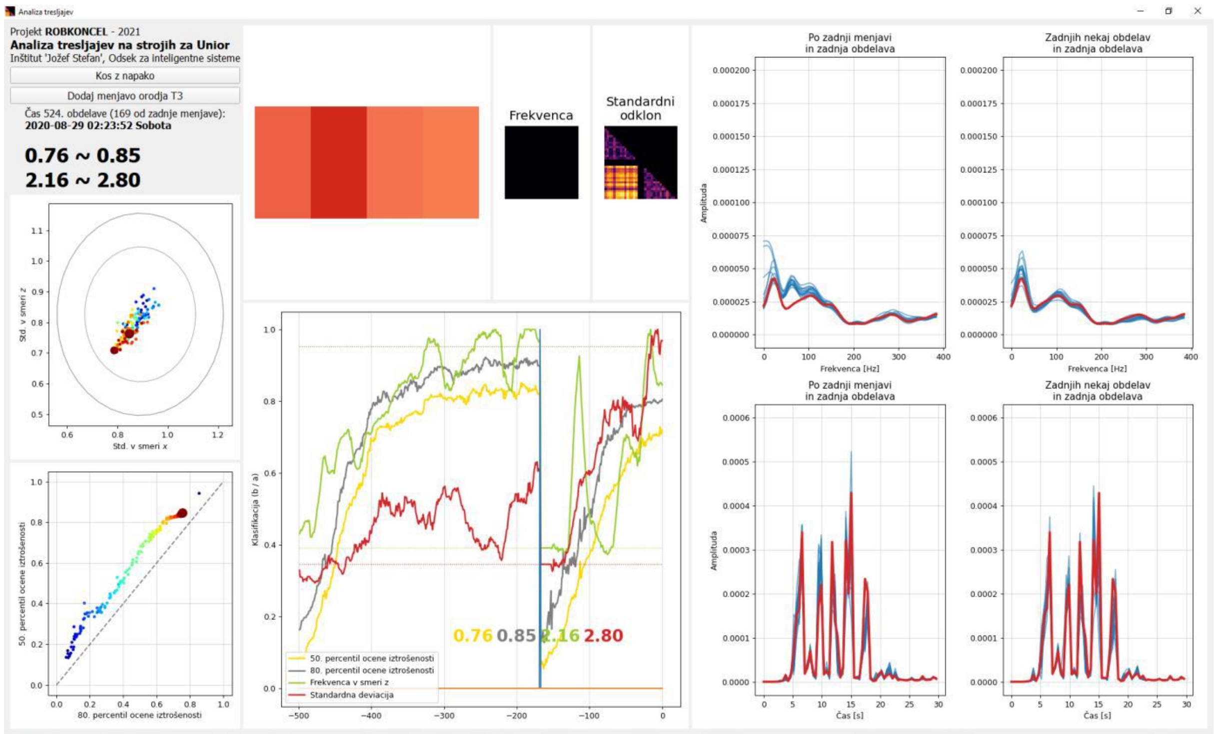

Figure 3: User interface of the program. Anže Marinko. 2021.

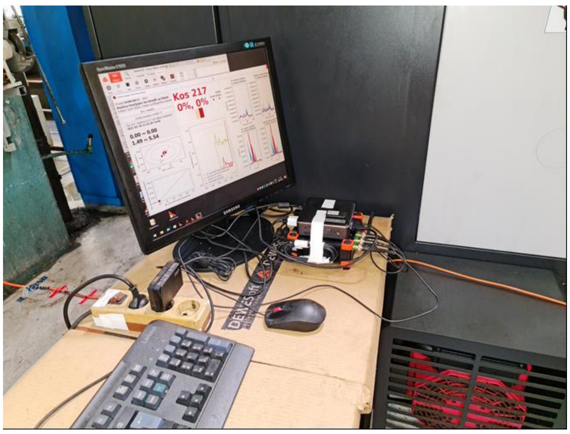

Figure 4: The CTLE systems runs on a PC connected to sensors on a lathe. Application in the UNIOR company. Anže Marinko. 2021.

Award announcement Best innovation with commercial potential

13:00 to 13:10

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Dr. Jon Wulff Petersen, Plougmann Vingtoft

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič, Slovene Enterprise Fund

Gregor Klemenčič, Deep Innovations

ANNOUNCEMENT OF THE WINNERS

The evaluation commission weighed all the criteria in the evaluation process and selected two equally ranked winning teams.

The award of 1250 Euro goes to the team members:

Andrej Seljak, Rok Dolenec, Rok Pestotnik, Matija Milanič, Peter Križan and Samo Korpar, Jožef Stefan Institute for Real-time fluorescence lifetime acquisition system – RfLAS.

The award of 1250 Euro goes to the team members:

Ita Junkar, Metka Benčina, Rok Zaplotnik and Matic Resnik, Jožef Stefan Institute for Novel surface finishing procedures for medical devices, especially vascular stents.

Congratulations!

Award announcement: WIPO IP Enterprise Trophy

From 13:10 to 13:20

Moderator:

Marjeta Trobec, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Alojz Barlič, Slovenian Intellectual Property Office (SIPO)

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

Nina Urbanič, Slovene Enterprise Fund

ANNOUNCEMENT OF THE WINNER WIPO IP ENTERPRISE TROPHY

Dear Ladies and Gentlemen,

It's a big honour for us to have the World Intellectual Property Organisation and Slovenian Intellectual Property Office among the co-organisers of this conference.

By celebrating the achievements of inventors, creators and innovative companies around the world, the WIPO Awards aim to foster a culture in which innovation and creativity are encouraged and appreciated at every level of society.

Last year at the 13th International Technology Transfer Conference the WIPO awards were given in Slovenia for the first time.

Today we will announce the recipients of two WIPO awards. The awards will be given tomorrow at the conference ceremony between noon and one o'clock and will be accessible via live streaming on the institutes' TV channel.

The selection committee consisting of Mrs. Nina Urbanič, Slovene Enterprise Fund and Mr. Matthias Keckl, Fraunhofer Technologie-Transfer Fonds who you already know, were joined by Mr. Alojz Barlič from the Slovenian Intellectual Property Office.

The WIPO Medal for Inventors will be announced just before the end of the conference.

The WIPO IP Enterprise Trophy is awarding a Slovenian enterprise for its good practice in constant and methodological use of the IP system in its business activities.

The main criteria for the selection were the following:

- the number of cooperations with public research organisations,
- no. of employments of your PhDs from public research organisations,
- new products or services launched to the market based on TT and IP protected,
- public campaigns to promote the appreciation of companies' IP assets,
- encouragements for creative and inventive activity among staff,
- programs to use the IP-based business also for public goals and
- commercial/marketing strategies based on effective use of the IP system.

May I use the words from a member of the selection committee: I am very impressed with the applications, and I think there are a lot of passionate and great people behind the technologies and companies.

Among the applications, the jury has decided to give the IP Enterprise Trophy to GEM Motors.

Short justification: GEM Motors is actively cooperating with several public-research organisations. They have a clear IP strategy with patents in EU, India, USA, Russia, Japan, China and S. Korea and that is essential for B2B business. Their in-wheel patented technology has been presented at several fairs and conferences. Through the social responsibility programs by promoting the urban e-mobility different project partners, other companies and schools are included. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff and encourage PhD employments.

Congratulations!

Keynote speech: PoC funding of research spin-offs

From 13:20 to 13:40

Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

ABSTRACT OF THE KEYNOTE SPEECH

Matthias Keckl is a Managing Partner of the FTTF - Fraunhofer Technologie Transfer Fonds GmbH, an independent Venture Capital unit and financing partner for Deep Tech Start-Ups using Fraunhofer technologies with an investing volume of € 60 million.

FTTF invests exclusively in starts-up using Fraunhofer technologies.

As a strong entrepreneurial partner with 30+ years of experiences in supporting Fraunhofer start-ups, FTTF offers financing in their pre-seed phase with up to 250.000 euros, and in further funding rounds with additional investments of up to five million euros.

FTTF provides fast investments process and on-site support. Moreover, the fund supports entrepreneurs with comprehensive founding experience and a broad network of investors in order to realize the full potential of their companies. FTTF is backed by Fraunhofer-Gesellschaft and the European Investment Fund (EIF).

FTTF focuses on bridging the gap – from tech to market - in close collaboration with internal Fraunhofer tech-transfer and incubation programs, like AHEAD and CoLab.

FTTF has access to German innovation hubs whilst bridging the gap between scientists as founders and investors.

FTTF ensures optimal and efficient setup/ structure of the start-up right from the beginning and provides runway 12 to 18 months.

FTTF begins investing in the very early PoC stage of the start-up (pre-seed) giving researchers the opportunity to start the business.

FTTF invests in the VC start-ups with growth and exit potential as well as funding requirement. FTTF doesn't invest only in founded companies that are also in pre-revenue phase – start-ups have already started pilot projects but usually do not yet have revenues.

FTTF requirements for a PoC (pre-seed) investment:

- Start-up has to have access to technology:
    - Freedom to operate
    - Acceptable license fees
    - Call option to take over IP, or at least option to start negotiations
- Founding team is the core of any FTTF investment. Investor has to know and understand the people behind the start-up, drivers of the team and their long-term entrepreneurship. FTTF strictly insists that tech competence is part of start-up and the founders are 100% committed to the start-up.

- Business Model characteristics are:
    - Market entry in attractive niche
    - Scalable products
    - Deep understanding of the market environment and problem/ solution fit

FTTF standard investment approach focuses on investing 250k EUR as a convertible loan for the 7,5% shares in the start-up equity. FTTF is usually the first investors whilst other investors may also join PoC investments – excluding strategic investors or non-profit organizations.

Keynote speech: CEETT Platform – Central Eastern European Technology Transfer Platform

From 13:40 to 14:00

Natalija Stošicki, Director, Investments and EU Programmes Department, SID Bank / SID – Slovenska izvozna in razvojna banka

ABSTRACT OF THE KEYNOTE SPEECH

In 2017 and 2018 Slovene Equity Growth Investment Program (SEGIP) with EUR 100m and Croatian Growth Investment Program (CROGIP) with EUR 80m were launched in cooperation between European Investment Fund (EIF) and SID Banka and Croatian Bank for Reconstruction and Development (HBOR), respectively, with the aim to support the growth segment of the private equity market in the two countries.

All available funds were transferred to the private equity funds for further equity and quasi equity funding of Slovene and Croatian companies in growth stage. SEGIP and CROGIP deployment exceeded initial expectations, prompting the parties to enhance the collaboration by expanding the scope of the respective program to the next level - Central Eastern European Technology Transfer (CEETT platform) that is based on the ITA Tech best practices.

The resulting joint initiative is the first investment program under the Central and Eastern European Technology Transfer (CEETT) initiative, to which SID Banka contributed an additional EUR 10 million to SEGIP, HBOR contributed additional EUR 10m to CROGIP and the EIF made further EUR 20 million available for investment. Thus, the total available funding amount indicatively represents EUR 40 million.

CEETT platform will support the most promising technology transfer projects originated at public research organizations in Slovenia and Croatia that would otherwise be considered not mature enough for traditional Venture Capital funds and thus trapped in so called “Valley of Death”.

CEETT platform shall actually close two financial gaps (two Valleys of Death) in the TRL ranges 4-9 that are: transition from laboratory to company and scale-up for high-risk innovative start-ups.

Existing grants that are dedicated to fund the TRL phases 1-7 are not big enough and not regularly available. Therefore, Tech Transfer Fund (VC TT Fund) that will address financing to the projects at lower TRL, would be established.

The fund will be focused on technology transfer activities across various fields providing financing primarily to university and research center spin-offs and to projects at the proof-of-concept stage, also providing follow-on financing to these projects at a later stage.

It is expected that projects in the proof-of-concept phase (pre-seed), in terms of the number of investments, will represent a majority focus of the Fund’s investments.

Beneficiaries, the enterprises, must be in the seed, start-up or later stage venture investment phase and must originate from a university or research institute.

Fund Manager will be looking for investments in collaboration with public research organizations, academia and industry partners on a contract and NDA basis. Fund manager will

be looking for private co-investors in projects and spin-outs, but also for private investors on the level of the Fund.

Investment program size is for both countries EUR 40m. SID Banka, Croatian Bank for Reconstruction and Development and EIF can invest additional funds in the platform it has promising pipe-line of projects and start-ups. We hope that Republic of Slovenia will complement the CEETT support of technology transfer also with grants for the TRL phases 1-7 taking part of the risk of closing two valleys of death gap, which will additionally incentivise transfer of research achievements and innovations into economy.

Paper presentations: scientific papers on technology transfer and intellectual property

From 14:00 to 15:30

Moderator:

Tomaž Lutman, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Title	Authors
Technology Transfer Fund - Central Eastern European Technology Transfer (CEETT) platform	Marijan Leban Špela Stres
Software Protection and Licensing Challenges in Europe: An Overview	Urška Fric Špela Stres Robert Blatnik
European Guiding principles for knowledge valorisation: An assessment of essential topics to be addressed	Špela Stres Levin Pal Marjeta Trobec
Digital Innovation Hubs and Regional Development: Empirical Evidence from the Western Balkan countries	Bojan Ćudić Špela Stres
Technology Transfer as a Unifying Element in EU Projects of the Center for Technology Transfer and Innovation	Duško Odić Špela Stres
Proof of Concept cases at the Jožef Stefan Institute in 2020 and 2021	Marjeta Trobec Špela Stres
European Industrial Strategy - a great opportunity to strengthen the role of technology transfer offices	Levin Pal France Podobnik Špela Stres
Knowledge generation in citizen science project using on-line tools: CitieS-Health Ljubljana Pilot	Jure Ftičar Miha Pratneker David Kocman
Overview of National Sources of Finance and Supports Available to Spin-Out Companies from Public Research Organizations	Vojka Žunič Marta Klanjšek Gunde
Application of 3D printing, reverse engineering and metrology	Remzo Dedić

	Željko Stojkič Igor Bošnjak
Towards the Market: Novel Antimicrobial Material	Tomaž Lutman Marija Vukomanović
Technology Transfer in Belarus	Alexander Uspenskiy Aliaksei Uspenski Maxim Prybylski

Opportunities arising from publicly funded research projects / presentations of successful scientific projects

From 15:30 to 16:40 (in Slovene and English languages)

Moderators:

dr. Vojka Žunič, National Institute of Chemistry, Knowledge Transfer Office, mag. Jure Vindišar, National Institute of Biology, Technology Transfer Office, Tomaž Lutman, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Title	**Presenter(s)**	**Organization**
Vloga glukagonu podobnega peptida-1 v reprodukciji / The role of GLP-1 in Reproduction	Prof. Dr. Mojca Jensterle Sever	University medical center Ljubljana
Does relatedness matter for bacterial interactions?	Prof. Dr. Ines Mandić-Mulec	Biotechnical faculty, University of Ljubljana
Kanabinoidni receptorji in zdravljenje hormonsko odvisnega raka dojke	Prof. Dr. Nataša Debeljak, Dr. Luka Dobovišek	Faculty of Medicine, University of Ljubljana, Institute of Oncology Ljubljana
6600 years of human and climate impacts on the environment, recorded in the lacustrine sediments of Lake Bohinj	Doc. Dr. Maja Andrič	Slovenian Academy of Sciences and Arts Research done in cooperation with Prof. Andrej Šmuc, University of Ljubljana and Prof. Nives Ogrinc, Jožef Stefan Institute.
COVID-19: Razvoj postopka za testiranje zaščitnih mask	Dr. Polona Kogovšek	National Institute of Biology
How we developed a living coating	Doc. Dr. Aleš Lapanje	Jožef Stefan Institute

DNA technologies and seafood / DNA tehnologije in hrana iz morja	Doc. Dr. Andreja Ramšak	National Institute of Biology

Award announcement: WIPO Medal For Inventors

From 16:40 to 16:50

Moderator:

Marjeta Trobec, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Alojz Barlič, Slovenian Intellectual Property Office (SIPO)

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

Nina Urbanič, Slovene Enterprise Fund

ANNOUNCEMENT OF THE WINNER WIPO IP MEDAL FOR INVENTORS

Dear Ladies and Gentlemen,

With the World Intellectual Property Organisation and the Slovenian Intellectual Property Office on-board as co-organisers we wish to announce the second WIPO award recipient today.

The WIPO IP Enterprise Trophy is awarding Slovenian enterprises for their good practice in constant and methodological usage of the IP system in their business activities.

That award went to GEM Motors. GEM Motors is actively cooperating with several public-research organisations. They have a clear IP strategy with patents in EU, India, USA, Russia, Japan, China and S. Korea and that is essential for B2B business. Their in-wheel patented technology has been presented at several fairs and conferences. Through the social responsibility programs by promoting the urban e-mobility different project partners, other companies and schools are included. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff and encourage PhD employments.

On the other hand, the WIPO Medal for Inventors is awarding a Slovenian public researcher for her contribution to the national wealth and development.

The awards will be given tomorrow at the conference ceremony between noon and one o’clock and will be accessible via live streaming on the institutes’ TV channel.

The selection committee members were Mrs. Nina Urbanič, Slovene Enterprise Fund, Mr Matthias Keckl, Fraunhofer Technologie-Transfer Fonds and Mr. Alojz Barlič from the Slovenian Intellectual Property Office.

The entry criteria for the selection were granted patents or utility models in the last 10 years. Further the patented invention had to show a significant economic and technological impact in Slovenia via:

- creation of a new company or
- creation of new jobs in the companies that cooperate with the researcher or
- the number of new products and services launched to the market.

May I use the words from a member of the selection committee: I am very impressed with the applications, and I think there are a lot of passionate and great people behind the technologies and companies.

They carefully ranked at all applications and decided that the "WIPO Medal for Inventors" goes to assoc. prof. Marta Klanjšek Gunde, researcher at the National Institute of Chemistry, innovator and a co-founder of a start-up.

Short justification: based on a patented invention, prof. Gunde has established a start-up company MyCol. In the company the licensed technology is a base for developing smart labels with temperature-sensitive ink, which permanently color when heated above a predetermined temperature. The invention resulted also in 5 new jobs created in the company.

Congratulations!

Research2Business meetings (R2B meetings)

Parallel session from 10:00 – 13:20

France Podobnik, Robert Premk, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

One of parallel sessions of *14. International Technology Transfer Conference* were bilateral meetings between researchers and companies (Research-2-Business, R2B). They took place once again in a virtual form due to COVID-19 restrictions, but also because of good experience from 2020 and how well accepted they were last year.

Registration period started already in May 2021 and lasted until the event. In this time 63 participants from 9 countries registered to the event – Slovenia, Belarus, India, Italy, Netherlands, Romania, Serbia, Spain and Turkey. International component of the meetings was also achieved with active support of Enterprise Europe Network members from Italy, Spain, Serbia, North Macedonia, Serbia, Netherlands and Turkey.

Main aim of the meetings was to promote knowledge exchange between academia and companies, especially in terms of cooperation between researchers and company representatives to overcome technology challenges, to discuss available commercially interesting technologies, to find options of cooperation in forthcoming European and other international projects, to get acquainted with experts on specific fields of interest and with the current trends, while also to get familiar with the topics, that might be relevant for companies/researchers in the near future …

Participants were in advance informed about the format of the meetings and how the concept of virtual meetings works in practice to avoid any technical issues at the time of the event. During the meetings main organizer was also available for support to the participants via phone and mail.

At the meetings participated 27 researchers, company representatives and other stakeholders. Their fields of expertise were diverse and covered robotics, artificial intelligence, new materials, (bio)chemistry, biotechnologies, environment, physics, etc. In total 31 meetings took place between 10:00 and 13:00 (CEST).

Virtual concept of meetings allowed participants to attend the meetings from any place at the pre-scheduled time. While the expected time for each conversation was set at 20 minutes, the average length of 31 meeting was around 15 minutes. The shortest meeting lasted 7 minutes, while the longest almost 26 minutes.

As results and feedback from the previous years show, we can expect in the following months that established contacts between participants from the industry and research community will lead to cooperation between them.

Connecting high-school education system with academia: Presentations of selected research topics from Jožef Stefan Institute and proposals for cooperation

Parallel session from 13:20 – 15:20

Moderator:

Urška Mrgole, Jožef Stefan Institute, Center for Technology Transfer and Innovation

About

In accordance with the Jožef Stefan Institute's mission, the Center for Technology Transfer and Innovation promotes scientific work and research accomplishments among young people and the rest of the interested public.

The event

At the 14th International Technology Transfer Conference a parallel section "Connecting the education system with academia: Presentations of selected research topics from the Jožef Stefan Institute and proposals for cooperation" took place. The section was aimed at primary and high school teachers where selected research topics from the Jožef Stefan Institute (JSI) and proposals for cooperation were presented.

At the beginning, activities for the promotion of science and research work, which Center for Technology Transfer and Innovation at the Jožef Stefan Institute carries out independently or in collaboration with the research departments at JSI, were presented. School visits: every Thursday during the school year, the Center for Technology Transfer and Innovation, with the help of other JSI departments, organizes visits to the Institute that are intended for primary and high schools, faculties and everyone else from the school sphere. Open day at JSI: each year at the end of March, traditional Stefan's Days take place at the Institute, marking the birthday (24 March) of the great Slovenian scientist, Jožef Stefan. In the scope of Stefan's Days, the Center for Technology Transfer and Innovation, in cooperation with the JSI research departments, organizes the Open Day at JSI. Visitors can choose from a number of visit programmes and look at the laboratories at Jamova cesta in Ljubljana and at the Reactor Center near Ljubljana. Open Week at JSI: In the scope of Stefan's Days an open week at JSI is organized, where every day of the week one school is welcomed to JSI for a visit. Preparation and implementation of lectures for teachers and principals: for closed groups of professors the Center for Technology Transfer and Innovation can organize trainings and lectures from the Jožef Stefan Institute's field of work with the aim of implementing new in-depth knowledge in classrooms. Mentorships for research assignments of high school students: The researchers from the Jožef Stefan Institute offer mentorships for research assignments for high school students. Participation in various European projects and initiatives such as "Science with and for Society": the Center for transfer technology and innovation at the Jožef Stefan Institute enthusiastically participates in various European projects and initiatives with the aim of promoting science and research work among Youth, e.g. the research festival Znanstival, the European Researchers' Night, and European projects such as STEM4Youth and SciChallenge. Within the STEM4Youth project nine modules in the field of chemistry were prepared and implemented in 19 Slovenian primary and secondary schools, with 20 mentors and over 500 elementary and high school students participating.

In the second part researchers from various research departments presented their work. Dr. Janja Vidmar, Department of Environmental Sciences, O2: The multidisciplinary research of the Department of Environmental Sciences focuses on the combination of physical, chemical and biological processes that influence the environment, man and human activities. One of the recent research projects was related to the investigation of drug abuse in educational institutions using wastewater analysis. Matej Kolarič, mag. biochem., Department of Biochemistry, Molecular and Structural Biology, B1: The mission of the department is related to enzyme analysis, molecular mechanisms of programmed cell death, and the immune response. Areas of research focus on proteolytic enzymes with the aim of treating and detecting diseases and improving the quality of life of patients. At the department the identification and quantification of different proteins, for example in human blood, is done via mass spectrometry. Assist. prof. dr. Peter Rodič, Department of Physical and Organic Chemistry, K3: The department is focused on the investigation of physicochemical processes on the surfaces of solids, such as corrosion and heterogeneous catalysis, as well as the synthesis of new compounds. The goal is to gain new insights and understanding of mechanisms of protection and degradation of materials in different environments. The activities of the department are also related to a phenomenon we all encounter every winter: what is the impact of road salting on corrosion. Sebastjan Nemec, mag. pharm., Department for Materials Synthesis, K8: The research at the Department is devoted to the development of advanced materials. Their main focus of the research are nanoparticles, especially magnetic nanoparticles which can be easily influenced from a distance with a magnet. Mark Zver, M. Sc., Department of Surface Engineering and Optoelectronics, F4: the main activities are focused on plasma generation, sustenance and characterization of the plasma which is later used for tailoring surface properties of various materials. Plasma is the most common state of matter in the visible universe. Low-temperature plasmas are usable for substance removal, surface cleaning, compound application, etc. Erik Novak, mag. prof. mat., Artificial Intelligence Laboratory, E3: The Department for Artificial Intelligence is concerned mainly with research and development in information technologies with an emphasis on artificial intelligence. Their main focus is development of practical solutions useful in the public and private sector. The department cooperates with videolectures.net which is an online repository of lectures from prestigious conferences and events. Dr. Živa Stepančič, Laboratory for Open Systems and Networks, E5: The focus of the laboratory is on research and development of next generation networks, telecommunication technologies, components and integrated systems, information society services and applications etc. The laboratory participated in the SI-PASS project, where hub (network) was established and the national e-services are integrated.

Center for Technology Transfer and Innovation at Jožef Stefan Institute wishes to bring the scientific work and accomplishments as close to the youth, teachers and other interested public as possible, believing that nothing can beat the personal experience and direct contact with the laboratories and top-level researchers. The event proved to be very useful and instructive for teachers who gained new ideas for the implementation of lessons at schools and learned new opportunities to cooperate with the Jožef Stefan Institute.

The Conference closing

From 16:50 to 17:00

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

It is time to close this year's conference. The topic of the conference was how to bridge the valley of death – and we received some answers to that question today.

While listening to the presentations I will quote dr. Spela Stres from the last year Conference closing: Water dripping day by day wears the hardest rock away (»Tiha voda bregove dere«). Tech transfer is always going to be the silent water almost going unnoticed. But that is how you maximise the impact of tech transfer: by being persistent and persistently professional.

But I would like to add also this, that many small springs of water coming together could bring strong river which is irrigating the deserts.

From the perspective of the Conference organizing committee we can say that this year's conference has been professional in every aspect. We are happy, though, that the conference is behind us, because there is a lot of work put into it every year, and we would like to thank all our colleagues here at the Center for Technology Transfer and Innovation at the Jožef Stefan Institute who worked tirelessly for the conference to take place in such a diverse format and with such perfect execution.

But what actually mattered today was that everyone who followed this conference was able to feel how far we can go with the collective spirit of the researchers from all public research organisations in Slovenia, and we have high hopes that all tech transfer offices are going to join in to that spirit as well. This has been a lovely event, despite the covid-19 situation.

We now feel this has been again the best conference we have ever had. Thank you all and see you soon!

Day 2

CONFERENCE CEREMONY

Overview of the Conference Ceremony

8 October 2021

Jožef Stefan Institute, Ljubljana, Slovenia

Location: Main Lecture room at the Jožef Stefan Institute (A-building)

12:00 – 12:05	Musical performance / Glasbena točka
12:05 – 12:10	**Welcome speech** Prof. Dr. Boštjan Zalar Director of Jožef Stefan Institute
12:10 – 12:20	**Opening speech** Mark Boris Andrijanič Minister za digitalno preobrazbo Republike Slovenije Minister for Digital Transformation
11:20 – 12:25	**Greetings** Prof. Dr. Mojca Ciglarič Chair of the Programme Committee of IS2020 Dean of Faculty of Computer and Information Science
12:25 – 12:55	**Awards of IS2021** prof. dr. Mojca Ciglarič, IS Programme Chair prof. dr. Matjaž Gams, IS Organization Chair prof. dr. Sašo Džeroski, SLAIS President Niko Schlamberger, President of Slovenian Society Informatika prof. dr. Andrej Brodnik, President of ACM Slovenia dr. Mark Pleško, President of Slovenian Academy of Engineering 14. ITTC: Awards ceremony – competition for the best innovation with commercial potential in the year 2021, WIPO Medal for Inventors and WIPO IP Enterprise Trophy 14. ITTC Organising Committee World Intellectual Property Organisation representative / Slovenian Intellectual Property Office representative Awards “Pioneers of computer education in high-schools”
12:55 – 13:00	Musical performance

Zbornik 24. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2021

Zvezek F

Proceedings of the 24th International Multiconference

INFORMATION SOCIETY – IS 2021

Volume F

Ljudje in okolje
People and Environment

Uredniki / Editors

Janez Malačič, Tomaž Ogrin, Matjaž Gams

http://is.ijs.si

6. oktober 2021 / 6 October 2021
Ljubljana, Slovenia

PREDGOVOR

Konferenca je sestavljena iz dveh:

- demografske, predsednik prof. dr. Janez Malačič, letos štirinajstič
- okoljske, predsednik mag. Tomaž Ogrin, letos tretjič.

Število umrlih za kovidom se približuje petim milijonom, število registriranih obolelih gre proti 250 milijonov. V primerjavi s 130 milijoni rojenimi in 60 milijoni umrlimi letno se pet milijonov ne zdi več zanemarljivih kljub uspešnim cepivom. Hkrati je razlika med rojenimi in umrlimi vsako leto manjša, a se bo zaradi strukturnih vplivov rast svetovnega prebivalstva nadaljevala še dolgo v prihodnost.

Za Slovenijo sta med najbolj perečimi tematikami staranje prebivalstva 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. Ekstrapolacija sedanje rodnosti pokaže uničujoče posledice že v nekaj prihodnjih stoletjih celo za tako velika prebivalstva, kot je japonsko. Še veliko težje posledice pa bi bile v Sloveniji in drugih majhnih evropskih prebivalstvih. Zato je za Slovenijo ključno, da v prihodnjih desetletjih vodi politiko, ki bo dvignila rodnost na ravnovesno raven.

Podobno travmatične so napovedi glede okolja. Medtem ko zavedanje o pomenu okolja narašča, mirno gradimo nova in nova veletrgovska središča na najboljši kmetijski zemlji, smo prvi v Evropi po m2 veletrgovin na prebivalca v Evropi, po tem kriteriju in kilometrih avtocest na prebivalca pa smo med prvimi na svetu. To je posledica kratkovidnosti, saj recimo narašča spletno nakupovanje in vse veletrgovine enostavno ne bodo mogle obstati. V letih od osamosvojitve smo 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 manj kot 50% samopreskrbo s hrano in podobno energetsko odvisnost. Od leta 2000 smo izgubili 10 odstotkov obdelovalnih 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, še posebej pa moti zaostalost v odnosu do okolja in demografije, kar se vidi npr. v čedalje več reklamah ob avtocestah. Večinoma so nezakonito postavljene na kmetijskih površinah, a ker je to v pristojnosti posameznih občin, se reklame množijo še naprej. Za primerjavo – na Češkem so jih prepovedali pred kar nekaj leti.

Je mogoče hkrati spodbujati tehnološki razvoj, uporabo obnovljivih virov in preprečevati negativne vplive na okolje? Smo sposobni preusmeriti antropocentrični razvoj v ekocentričnega, v trajnostnega? 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, ali bodo imela 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. Politično vodstvo je sprejelo okoli 10 predlogov izmed zbranih 50, kar bi optimist ocenil kot dobro, pesimist pa kot slabo. A najbrž je pot do trajnostnega razvoja še dolga, dolga!

Janez Malačič, Tomaž Ogrin in Matjaž Gams

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DEMOGRAPHIC PROCESSES AND THEIR ROLE IN FULFILMENT OF THE OBJECTIVES OF AGENDA 2030

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Abstract:
Demographic processes throughout the whole history of the development of human society were an important factor of development and survival whereas for many fields are also crucial. Demographic phenomena are one of the main challenges for sustainable development as they have an impact on a wide range of issues including sustainable development.
One of the most important elements of sustainable development which is also expressed in the most important document of the contemporary concept of sustainable development which is Agenda 2030 and Agenda 21., are demographic trends and factors, therefore, as such, they should be incorporated in the general analyses by exploring the interaction between demographic trends and sustainable development.
Demographic components are the basis for progress, survival and development for all societies/humanity and ignoring this basic truth sooner or later brings negative results in other areas of life.
However, regardless of which socio-economic or environmental sector is in question, the path to sustainable development is the people so it is imperative that the problems and demographic potential be taken into account if we are to find answers to the demand for sustainability in economic, social, ecological, etc. development.
Thus for the sustainable development of countries, regions, municipalities, etc., it is necessary in the first place to ensure demographic sustainability.

Keywords: demographic processes, demographic sustainability, sustainable development, etc.

1 INTRODUCTION

In the perspective of the development and progress of human society, the concept of sustainable development is given the main attention, transforming sustainability as the most important part of development policies of all spheres of life whether those of global, regional or local levels.
In the contemporary literature there are various definitions of sustainable development, however, the most widespread and comprehensive definition is the definition of the World Commission on Environment and Development which defines the sustainable development as: "..... development that meets the requirements of the current generation and at the same time does not endanger the opportunities of future generations to meet their own requirements" where special importance is given to the third generation.

Figure 1. *Sustainable development scheme*

Sustainable development means qualitative growth and socio-economic and cultural development which is in relation to the capacities of the living environment which must be developed so that future generations are not hampered (endangered) by the possibilities of existence.
However, sustainable development can not be conceived only as activity which is oriented towards environmental protection and environmental problems (the first concepts for sustainable development) but is a multidimensional process of global character which includes social, economic, demographic, political issues, etc.
Agenda 2030 and Agenda 21 which have been transformed into: "global partnership for sustainable development" and "work program for the 21st century", underline the weight of demographic developments for sustainable development, therefore it is necessary: the incorporation of demographic

factors and trends in the analysis of sustainable development.

Having regard to the role and importance of demographic processes for sustainable development and the fact that the population is the biological structure of society and the economy of all geographical areas, it is necessary that for the sustainable development of contries, regions or municipalities in the first place to ensure demographic sustainability thus transforming demographic sustainability as a subsystem into the sustainability system.

*Also the specialized research institutions of the United Nations (United Nations Institute for Social Development - UNRISD and the United Nations Development Program - UNDP), demographic developments and their forecast rank (second) among the six main areas for completion of the objectives of Agenda 2030. The most important demographic components for completing the Agenda 2030 are: population growth trends, population trends by age, migration trends, urbanization trends and demographic projections**(1)***.

2 SUSTAINABLE DEMOGRAPHIC DEVELOPMENT - SUSTENDEMO

At the center of sustainable development is undoubtedly the human-the population expressed also in the most important document of the contemporary concept of sustainable development which is the Rio Declaration 1992, respectively Agenda 21.

An important part (Chapter V) of Agenda 21 is devoted to the role and importance of demographic dynamics and its sustainability for sustainable development. For sustainable development in the future it is necessary that: demographic factors and trends be incorporated into the global analysis of environment and development;

Having regard to the role and importance of demographic movements for sustainable development and the fact that population is the biological structure of society and the economy of all geographical areas, demographic sustainability should be considered as a subsystem in the system of sustainability **(2)** - SUSTENDEMO.

Figure 2. *Sustainable demographic development scheme - Sustendemo*

However, the sustainable demographic development is also often conceived in a very reduced way, only in population growth and the gender and age structure of the population. Based on this approach, different authors define sustainable demographic development with the state of the population which ensures at least simple reproduction of the population or "optimal population growth" which corresponds to the fertility level of 2.1 children per woman (reproduction with the same contingency as the previous generation). Other authors conceive of sustainable demographic development as a ratio between active (productive) and inactive (non-productive) population or even as a numerical balance in gender representation.

The most comprehensive and complete definition is the definition of the authors who emphasize that the definition of sustainable demographic development should include the socio-economic characteristics of the population ***(2)***.

Based on this definition the SUSTENDEMO model consists of two dimensions of equal importance which are the quantitative and the qualitative dimensions.

The quantitative dimension consists of components of natural growth and migration, overall population growth, and population structure by age and gender.

The qualitative dimension consists of the socio-economic characteristics of the population, including in the first place the educational structure of the population, professional training and economic activity.

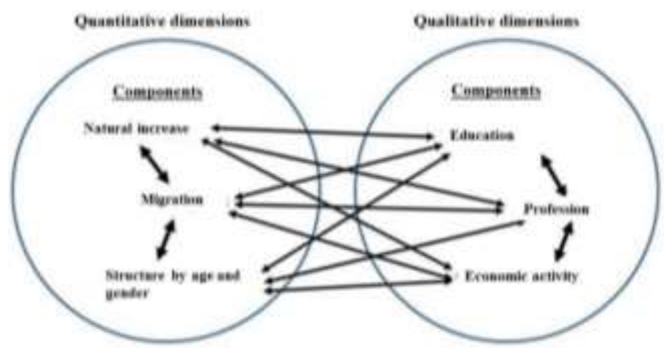

Figure 3. *Demographic sustainability subsystems* ***(3)***

For sustainable demographic development of a certain area is required minimal demographic development (corresponding to at least simple reproduction - stationary type of population S.B) in quantitative and qualitative terms, in order to endure economic and social sustainability.

From the quantitative dimension a territory is considered demographically stable when there is an optimal correlation between: growth, size, migration and population structure by age and gender, while in qualitative terms a territory is considered demographically stable when there is a balance in socio-economic structures of the population ***(3)***.

Consequently, the United Nations forecasts of the end of the last century for the trends of the global population at the beginning of the 21st century have also been revised and corrected in all scenarios, as Bricker and Ibbitson point out. *"We are not facing the challenge of a population bomb, but of reducing the human population."* ***(4)***

3 DEMOGRAPHIC PROCESSES AND SUSTAINABLE DEVELOPMENT

3.1 Are demographic changes the key to sustainable development

People are the main concern of sustainable development (Rio Declaration, 1992, Principle 1). In an effort to promote sustainable development, demographic movements must also be taken into account) - number, location, age structure, other structures, especially education, living conditions, ambitions and opportunities, etc. (IIASA and UNFPA, 2011).

The most comprehensive and complete definition is the definition: sustainable demographic development should also include the socio-economic characteristics of the population.

The World Bank defines sustainable development as: *development which involves the transfer of an equal reserve or according to the greatest possibilities of human, economic and social capital, to future generations**(5)**.*

Based on the above definitions, it can be concluded that for sustainable development of countries or regions, sustainable demographic development is necessary, which at least requires that each country should achieve a stationary population model, which means that the next generation will be the same as the existing one.

In order to achieve the necessary minimum and achieve demographic development which will not be limiting factors for sustainable development and fulfillment of the objectives of Agenda 2030, it is necessary to meet several objectives in demographic developments which are:

3.2 Total number of population

Total number of population - in order to achieve the stationary type of population where the next generation is the same as the existing one or the level of simple population regeneration or the replacement of generations means that at the individual level a woman in the period of her fertility should be replaced by a female child - the net reproduction rate is equal to one, or the overall fertility rate is 2.1 children per woman (reproduction with the same contingency as the previous generation).

3.3 Population structure by age

It shows not only the past but also the present and the future of demographic development and is the most important demographic indicator which in addition to population development also affects all other socio-economic spheres, therefore the analysis of population structure by age is basic. not only in demographic research but also for all other socio-economic spheres turning the process into an important factor for sustainable socio-economic and spatial development in general.

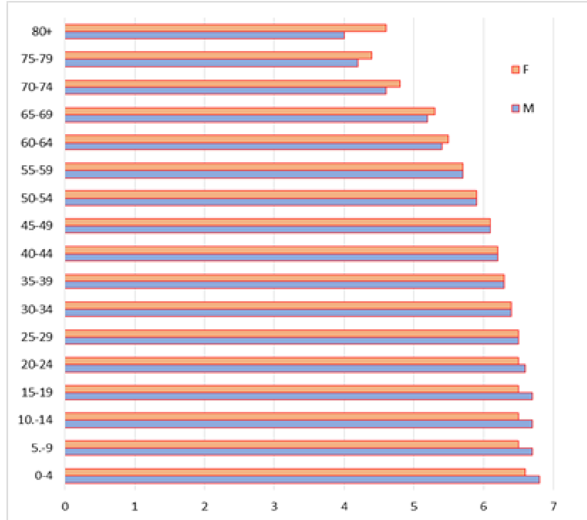

Figure 4. *Pyramid model of the population of stationary population type **(6).***

A territory is considered demographically stable (in terms of population structure by age), when there is an optimal correlation in population structure by age and gender (graph 5).

3.4 Demographic ageing

Agenda 2030 presents a universal action plan towards sustainable development in the protection and realization of the rights of all people without ignoring anyone and any group of society, including all segments of society, all ages, with a special focus on more vulnerable groups such as the elderly people.

The fact that the 21st century will be a century of ageing, the key to dealing with this process is the fact that the opportunities offered by these age groups will be used (incomparable experience and skills, active participation of older generations in the economy, labor market and society in general, etc.), to face the challenges posed by the process, to respond to the ageing of the population and to promote a sustainable development of ageing.

With the increase of the participation of the elderly in the general population of a country, the society should increase the knowledge about the importance, needs, rights of the elderly, with the purpose of eliminating prejudices and discrimination against the elderly.

In this way the main goal of the Agenda 2030 will be fulfilled through comprehensiveness and not bypassing anyone.

3.5 Population migrations

In the Agenda 2030 for Sustainable Development, migrations attract special attention in fulfilling this agenda and require interdisciplinary approach and multidimensional and comprehensive commitment in addressing the role and importance of migrations in order to fulfil the objectives of Agenda 2030.

Population migrations present significant potential to lift millions of people out of poverty by providing greater employment and access to decent jobs thus affecting sustainable development.
The close correlation that exists between development migration (both in the country of origin and the country of destination) and the weight of migration to achieve the SDOs make migrations an integral part of Agenda 2030 **(7)**. In reality, migration is important for 8 of the 17 SDOs that show the role and importance of migration in fulfilment of the objectives of Agenda 2030. The agenda, specifically in Objective 10.7, requires: facilitation of migration, safe, orderly and accountable migration" implementation and good management of "migration policies"- sustainable migration model.

3.6 Urbanization

From the demographic point of view urbanism is understood as the process of concentration of population in cities (urban areas); from the urban point of view the issue is about the concentration of functions in a settlement; economists with urbanism imply the concentration of productive power in industry and post-industrial activities, whereas from the sociological point of view urbanism is a process of the level of social development which is accompanied by changes in the way of life.
The specialized organizations of the United Nations specify that the Agenda 2030 for Sustainable Development and its 17 objectives can only be successfully implemented and achieved if countries begin a transition towards sustainable urbanization. The necessity for sustainable urbanism derives from a demographic fact that until the end of the first half of the 21st century , over 65% of the world population will live in cities and towns.
Sustainable urban development is exclusively related to Objective 11 of the Agenda 2030.
In fact, sustainable urban development is essential for 11 of the 17 objectives of Agenda 2030.**(8)**

3.7 Population projections

In the scope of the ways to promote sustainable development and fulfill the Agenda 2030, among the most important elements, according to UNFPA experts, is the integration of population projections in development strategies and policies ***(9)***, emphasizing once again the role, importance and necessity of demographic developments for sustainable development.
Trends and perspectives on population growth, demographic ageing - population ageing, migration and urbanization represent the main opportunities and challenges of countries towards the Objectives for Sustainable Development and fulfillment of the Agenda 2030, with direct and indirect implications **(10)**.

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Za mlajše prebivalstvo v boljšem okolju

For younger population in better environment

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ABSTRACT / POVZETEK

Avtor s pomočjo statističnih podatkov o primanjkljaju rojstev in starostni sestavi prebivalstva v Sloveniji prikaže grozljive razsežnosti primanjkljaja ljudi v delovni starosti v naslednjih desetletjih. Državni razvojni dokumenti razsežnosti tega primanjkljaja podcenjujejo; ne uvrščajo ga med razvojno pomembne makroekonomske spremenljivke in ne predlagajo ukrepov družinske politike za povečanje rojstev, ki bi ga dolgoročno zmanjšali. Vlada naj razkrije njegove razsežnosti za naslednja desetletja, oceni gospodarske in družbene posledice, predlaga ukrepe in oceni njihovo trajanje, stroške in doprinos. Ob prizadevanju za izboljšanje okolja je treba poskrbeti, da bo v tem boljšem okolju imel kdo živeti.

Using statistical data on birth deficit and population age structure in Slovenia, the author shows frightening dimensions of deficit of people in their working age in the following decades. The public development documents underestimate this deficit; they do not include it among important macroeconomic variables and they do not try to diminish it on the long term by proposing family policy measures to increase the number of births. Government should unveil its dimensions for the next decades, estimate its economic and social consequences, propose measures and estimate their duration, cost and benefit. While striving for better climate, we have to make sure that somebody remains to live in the better climate.

KEYWORDS / KLJUČNE BESEDE

Demografija, rodnost, obnavljanje prebivalstva, primanjkljaj rojstev, selitveni prirast, delovna starost, vladni ukrepi, okolje, kadrovska vrzel.

Demography, fertility, population regeneration , births deficit, migration surplus, working age, governmental measures, environment, human, resources gap.

*Article Title Footnote needs to be captured as Title Note
†Author Footnote to be captured as Author Note

1.Neprijetna dejstva

Število rojstev v Sloveniji je že dolgo bistveno premajhno za enostavno dolgoročno obnavljanje prebivalstva. Skupni primanjkljaj rojstev do števila, ki bi zagotavljalo dolgoročno obnavljanje, je od leta 1980 dalje že presegel 350 tisoč oseb in je vsako leto večji. Rastoči primanjkljaj ljudi v delovni starosti, kadrovska vrzel, ki izvira iz primanjkljaja rojstev in odseljevanja državljanov RS, gospodarstvu že nekaj let povzroča velike težave.

Grozljivo padanje števila ljudi v delovni starosti do leta 2045 lahko prikažemo s pomočjo podatkov SURS za prebivalstvo 1.7. 2020. Ker je povprečna starost iskalcev prve zaposlitve pri nas višja od 25 let, in delamo okrog 40 let, smo za delovno starost vzeli 40 let širok starostni interval od 25 do 64 let, čeprav nekateri postavljajo spodnjo mejo na 20 ali celo na 15 let. Leta 2020 jih je v starostni skupini 25 do 64 let bilo 1 156 498. Čez 25 let bodo v tej skupini tisti, ki so bili leta 2020 stari od 0 do 39 let; bilo jih je 912 986. Od njih jih bo v teh 25 letih umrlo 28 272, če bodo po starosti umirali tako kot so po podatkih SURS leta 2019. Tako jih bo ob ničelnem priseljevanju in odseljevanju, dne 1. 7. 2045 v skupini 25 do 64 let 884 717**, torej za 271 784 manj kot 1. 7. 2020**. Enako število ljudi v delovni starosti bi izgubili, če bi pandemija COVID trajala do leta 2045 in bi zaradi nje dodatno umrlo vsak dan 30 ljudi iz te starostne skupine.
Selitveni prirast je bil v 2020 najvišji po letu 2008: priselilo se je 18.365 prebivalcev več, kot se jih je odselilo.[1]

2.Državni razvojni dokumenti ne predlagajo zdravil

Razvojni dokumenti - *Strategija dolgožive družbe*[2], *Strategija razvoja Slovenije 2030*[3], *Poročilo o razvoju 2019*[4]- temu ne posvečajo dovolj pozornosti. Prebivalstveni primanjkljaj omenjajo olepševalno, kot oviro za hitrejši razvoj, ne pa kot hudo grožnjo sedanji ravni blaginje. V *Poročilu o razvoju 2019*, ki predstavlja spremljanje uresničevanja Strategije razvoja Slovenije 2030, UMAR leta 2019 predstavi 70 kazalnikov uspešnosti, vendar se niti eden ne nanaša na število ljudi v delovni starosti, ali na rodnost. Zapiše, da »tudi ob pozitivnih neto migracijah… okoli štiri tisoč oseb na leto bo po

[1] Barica Razpotnik, Selitveni prirast pozitiven, https://www.stat.si/StatWeb/News/Index/9650, 19.9. 2021
[2] *Vlada RS, julij 2017,* https://www.umar.gov.si/fileadmin/user_upload/publikacije/kratke_analize/Strategija_dolgozive_druzbe/Strategija_dolgozive_druzbe.pdf
[3] *Vlada RS, december 2017, https://www.gov.si/assets/vladne-sluzbe/SVRK/Strategija-razvoja-Slovenije-2030/Strategija_razvoja_Slovenije_2030.pdf*
[4] *UMAR, april 2019, https://www.umar.gov.si/fileadmin/user_upload/razvoj_slovenije/2019/Porocilo_o_razvoju_2019.pdf*

projekcijah do leta 2030 prišlo do zmanjševanja aktivnega prebivalstva v povprečju za 10 tisoč oseb na leto.«, vendar ob tem ne vključi sirene. Odsoten je pogled za več kot 10 let naprej. Bralec ne dobi občutka za ogromnost prebivalstvenega primanjkljaja niti zavesti o nujnosti ukrepanja.

Poročilo o razvoju 2020[5] pogosteje in z večjim poudarkom omenja demografske spremembe in pomanjkanje *ustrezne delovne sile*. Na strani 9 UMAR zapiše: »*Vse to zahteva zelo hitro in še precej korenitejše ukrepanje za zagotavljanje ustrezno usposobljenih človeških virov oziroma znanj in spretnosti.* » in opredeli nekaj prednostnih nalog za zmanjševanje tega pomanjkanja. Med njimi ni ukrepov za povečanje rodnosti. Slika 28 na strani 53 pozornemu bralcu pove, da samo petina odstotka prebivalcev EU živi v državah, ki imajo neugodnejše *Projekcije javnih izdatkov, povezanih s staranjem, 2016–2070*. S *Sliko 31* na strani 56 pove o zmanjševanju števila ljudi v delovni starosti, kar je povedal že leto dni prej, namreč, da jih bo do leta 2030 vsako leto za 14 do 15 tisoč manj; graf zelo nazorno prikaže večanje primanjkljaja. Škoda, da slike ne podaljša preko leta 2030.

Poročilo o razvoju 2021[6] v glavnih ugotovitvah sicer omenja »povečanje javnih izdatkov, povezanih s staranjem prebivalstva«, ne omenja pa vpliva epidemije na družine z otroki in na odločanje mladih za otroke. Med *Priporočili razvojni politiki* navede pospešitev rasti produktivnost, vključujoči družbeni razvoj in medgeneracijsko solidarnost (med drugim *z zagotavljanjem zadostnega obsega delovne sile tudi z aktivnim vključevanjem priseljencev v socialno in družbeno življenje*), pospešeni prehod v nizkoogljično krožno gospodarstvo ter krepitev razvojne vloge države in njenih institucij, ne omeni pa premajhnega števila rojstev, oziroma potrebe po povečanju. V poglavju *Visoko produktivno gospodarstvo, ki ustvarja dodano vrednost za vse* ugotovi, da »se obseg ponudbe delovno sposobnega prebivalstva zmanjšuje«, in to pomeni težavo pri »zapiranju razvojne vrzeli«, vendar zdravilo išče samo v povečanju produktivnosti, potrebe po povečanju rodnosti pa ne omeni. Med 19 kazalniki nobeden ne prikazuje primanjkljaja rojstev ali kadrov. *V poglavju Vključujoča, zdrava, varna in odgovorna družba* omenja ranljive skupine, vendar med njimi na nademo družin z otroki. Omeni in oceni povečanje izdatkov povezanih s staranjem z 20,7 % BDP v letu 2019 na 29,8 % v letu 2070, oceni povečanje izdatkov za pokojnine in zapiše, da se bo leta 2050 število upokojencev izenačilo s številom zaposlenih, vendar ne omeni možnosti, da bi vplivali na demografske spremembe. Od 21 kazalnikov, nobeden ni povezan s pomanjkanjem ljudi.
V poglavju *Učenje za in skozi vse življenje* prikaže Sliko 26, ki kaže, da je že konec leta 2018 kadrov primanjkovalo polovici vseh podjetij, med njimi 70 odstotkom velikih podjetij. Med 8 kazalniki nobeden ne obravnava pomanjkanja ljudi.V poglavjih *Ohranjeno zdravo naravno okolje* in *Visoka stopnja sodelovanja, usposobljenosti in učinkovitosti upravljanja* in njunih skupno 22 kazalnikih ne omenja kadrovske vrzeli. Med vsemi 70 kazalniki nobeden ne naslavlja primanjkljaja ljudi.

V *Pomladanski napovedi gospodarskih gibanj 2021*[7], UMAR zapiše, da bo predvidena gospodarska rast tudi posledica *»nadaljnje ugodne dinamike pritoka tuje delovne sile, ki je tudi v preteklem zaostrenem letu ostal na visoki ravni, in nadaljnjega zviševanja stopnje aktivnosti. To bo tudi vidno blažilo postopno upadanje števila prebivalcev v starosti 20–64 let, ki zadnjih deset let negativno vpliva na obseg razpoložljive delovne sile*.«

Načrt za okrevanje in odpornost (NOO) je Vlada sprejela 28. aprila 2021[8] . Sloveniji prinaša 1,8 milijarde evrov nepovratnih sredstev. Države morajo vsaj 37 odstotkov sredstev nameniti stebru *Zeleni prehod*, vsaj 20 odstotkov pa stebru *Digitalne spremembe*. Slovenija je prvemu namenila 42, drugemu pa 21 odstotkov vseh sredstev. V poglavju *Politike za naslednjo generacijo*(str.17) , kjer bi pričakovali ukrepe za povečanje števila rojstev in s tem števila mladih, je za mlade od vrtca do univerze predvidenih mnogo koristnih ukrepov, vendar ni ukrepa, ki bi zagotavljal ali prispeval k temu da mladi bodo in da jih bo več kot sedaj. V poglavju o *Stanovanjski politiki* (str. 454), pri izzivih sicer zapiše, da »se mladi zaradi oteženega dostopa do stanovanj kasneje osamosvajajo in odločajo za oblikovanje družine, kar se odraža na demografskih trendih«(str.455). Med ciljnimi skupinami stanovanjske politike, ki gotovo lahko bistveno prispeva k odločanju mladih za otroke, navaja tudi družine z več otroki (str. 462); vendar med cilji ukrepov ne navede večjega odločanja za otroke(str.457). Povišanje rodnosti ni omenjeno. Treba bi bilo omeniti vpliv pandemije na zniževanje rojstev in na položaj družin v rodni dobi ter določiti razumen del sredstev EU za odpravo posledic in za zvišanje rodnosti. Pohvaliti je treba poskus projekcije vpliva NOO na ključne makroekonomske spremenljivke do leta 2040 na strani 502 in 505, žal pa med njimi ni tistih, ki odražajo primanjkljaj ljudi.

3. Zakaj ne ukrepamo?

Pred Slovenijo sta dve nujni nalogi. Prva je, zagotoviti dovolj ljudi v delovni starosti za gospodarsko in narodno preživetje v naslednjih 25 letih. Iz razvojnih dokumentov je videti, da se te naloge vedno bolj zavedamo, in tudi razmišljamo, kako jo reševati, ne najdemo pa ničesar o drugi dolgoročno ključni nalogi, to je predlogov za povečanje rodnosti.

Če je kaj vsakomur jasno, je jasno to, da če imamo danes premalo ljudi v delovni starosti, je to zato, ker se nam jih je pred desetletji premalo rodilo. Zakaj ne zgrabimo bika za roge in odpravimo problema pri korenini? Kako, da v razvojnih dokumentih ne najdemo prizadevanj za povečanje rojstev?

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[5] UMAR, junij 2020, https://www.umar.gov.si/fileadmin/user_upload/razvoj_slovenije/2020/slovenski/POR2020.pdf

[6](UMAR, junij 2021, https://www.umar.gov.si/publikacije/single/publikacija/news/porocilo-o-razvoju-2021/?tx_news_pi1%5Bcontroller%5D=News&tx_news_pi1%5Baction%5D=detail&cHash=c64dcbcdb53bdad9c7a048e131d72d09

[7] UMAR, Ljubljana, marec 2021 https://www.umar.gov.si/fileadmin/user_upload/napovedi/pomlad/pomladanska_2021/Pomladanska_napoved_2021-splet_01.pdf

[8] (https://www.eu-skladi.si/sl/dokumenti/rrf/01_si-rrp_23-7-2021_lekt.pdf)

Poročilo o spletnem dogodku *Ekonomija pod žarometi*[9] navaja ekonomista in bivšega finančnega ministra dr. Dušana Mramorja: » *Vse meni znane napovedi ekonomskih gibanj za prihodnjih približno 30 let vodijo do naslednjega sklepa. Materialna blaginja srednjega in visoko razvitega sveta, tudi Slovenije, je izjemno ogrožena. Pričakujemo lahko nižji življenjski standard, torej zmanjšanje dobrin, ki bodo na razpolago posameznemu prebivalcu. Ključni problem, zaradi katerega so napovedi tako črnoglede, so na eni strani vedno bolj katastrofalne spremembe v okolju in na drugi strani staranje prebivalstva*.«

Naslov letošnje konference *Ljudje in okolje* torej zadene žebljico na glavico. Nočemo prezreti pomena COVIDA, vendar je ta, kar se tiče preventivnih ukrepov na boljšem. Ko posledice virusa vidim danes in tukaj na svojih najbližjih, meni pa grozijo že jutri, se mi ni težko odločiti za najbolj zdravilen ukrep, čeprav ni najbolj prijeten. Posledice današnje nizke rodnosti pa bomo čutili šele čez 25 let. In kakšne bodo? Znanost že desetletja ponazarja, slika in preračunava dolgoročne posledice podnebnih sprememb. Po desetletjih risanja in ponavljanja teh posledic v medijih, šoli, politiki in drugod je vladam mogoče sprejeti ukrepe, ki za okolje namenjajo ogromne vsote. Pri nizki rodnosti je drugače. Kratkoročno je blagodejna, težave in slabe posledice nastopijo čez desetletja. Nihče pa nam nazorno ne prikaže teh posledic za pokojnine in proračun, za zdravstvo, šolstvo, znanost, kulturo, kakovost življenja.

Pri virusu in pri podnebju vsi vemo, da bomo skupaj zmagali ali skupaj poraženi, kajti ne virus ne podnebje ne spoštujeta državnih meja. Ker pa vsaka država skrbi za svoje upokojence, za bolnike …, medtem ko mladi in zdravi lahko vanje vložena državna sredstva podarijo komurkoli, so finančne in druge posledice nizke rodnosti zaprte v meje posameznih držav. Vsaka sama sprejema odločitve in nosi odgovornost zanje.

Matjaž Gams je leta 2018 kot enega od vzrokov za neukrepanje na ravni EU zapisal tudi dejstvo, da so voditelji 8 ključnih evropskih inštitucij takrat imeli skupno 2 otroka, leta 1951 pa so imeli ti voditelji 32 otrok.[10] Ni pričakovati, da nas bo EU ljubeče opominjala, naj zvišamo rodnost, vendar je prav, da si kot njena enakopravna članica z vplivom na oblikovanje njenih odločitev in razporejanje sredstev, za primerne politike prizadevamo tudi v okviru povezave.

Evropska ljudska stranka je na kongresu leta 2019 na predlog HDZ sprejela resolucijo *Demografski izziv na podeželskih območjih EU: nikogar več ni! (leaving nobody behind*). V njej opozarja na področja, ki se soočajo s krčenjem prebivalstva, izgubo mladih, slabšanjem življenjskih pogojev, in zapiše: »*Zaradi alarmantnih posledic demografskega razvoja zahtevamo nujno ukrepanje.«* Države z boljšo starostno sestavo od Slovenije se zavedajo, da je skrajni čas za znak za preplah, in zahtevajo ukrepe EU.

4. Sklep.

Velik primanjkljaj rojstev v preteklih štirih desetletjih že sam po sebi ogroža obstoj Slovenije in slovenstva. Primanjkljaj ljudi v delovni starosti ogroža ne le gospodarski razvoj in gospodarsko rast, ampak tudi sedanjo raven blaginje. Nemudoma je treba prepoznati demografski primanjkljaj kot hudo grožnjo in v povezavi s tem potrebo po takojšnjem ukrepanju s pogledom 30 in več let naprej. Titanic ni šel pod vodo, ker bi spregledali ledeno goro, ampak ker so jo ugledali prepozno in prepozno zasukali krmilo.

Pristojne ustanove naj priskrbijo podatke; vsi imamo pravico do njih. Tako kot pri osvetljevanju okoljske problematike, naj tudi na področju starostne zgradbe ovrednotijo in prikažejo posledice nesprejemanja ukrepov za povečevanje števila mladih. Če je Nemčija lahko ocenila svoj primanjkljaj delavcev, ga lahko zase tudi Slovenija. Če lahko predvidimo in ocenimo zaloge lesa in pitne vode, samooskrbo z mlekom, mesom, elektriko, premogom …, naj vlada s strokovnimi uradi in službami oceni in objavi zaloge in samooskrbo z delovnimi rokami in bistrimi glavami za nekaj desetletij naprej. Ukrepati je treba ne le v Sloveniji, ampak tudi na mednarodni ravni: z dejavnim sodelovanjem pri oblikovanju ukrepov EU, ki bodo pripomogli, da ne bomo del področij EU, kjer »nikogar več ni«; v drugih mednarodnih organizacijah in v dvostranskih odnosih s posameznimi državami. Pandemija dodatno ogroža življenja in povečuje potrebo po prizadevanju za razvoj in obstoj. Zato je poglobljena vsebinska javna razprava na osnovi dejstev in podatkov – tudi tistih, ki jih prinaša virus – v času virusa še nujnejša kot prej. Na osnovi razprave pa so potrebni odločni ukrepi.

Z ukrepi družinske politike in drugimi spodbudami je treba pri mladih spodbuditi odločanje za življenje in povečati število rojstev, da ne bomo čez 25 let spet v istem položaju kot danes, to je z ogromnim primanjkljajem ljudi, sposobnih in voljnih delati, za naslednjih 25 let. Evropske države z načrtno družinsko politiko imajo zdaj skoraj dovolj rojstev za dolgoročno obnavljanje prebivalstva. Desetletja so se zavedale, zdaj pa se je jasno pokazalo in potrdilo, da družinska politika spodbujanja odločanja za življenje ni le socialna politika pomoči potrebnim, ampak najbolj donosno vlaganje v gospodarsko uspešnost in vsakršni razvoj. Prizadevanje za večjo rodnost je povezano in utemeljeno tudi z dejstvom, da smo si Slovenci v zadnjih stoletjih prizadevali za lastno državo tudi zato, da bi si z njo zagotovili dolgoročni razvoj in obstoj. Vzporedimo strah pred taljenjem arktičnega ledu s strahom pred revščino in izumrtjem in v skladu s tem določimo razmerje med sredstvi za okolje in sredstvi za nova življenja. Poskrbeti moramo. da bo v boljšem okolju imel kdo živeti.

Preveč je pričakovati, da bo sedanja vlada ob boju z virusi in opozicijo ter predsedovanju EU v tem mandatu zmogla dosti popraviti za nazaj in narediti velik korak naprej na tem področju. Na naslednjih volitvah je treba dati možnost vladanja tistim strankam, ki bodo v svojih programih pokazale dolgoročen pogled, voljo do dejavne vloge v prebivalstvenem razvoju in odločanju o lastni usodi ter zavedanje, da pri tako velikem primanjkljaju ne gre le za razvoj, temveč za obstoj.

Dr. Drago Čepar

[9] Okoljski izzivi in staranje so ključni problem, Gospodarska redakcija, Delo 23. 4. 2021

[10] Matjaž Gams, Demografski trendi v svetu in Sloveniji, Kako preprečiti izumiranje slovenskega naroda?, INFORMACIJSKA DRUŽBA, Zbornik 21. mednarodne multikonference–IS 2018, Uredili Thomas Bartz-Beielstein in drugi, IJS, Ljubljana, 2018, str.291, http://library.ijs.si/Stacks/Proceedings/InformationSociety/2018/IS2018_Zbornik_Komplet.pdf, 3.3.2019.

Plačna vrzel po starosti in spolu pri inovativni in neinovativni vrsti dela

The age and gender wage gap in innovative and non-innovative type of work

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POVZETEK

V prispevku ugotavljamo velikost plačne vrzeli po starosti in po spolu pri inovativni in neinovativni vrsti dela, pri čemer inovativno delo opredelimo s tremi vrstami neotipljivega kapitala. Na podlagi Statističnega registra delovno aktivnega prebivalstva in dohodki iz dela za obdobje od leta 2009 do leta 2017, ugotavljamo, da je plačna vrzel po starosti in spolu odvisna od vrste dela in od vrste neotipljivega kapitala.

KLJUČNE BESEDE

Neotipljivi kapital, plačna vrzel med starostnimi skupinami, plačna vrzel med spoloma

ABSTRACT

In this paper, we identify the size of the wage gap by age and by gender for innovative and non-innovative types of work, where innovative work is defined in terms of three types of intangible capital. Based on the Statistical Register of the Working Population and Labour Income for the period 2009 to 2017, we find that the age and gender wage gap depends mainly on the types of intangible capital.

KEYWORDS

Intangible capital, age wage gap, gender wage gap

1 UVOD

Produktivnost posameznika se skozi življenje spreminja iz več razlogov, npr. zaradi pridobljenih delovnih izkušenj, njegovih kognitivnih in fizičnih sposobnosti, motivacije, usklajenosti med delavcem in delavno nalogo [1]. Številne empirične študije kažejo upad delovne uspešnosti posameznikov v starejših letih. Upad je še posebej očiten pri posameznikih, starejših od 50 let [2] ter pri delovnih nalogah, ki zahtevajo reševanje problemov, dodatno učenje in hitrost. Nasprotno je upad produktivnosti pri višji starosti manjši, ali pa ga sploh ni zaznati, pri tistih delovnih nalogah, ki so povezane z izkušnjami in verbalnimi sposobnostmi [1]. Ob tem pa je potrebno dodati, da lahko pridobljene izkušnje iz preteklosti tudi zmanjšujejo produktivnost starejših, še posebej v današnji informacijski dobi, kjer znanje in izkušnje delavcev postanejo zastarele [3].

Zmanjšana produktivnost zaposlenih pa je v nasprotju s po večini empirično ugotovljenimi višjimi plačami v starosti [2]. Ena najbolj znanih teorij, ki pojasnjuje razlike v starostni porazdelitvi plač in produktivnosti je Lazear-jeva »alternativna teorija«, ki zagovarja, da so mlajši posamezniki plačani pod svojo mejno produktivnostjo, medtem ko so starejši posamezniki plačani nad svojo mejno produktivnostjo [4]. Razlog za to so med drugim tudi plače, vezane na senioriteto [5]. Potrebno pa se je zavedati, da se bo produktivnost starejših delavcev v prihodnosti verjetno zviševala, saj se bodo izboljševale njihove kognitivne sposobnosti in njihovo zdravje. Prav tako razvoj zmanjšuje potrebo po fizični moči delavcev [1].

Na drugi strani, v skladu z modeli človeškega kapitala, ženske zaradi svoje tradicionalne vloge v družini manj kontinuirano sodelujejo na trgu dela, kar povzroča njihovo nižjo produktivnost in s tem tudi nižje plače v primerjavi z moškimi [6] [7] [8]. Poleg tega ženske običajno izbirajo manj tvegane in s tem slabše plačane poklice [7] [9], na trgu dela pa se soočajo tudi z diskriminacijo [10]. Vendar pa se razlika v plačah med spoloma skozi čas zmanjšuje [7], predvsem zaradi manj pogoste diskriminacije na delovnem mestu [11]. Poleg tega si moški in ženske skozi čas izbirajo vedno bolj podobna področja študija in podobne poklice [12], kar dodatno znižuje plačno vrzel med spoloma.

V tem članku analiziramo razlike v plačah po starosti in med spoloma, in sicer ločeno za inovativne in neinovativne oz. tradicionalne oblike dela. Konkretno nas zanima, kakšna je povprečna plača posameznega tipa delavca in na drugi strani, pri katerih starostnih skupinah ter oblikah dela obstaja statistično značilna razlika med plačami moških in žensk.

2 METODOLOGIJA IN PODATKI

V raziskavi se osredotočamo na razlike v plači med različnimi skupinami zaposlenih. Zaposleni so razdeljeni v skupine na podlagi treh različnih spremenljivk: starosti (do 30 let, med 30 in 49 let, od 50 let dalje), spola (moški, ženske) in vrste neotipljivega kapitala.

Pri določanju vrste neotipljivega kapitala izhajamo iz definicije, ki se uporablja v projektu Globalinto [13] in določa tri vrste neotipljivega kapitala: (i) organizacijski, (ii) raziskovalno-razvojni in (iii) informacijski neotipljivi kapital. Vrsta neotipljivega kapitala se določi glede na poklic zaposlenega ter njegovo stopnjo in vrsto izobrazbe. Zaposleni, ki imajo terciarno izobrazbo družbenih ved, novinarstva in informacijskih znanosti ali poslovnih in upravnih ved ter prava in opravljajo poklice kot na primer generalni direktorji/generalne direktorice, člani/članice uprav, menedžerji/menedžerke, strokovnjaki/strokovnjakinje za finančno poslovanje, upravljanje procesov dela in ljudi, prodajo, trženje in odnose z javnostmi, pravni strokovnjaki/pravne strokovnjakinje so tisti zaposleni, ki sodijo v skupino zaposlenih z organizacijskim neotipljivim kapitalom [13] [14] [15]. V skupino zaposlenih z raziskovalno-razvojnim neotipljivim kapitalom sodijo posamezniki s terciarno izobrazbo naravoslovja, matematike in statistike in opravljajo poklice kot na primer strokovnjaki/strokovnjakinje fizikalnih in zemeljskih ved, tehnično-tehnoloških strok ali elektrotehnike, zdravstveni strokovnjaki/strokovnjakinje, tehniki/tehnice tehnično-tehnoloških strok. V skupino zaposlenih z informacijskim neotipljivim kapitalom pa so uvrščeni zaposleni s terciarno izobrazbo informacijske in komunikacijske tehnologije in upravljajo poklice kot na primer razvijalci in analitiki/razvijalke in analitičarke programske opreme in aplikacij, strokovnjaki/strokovnjakinje za podatkovne zbirke in računalniška omrežja, tehniki/tehnice za telekomunikacije in oddajanje. Posamezniki, ki niso razvrščeni v nobeno izmed treh skupin neotipljivega kapitala, so zaposlenih, ki jih v nadaljevanju označujemo z »brez neotipljivega kapitala« in predstavljajo neinovativno vrsto dela.

Na podlagi starostnih skupin (3 skupine), spola (2 skupini) in vrste neotipljivega kapitala (4 skupine), so zaposleni razvrščeni v eno izmed 24 skupin. Za vsako izmed skupin je najprej izračunana povprečna plača, nato pa so razlike v povprečni plači primerjane s *t*-testom. Skupine, njihove povprečne plače in razlike v plači po starostnih razredih so prikazane v Tabeli 1, skupine, njihove povprečne plače in razlike v plači med spoloma pa so prikazane v Tabeli 2.

Za izračun povprečnih plač posamezne skupine smo uporabili podatke Statističnega registra delovno aktivnega prebivalstva (SRDAP) za obdobje od leta 2009 do leta 2017 ter podatke o dohodkih iz dela (dohodninski podatki) za enako obdobje [16]. Dohodki iz dela so navedeni kot bruto vrednosti, popravljene za rast cen življenjskih potrebščin v času, in jih v nadaljevanju imenujemo povprečna plača. Celotno število opazovanj znaša 7.085.588 zaposlenih. Približno tretjina (32,25 %) vseh opazovanj so moški stari od 30 do 49 let, sledijo ženske iste starostne skupine (28,91 %). Moški, stari 50 let in več, predstavljajo 13,47 odstotka celotnega vzorca, ženske v isti starostni skupini pa 10,63 odstotka. Najmlajša starostna skupina predstavlja najmanjši delež v celotnem vzorcu, kjer moški, stari do 30 let, predstavljajo 8,83 odstotka celotnega vzorca, ženske pa 5,91 odstotka.

Večina opazovanih posameznikov je takšnih, ki niso uvrščeni v nobeno izmed skupin neotipljivega kapitala, saj je le 3,3 odstotka celotnega vzorca opredeljenih kot takih. 2,8 odstotka zaposlenih je uvrščenih v skupino organizacijskega kapitala, sledi skupina raziskovalno-razvojnega kapitala (0,3 % vzorca) in informacijskega kapitala (0,2 %).

3 REZULTATI

V Tabeli 1 so najprej predstavljene razlike v plači med starostnimi razredi in po spolu ter vrstah inovativnega dela (neotipljivega kapitala). V povprečju velja, da so starejši delavci, ne glede na vrsto neotipljivega kapitala in spol, prejeli višje plače. Največje relativne razlike med starostnimi razredi so med zaposlenimi starimi do 30 let in tistimi, ki so stari med 30 in 49 let. Na primer, moški v skupini organizacijskega kot tudi raziskovalno-razvojnega neotipljivega kapitala, ki so stari do 30 let, so v povprečju prejeli 49 odstotkov nižjo plačo kot tisti, stari med 30 in 49 let. Podobno visoke so tudi relativne razlike za obe omenjeni skupini neotipljivega kapitala med ženskami v prvi in drugi starostni skupini. Tako so ženske v skupini organizacijskega neotipljivega kapitala, ki so stare do 30 let, v povprečju prejele 45 odstotkov nižjo plačo od žensk v starostni skupini med 30 in 49 let, v skupini raziskovalno-razvojnega neotipljivega kapitala pa 42 odstotkov nižjo plačo.

Razlike med drugim in tretjim starostnim razredom, torej med posamezniki, starimi od 30 do 49 let, in posamezniki, starimi 50 let in več, so razlike še vedno statistično značilne, vendar manjše, kar velja predvsem za moške. Tako so moški, stari med 30 in 49 let v povprečju prejeli med 10 in 19 odstotkov nižje plače, odvisno od vrste neotipljivega kapitala, kot moški, stari 50 let in več. Večje razlike so pri ženskah, predvsem v skupini raziskovalno-razvojnega neotipljivega kapitala, kjer so ženske v starostni skupini od 30 do 49 let v povprečju prejele 34 odstotkov nižjo plačo od žensk starih 50 let in več, ter v skupini informacijskega neotipljivega kapitala, kjer so ženske stare od 30 do 49 let prejele 33,6 odstotkov nižjo plačo od žensk starih 50 let in več.

Tabela 1: Razlike v letni bruto plači med starostnimi razredi

Skupina	Moški, <30 let	Moški, 30-49 let	Abs. razlika	Rel. razlika (%)
Brez n.k.	11.823	17.939	6.116	34,1***
Org. k.	17.643	34.973	17.329	49,6***
R&R k.	15.643	31.109	15.466	49,7***
Inf. k.	16.519	25.377	8.858,	34,9***
Skupina	Moški, 30-49 let	Moški, 50+ let	Abs. razlika	Rel. razlika (%)
Brez n.k.	17.939	20.047	2.107	10,5***
Org. k.	34.973	38.733	3.759	9,7***
R&R k.	31.109	38.362	7.252	18,9***
Inf. k.	25.377	30.496	5.119	16,8***
Skupina	Ženske, <30 let	Ženske, 30-49 let	Abs. razlika	Rel. razlika (%)
Brez n.k.	10.002	15.844	5.842	36,9***
Org. k.	14.573	26.616	12.043	45,2***
R&R k.	15.083	25.888	10.805	41,7***
Inf. k.	14.841	21.703	6.862	31,6***
Skupina	Ženske, 30-49 let	Ženske, 50+ let	Abs. razlika	Rel. razlika (%)
Brez n.k.	15.844	18.891	3.046	16,1***
Org. k.	26.616	35.896	9.280	25,9***
R&R k.	25.888	39.691	13.802	34,8***
Inf. k.	21.703	32.697	10.993	33,6***

Opombe: Brez n.k. – skupina zaposlenih, ki ni uvrščena v nobeno izmed skupin neotipljivega kapitala; Org. k. – organizacijski neotipljivi kapital; R&R k. – raziskovalno-razvojni neotipljivi kapital; Inf. k. – informacijski neotipljivi kapital. * značilno pri 10 %, ** značilno pri 5 %, *** značilno pri 1 %.

V Tabeli 2 so predstavljene razlike v letni bruto plači med spoloma, in sicer za 24 skupin zaposlenih, ki so v tabeli prikazane v treh delih glede na starostne skupine in ločeno po spolu. V najmlajši starostni skupni, torej med zaposlenimi, starimi manj kot 30 let, so v povprečju moški prejeli višje dohodke iz dela. V skupini zaposlenih, ki opravljajo ne inovativno delo, so moški, stari manj kot 30 let v povprečju prejeli 15 odstotkov višjo plačo kot ženske; v skupini organizacijskega neotipljivega kapitala pa je relativna razlika v povprečnem dohodku iz dela najvišja in znaša 17 odstotkov. V skupini informacijskega neotipljivega kapitala je bila razlika 10 odstotna. Razlika v plači med moškimi in ženskami, starimi manj kot 30 let v skupini raziskovalno-razvojnega neotipljivega kapitala, ni statistično značilna. Največja relativna razlika v plači med moškimi in ženskami je v skupni organizacijskega neotipljivega kapitala, za stare med 30 in 49 let, in znaša 24 odstotkov. Na drugi strani pa so ženske, stare 50 let in več, v skupini razvojno-raziskovalnega neotipljivega kapitala v povprečju prejele 3 odstotka višjo plačo od moških. To je tudi edina statistično značilna razlika v plači med moškimi in ženskami, ki je v prid žensk.

Tabela 2: Razlike v letni bruto plači med spoloma

Skupina	Moški, <30 let	Ženske, <30 let	Abs. razlika	Rel. razlika (%)
Brez n.k.	11.823	10.002	1.820	15***
Org. k.	17.643	14.573	3.070	17***
R&R k.	15.643	15.083	559	4
Inf. k.	16.519	14.841	1.677	10**
Skupina	**Moški, 30-49 let**	**Ženske, 30-49 let**	**Abs. razlika**	**Rel. razlika (%)**
Brez n.k.	17.939	15.844	2.094	12***
Org. k.	34.973	26.616	8.356	24***
R&R k.	31.109	25.888	5.221	17***
Inf. k.	25.377	21.703	3.673	14***
Skupina	**Moški, 50+ let**	**Ženske, 50+ let**	**Abs. razlika**	**Rel. razlika (%)**
Brez n.k.	20.047	18.891	1.155	6***
Org. k.	38.733	35.896	2.836	7***
R&R k.	38.362	39.691	-1.328	-3***
Inf. k.	30.496	32.697	-2.200	-7

Opombe: Brez n.k. – skupina zaposlenih, ki ni uvrščena v nobeno izmed skupin neotipljivega kapitala; Org. k. – organizacijski neotipljivi kapital; R&R k. – raziskovalno-razvojni neotipljivi kapital; Inf. k. – informacijski neotipljivi kapital. * značilno pri 10 %, ** značilno pri 5 %, *** značilno pri 1 %.

4 ZAKLJUČEK

V prispevku ugotavljamo velikost plačne vrzeli med spoloma in po starosti pri inovativni in neinovativni obliki dela, pri čemer inovativno delo opredelimo s tremi vrstami neotipljivega kapitala. Na podlagi Statističnega registra delovno aktivnega prebivalstva in dohodki iz dela za obdobje od leta 2009 do leta 2017, ugotavljamo, da je plačna vrzel predvsem odvisna od vrst neotipljivega kapitala.

Ugotavljamo, da v povprečju starejši delavci, ne glede na vrsto neotipljivega kapitala in spol, prejemajo višje plače. Največje relativne razlike se kažejo med starostnima skupinama pod 30 let in 30-49 let. Na primer, moški, stari pod 30 let, ki opravljajo delo v skupini organizacijskega ali pa raziskovalno-razvojnega neotipljivega kapitala so v povprečju prejeli 49 odstotkov nižjo plačo kot tisti, stari med 30 in 49 let. Podobno velja tudi za ženske.

V prispevku ugotavljamo tudi, da moški v povprečju zaslužijo več kot ženske, vendar je razlika odvisna od starosti in vrste dela, ki jo posamezniki opravljajo. Rezultati kažejo, da je največja relativna razlika v plači med moškimi in ženskami v skupni organizacijskega neotipljivega kapitala, in sicer za stare med 30 in 49 let, ki znaša 24 odstotkov. Na drugi strani pa so ženske, stare 50 let in več v skupini razvojno-raziskovalnega neotipljivega kapitala v povprečju prejele 3 odstotka višjo plačo kot moški. To je tudi edina statistično značilna razlika v plači med moškimi in ženskami, ki je v prid žensk.

V prihodnjih raziskavah bi bilo med drugim zanimivo pogledati še razlike v panogah, predvsem za razlike med javnim in zasebnim sektorjem ter proizvodnjo in storitvami.

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Vpliv pandemije covid-19 na razlike med spoloma v plačanem in neplačanem delu

The impact of the COVID-19 pandemic on gender differences in paid and unpaid work

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POVZETEK

Članek analizira razlike med spoloma v času, porabljenem za plačano in neplačano delo pred in med pandemijo covid-19 v Sloveniji. Na podlagi primarnih podatkov ugotavljamo, da so se med pandemijo razlike med spoloma v času, porabljenem za plačano delo povečale, pri čemer moški delajo več kot ženske. Na drugi strani so se zmanjšale razlike med spoloma v času, namenjenemu varstvu otrok, kuhanju in čiščenju, ki predstavljajo aktivnosti, ki so v večji meri izvajane s strani žensk, ter v vzdrževanju doma, kjer so aktivnosti v večji meri izvajane s strani moških.

KLJUČNE BESEDE

Neplačano delo, covid-19, razlike med spoloma, Slovenija, poraba časa

ABSTRACT

This paper analyses gender differences in time spent on paid and unpaid work in Slovenia before and during the pandemic COVID-19. Based on primary data collection, we find that during the pandemic, gender gaps in time spent on paid work actually widened, with men working more than women. On the other hand, gender gaps narrowed in time spent on childcare, cooking and cleaning, which are activities that are predominantly done by women, and household maintenance, which is predominantly done by men.

KEYWORDS

Unpaid work, COVID-19, gender gap, Slovenia, time use

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1 UVOD

Od konca leta 2019 se ljudje po vsem svetu soočajo z obsežno katastrofo, ki jo povzroča akutna okužba dihal covid-19 [3]. Ukrepi za preprečevanje hitrega širjenja virusa iz človeka na človeka [1] so med drugim vključevali zaustavitev gospodarstva, zaprtje vrtcev, šol, delo od doma in družbeno distanciranje. Ukrepi so med drugim vplivali tudi na način preživljanja našega časa. V tem prispevku tako preučujemo, kako se je porabljen čas za 14 aktivnosti na povprečni delovni dan spremenil v času prvega vala epidemije covid-19 v Sloveniji. Pri tem se osredotočamo predvsem na razlike v porabljenem času za posamezno aktivnost med spoloma, in sicer pred epidemijo ter na morebitne spremembe v času epidemije. Prispevek najprej opisuje zbrane podatke s pomočjo ankete o porabi časa in uporabljeno metodologijo, sledita predstavitev rezultatov ter zaključek.

2 PODATKI IN METODOLOGIJA

Raziskava temelji na podatkih, zbranih v začetku maja 2020, in sicer med razglašenim prvim valom epidemije covid-19, ko so veljali strogi ukrepi glede omejevanja širjenja virusa. Posamezniki so bili naprošeni, da izpolnijo anketo o porabi časa, ki se je nanašala na dve obdobji: pred epidemijo in med epidemijo. Čas pred epidemijo je bil opredeljen kot čas pred razglasitvijo Odloka o začasni splošni prepovedi gibanja in zbiranja ljudi na javnih mestih in površinah v Republiki Sloveniji (UR št. 30/20), čas med epidemijo pa kot čas veljave omenjenega odloka. Vprašanja so se nanašala na običajen delovni dan, pri čemer so posamezniki 24 ur razdelili med 14 različnih aktivnosti: (i) spanje, (ii) priprava obrokov, prehranjevanje, (iii) umivanje, oblačenje, (iv) delo (plačano), (v) pospravljanje, pranje, likanje, (vi) vrtnarjenje, skrb za hišne ljubljenčke, (vii) vzdrževanje, gradnja (npr. stanovanja, hiše, opreme), (viii) nakupovanje, urejanje dokumentacije, (ix) študij, (x) skrb za otroke (varstvo/igra/ustvarjanje), (xi) skrb za ostale posameznike (npr. ostale družinske člane, ki niso otroci), (xii) druženje (npr. pogovor s prijatelji, praznovanja, telefoniranje, videoklici), (xiii) rekreacija, sprehod, vadba, (xiv) prosti čas (npr. poslušanje radia, gledanje televizije, početek). Aktivnosti so bile usklajene z vprašalnikom o porabi časa [1].

V raziskavo je bilo vključenih 467 delovno sposobnih posameznikov, starih med 25 in 65 let. V vzorcu je bilo 50,5 % moških in 49,5 % žensk. 47,8 % anketirancev je živelo v mestnem okolju. Ker v raziskavi preučujemo razlike med spoloma v porabi časa za različne aktivnosti, med drugim tudi za plačano in neplačano delo, smo med anketirance vključili predvsem tiste, ki so živeli v partnerski zvezi (95,3 % posameznikov v vzorcu). 67,2 % posameznikov je živelo v gospodinjstvu z vsaj enim otrokom mlajšim od 18 let, od tega jih je imelo 42,4 % vsaj enega otroka v vrtcu ali osnovni šoli. Večina anketirancev je bila sekundarne (48,2 %) ali terciarne izobrazbe (54,4 %). 80,7 % posameznikov je bilo zaposlenih, samozaposlenih, ali so opravljali delo preko drugih oblik dela (npr. preko avtorske pogodbe ali pa so opravljali priložnostno delo); 6,6 % je bilo brezposelnih; 5,6 % je bilo upokojenih. Od tistih, ki so delali, jih je v času anketiranja 37,0 % delalo na svojem delovnem mestu, 22,7 % jih je delalo od doma, 16,3 % je čakalo na delo, preostali pa niso delali iz drugih razlogov, npr. zaradi varstva otrok.

V nadaljevanju prispevka je na podlagi vzorca najprej predstavljen povprečen čas, porabljen za različne aktivnosti pred in med epidemijo covid-19 v Sloveniji, in sicer za oba spola skupaj. Nato analiziramo povprečni čas, ki so ga moški in ženske porabili za različne dejavnosti v obeh obdobjih. Razlike med spoloma v obdobju pred in med epidemijo so tudi testirane s t-testom za neodvisne vzorce.

3 REZULTATI

Pred pandemijo so posamezniki v povprečju na delovni dan 6,8 ur spali, 6,7 ur delali, 1,6 ure pripravljali obroke in jedli. Povprečno so porabili 1,4 ure za prosti čas in približno eno uro za: čiščenje, pranje perila, likanje (1,0 ure), varstvo otrok (1,0 ure), rekreacijo (0,9 ure), nego drugih posameznikov (0,9 ure), umivanje in oblačenje (0,9 ure), vrtnarjenje, skrb za hišne ljubljenčke (0,9 ure). Pred pandemijo so ljudje v povprečju manj kot eno uro dnevno porabili za nakupovanje in pripravo dokumentacije (0,7 ure), druženje (0,6 ure), vzdrževanje in gradnjo doma (0,5 ure) ter študij (0,3 ure). Pred pandemijo je povprečni čas, porabljen za neplačano delo, tako znašal 6,5 ur. Med pandemijo se je povečal predvsem porabljen čas za študij (za 48,0 %), vzdrževanje doma (za 22,8 %) in druženje (za 23,8 %). V času pred in med epidemijo se je porabljen čas zvišal tudi v primeru skrbi za druge (za 18,2%), vrtnarjenje in nego hišnih ljubljenčkov (za 14,7%), prosti čas (za 14,2%) in spanje (za 2,3%). Ta dodatni čas je bil nadomeščen z veliko manj plačanega dela - v času pandemije so ljudje delali v povprečju 19,5 % oz. 1,3 ure manj kot pred pandemijo. Za prehranjevanje in pripravo obrokov je bilo porabljenih 1,7 ure, za druga gospodinjska opravila pa v povprečju 5,5 ur. Čas, namenjen neplačanemu delu, se je tako zvišal za skoraj 45 minut na dan.

Za ponazoritev razlik med spoloma v obdobju pred pandemijo je v tabeli 1 prikazan povprečni čas moških in žensk ter absolutna in relativna razlika pred pandemijo za vsako aktivnost posebej, medtem ko tabela 2 prikazuje enake kazalnike za obdobje med pandemijo. Pred pandemijo so moški na trgu dela delali v povprečju 1,5 ure več kot ženske, pri čemer je razlika med spoloma predstavljala 21,6 % povprečnega časa, ki so ga posamezniki (ne glede na spol) namenili plačanemu delu. Moški so prav tako porabili veliko več časa za vzdrževanje doma (v povprečju 23 minut več kot ženske), pri čemer je razlika med spoloma predstavljala 75 % celotnega povprečnega časa, porabljenega za vzdrževanje. Na drugi strani so ženske porabile bistveno več časa za pripravo obrokov (približno pol ure oz. 38,5 % več kot moški) in za čiščenje (kjer je absolutna razlika znašala 0,5 ure, relativna pa 44,8 %). Pred pandemijo je obstajala tudi znatna razlika med spoloma v času, porabljenem za varstvo oz. nego otrok, čemur so ženske namenile več časa kot moški. Razlika med spoloma je predstavlja 30 % celotnega časa, porabljenega za varstvo otrok. Pred pandemijo ni zaznati statistično značilnih razlik med spoloma v času, porabljenem za spanje, rekreacijo, prosti čas, vrtnarjenje in nego hišnih ljubljenčkov.

Tabla 1. Razlike med spoloma v porabljenem času pred pandemijo

	Porabljen čas (v urah)			
	Moški	Ženske	Absolutna razlika (M-Ž)	Relativna razlika (kot % porabljenega časa vseh posameznikov)
Spanje	6.81	6.86	-0.05	-0.79
Priprava obrokov, hranjenje	1.27	1.87	-0.60	-38.45***
Umivanje, oblačenje	0.81	0.90	-0.10	-11.21*
Plačano delo	7.44	5.98	1.45	21.59***
Čiščenje, pranje, likanje	0.81	1.27	-0.46	-44.81***
Vrtnarjenje, nega hišnih ljubljenčkov	0.83	0.87	-0.04	-4.35
Vzdrževanje, gradnja doma	0.69	0.31	0.38	75.48***
Nakupovanje, urejanje dokumentacije	0.66	0.78	-0.12	-16.75*
Študij	0.20	0.33	-0.13	-45.76
Nega otrok	0.81	1.11	-0.29	-29.96†
Nega ostalih posameznikov	0.83	0.85	-0.02	-2.88
Druženje	0.52	0.66	-0.15	-24.33**
Rekreacija	0.93	0.94	-0.01	-0.75
Prosti čas	1.43	1.29	0.14	10.16

Opomba: ***p < 0.001; **p < 0.01; *p < 0.05; †p ≤ .10
Absolutna razlika je opredeljena kot razlika med povprečnim časom, ki so ga moški in ženske porabili za posamezno aktivnost pred pandemijo. Relativna razlika pa kot absolutna razlika, relativno glede na povprečni čas, porabljen s strani celotnega (po spolu nerazčlenjenega) vzorca pred pandemijo.

Med pandemijo (glej tabelo 2) so moški zopet porabili statistično značilno več časa za plačano delo, v povprečju eno uro in 24 minut oz. 25,9 % več kot ženske. Moški so porabili tudi več časa za vzdrževanje doma in gradbena dela (približno 25 minut več kot ženske). Po drugi strani so ženske porabile več časa za pripravo obrokov (približno 38 minut oz. 39,9 % več kot moški) in za čiščenje, pranje in likanje (približno 27 minut oz. 39,5 % več kot moški). Kot je razvidno tudi iz tabele 1 za obdobje pred pandemijo, so ženske tudi v času pandemije v povprečju porabile več časa za študij, druženje in nakupovanje kot moški. Iz tabele 2 je razvidno tudi, da so se v času pandemije zmanjšale razlike med spoloma v času, porabljenem za nego otrok – ta razlika je postala tudi statistično neznačilna. V času med pandemijo ostajajo statistično neznačilne razlike med spoloma v količini časa, ki ga posamezniki porabijo za nego drugih (običajno ostalih družinskih članov), pa tudi v količini spanja in času, porabljenem za rekreacijo in prosti čas.

Tabla 2. Razlike med spoloma v porabljenem času med pandemijo

	Porabljen čas (v urah)			
	Moški	Ženske	Absolutna razlika (M-Ž)	Relativna razlika (kot % porabljenega časa vseh posameznikov)
Spanje	6.98	7.00	-0.03	-0.36
Priprava obrokov, hranjenje	1.34	1.97	-0.63	-37.91***
Umivanje, oblačenje	0.80	0.90	-0.10	-11.42**
Plačano delo	6.11	4.71	1.40	25.86***
Čiščenje, pranje, likanje	0.92	1.36	-0.45	-39.53***
Vrtnarjenje, nega hišnih ljubljenčkov	0.96	0.99	-0.03	-3.26
Vzdrževanje, gradnja doma	0.82	0.41	0.41	65.78***
Nakupovanje, urejanje dokumentacije	0.62	0.76	-0.14	-20.88**
Študij	0.31	0.51	-0.20	-49.42**
Nega otrok	1.03	1.14	-0.11	-10.35
Nega ostalih posameznikov	0.98	1.03	-0.05	-5.11
Druženje	0.65	0.84	-0.18	-24.49***
Rekreacija	1.05	1.07	-0.02	-1.82
Prosti čas	1.69	1.44	0.25	15.96

Opomba: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; †$p \leq .10$
Absolutna razlika je opredeljena kot razlika med povprečnim časom, ki so ga moški in ženske porabili za posamezno aktivnost med pandemijo. Relativna razlika pa kot absolutna razlika, relativno glede na povprečni čas, porabljen s strani celotnega (po spolu nerazčlenjenega) vzorca med pandemijo.

4 ZAKLJUČEK

Spomladi 2020, ko je bila razglašena pandemija covid-19 tudi v Sloveniji in so vlade izvajale vrsto ukrepov za preprečevanje širjenja virusa, so bili posamezniki prisiljeni spremeniti način preživljanja časa. Spremembe v porabljenem času za različne aktivnosti so bile med moškimi in ženskami neenakomerno porazdeljene. V članku tako preučujemo vpliv pandemije covid-19 na čas, ki ga posamezniki v povprečnem delovnem dnevu porabijo za različne dejavnosti. Naši rezultati kažejo, da se je med pandemijo znatno povečala količina porabljenega časa za spanje, kuhanje, čiščenje, vzdrževanje doma in skrb za druge. Poleg tega so posamezniki porabili več časa za študij in povečali količino prostega časa. Ta dodatno porabljen čas je bil nadomeščen z veliko manj dela - v povprečju so posamezniki med pandemijo delali 20 % manj kot pred pandemijo.

Ob osredotočenju na razlike med spoloma ugotavljamo, da so moški na trgu dela pred pandemijo običajno delali 1,5 ure več kot ženske. Moški so porabili tudi znatno več časa za vzdrževanje doma kot ženske. Na drugi strani so ženske porabile bistveno več časa za kuhanje, čiščenje in druge gospodinjske dejavnosti. Med pandemijo se je razlika med spoloma v plačanem delu relativno še povečala. Moški so začeli tudi več kuhati in še posebej čistiti, medtem ko so ženske začele porabljati več časa za vzdrževanje doma. Moški so tudi v času pandemije več počivali, a so namenili tudi znatno več časa skrbi za otroke kot pred pandemijo, kjer je razlika med spoloma med pandemijo postala statistično neznačilna.

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Staranje prebivalstva in več vidikov zdravljenja z zdravili

Population ageing and several aspects of pharmacological treatment

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POVZETEK

V okviru naraščajoče porabe zdravil na recept je razvidna tudi rast predpisovanja zdravil starejšim osebam. Obstajajo tveganja pri polifarmakoterapiji, sočasnem predpisovanju več zdravil. Premagovanje ovir pri jemanju zdravil prispeva k izboljšanem sprejemanju zdravljenja in boljšim terapevtskim rezultatom. Razpoznan je pomen ustreznega razumevanja pisnih virov o zdravilih, ki vpliva na jemanje zdravil ter njihovo učinkovitost in varnost. Starejšim osebam je treba pomagati pri navodilih za jemanje zdravil in razumevanju informacij o zdravilih, posebej v pogojih pandemije.

KLJUČNE BESEDE

Zdravila na recept, zdravila brez recepta, starejše osebe, racionalno predpisovanje zdravil, razumevanje pisnih virov

ABSTRACT

Related to an increasing prescription medicine usage also an increased usage of the medicines, prescribed to the elderly patients, has been observed. Risks at a polypharmacy, a concomitant prescribing of medicines, have existed. Overcoming the barriers at taking medicines has contributed to an improved treatment adherence and to better therapeutic results. The meaning of an appropriate written medicine sources' comprehension has been recognized, with an effect on the medicine taking and their efficacy and safety. Elderly persons should be assisted at the instructions for taking of medicines and at a comprehension of the medicines' information, especially within the pandemic requirements.

KEYWORDS

Prescription medicines, over-the-counter medicines, elderly persons, rational prescribing of medicines, comprehension of written sources

1 UVOD

Prispevek pregledno obravnava več vidikov varovanja zdravja, s poudarkom na določenih ovirah pri zdravljenju z zdravili, v povezavi s staranjem prebivalstva. Že več let se na demografski konferenci, v okviru multikonference Informacijska družba, predstavljajo raziskovalni prispevki, ki poudarjajo pomemben vpliv demografskih sprememb ne le na področju zdravljenja, temveč tudi na sociološkem, antropološkem, ekonomskem in drugih področjih.

Staranje prebivalstva je proces, razviden v Sloveniji, pa tudi globalno. D. N. Weil [1] je že pred več kot dvema desetletjema analiziral trend staranja prebivalstva na svetovni ravni. Ta trend je zelo izrazit v razvitih državah, s pomembnim povečanjem deleža prebivalcev nad 65 let in sočasnim zmanjšanjem deleža prebivalcev, mlajših od 20 let. Čeprav je staranje prebivalstva razmeroma počasen proces, se predvidevajo ekonomske posledice staranja prebivalstva.

2 RACIONALNO PREDPISOVANJE ZDRAVIL STAREJŠIM OSEBAM IN RAZLIKE V UČINKOVANJU ZDRAVIL

V zahodnih državah se stroški za zdravstveno varstvo povečujejo. S staranjem prebivalstva povezujejo zmerno povečanje stroškov akutnega zdravljenja in znatno povečanje stroškov zdravljenja kroničnih bolezni [2]. Pomemben dejavnik rasti stroškov za zdravstveno varstvo je medicinska tehnologija, ki je močno povezana s starostjo in zdravjem. Razvoj medicinske tehnologije omogoča, da tudi osebe s kroničnimi boleznimi prebivajo doma, kar vodi v znatne prihranke v dolgotrajni oskrbi. Osebe z boljšim zdravstvenim stanjem lahko tudi v starejših letih več prispevajo v delovnem okolju. Večji obseg stroškov za varovanje zdravja starejših oseb lahko tudi bremeni medgeneracijsko solidarnost.

Iz poročila slovenske zdravstvene zavarovalnice ZZZS [3] je razvidno, da so v letu 2020 odhodki za zdravila in živila znašali 11,6 % vseh odhodkov ZZZS v tem letu. Glede na predhodne leto so se odhodki ZZZS za zdravila povečali za 15,3 %. Število predpisanih receptov na prebivalca je bilo 8,35 v letu 2020. Čeprav se je število receptov glede na leto 2019 zmanjšalo (za 1,4 %), se je poraba zdravil na posamezno osebo, ki je prejela zdravilo, povečala za 7,9 %, oziroma za 2,9 % letno v zadnjih petih letih.

V poročilu [3] omenjeni trend upočasnitve naraščanja predpisanih receptov na prebivalca ima ekonomski smisel. Bolj racionalno predpisovanje zdravil pa je obenem tudi terapevtsko smiselno, če pacient pri tem prejme ustrezno terapijo. V poročilu je navedena tudi zahtevana pozornost pri sočasnem predpisovanju več zdravil hkrati (polifarmakoterapija). Posebej pri starejših osebah se lahko, zaradi možnega medsebojnega delovanja zdravil, pojavijo neželeni učinki.

Ugotovitve raziskovalcev so namenjene tudi podpori ukrepov odločevalcev. Ti ukrepi bi morali voditi v izboljšano kakovost življenja starejših oseb, posebej tistih, ki prebivajo sami. Pomembna je učinkovita odzivnost na demografske spremembe, saj nekateri ukrepi učinkujejo šele po določenem času, na primer gradnja domov za starejše osebe, investicije v zdravstvu, spremembe na ekonomskem področju in drugi ukrepi.

3 JEMANJE ZDRAVIL PRI STAREJŠIH OSEBAH

Že podatki iz leta 2008 kažejo povečanje povprečne vrednosti receptov zdravil (brez dragih zdravil), ko se pomikamo od starostne skupine otrok do skupine starejših oseb. Posebej izrazito je to povečanje v starostnih skupinah nad 65 oziroma nad 85 let [4]. V Sloveniji se je v letu 2015 preko 178 tisoč oseb zdravilo z zdravili, ki vsebujejo pet do devet zdravilnih učinkovin oziroma več kot 23 tisoč oseb z zdravili z vsebnostjo deset ali več zdravilnih učinkovin.

Zdravila imajo številne pozitivne učinke pri zdravljenju in zmanjševanju simptomov bolezni [5]. Koristi zdravljenja pa je treba ovrednotiti glede na možna tveganja. Po ocenah delež bolnišničnih obravnav zaradi jemanja zdravil znaša med 2,4 % in 6,2 %. Veliko izmed teh neželenih učinkov bi bilo mogoče preprečiti. Tveganje za neželene učinke je podvojeno, če je pacient star 65 let, ali več, posebej če pacient sočasno jemlje več zdravil. Poročajo, da je celo 30 % bolnišničnih sprejemov pacientov starih 65 let ali več zaradi neželenih učinkov zdravil. Starejše osebe pogosto sočasno jemljejo dve ali več zdravil [6]. Staranje je povezano z anatomskimi in fiziološkimi spremembami, ki vplivajo na delovanje zdravil. Te spremembe vključujejo razlike v absorbciji, metabolizmu in izločanju zdravilnih učinkovin. Pri starejših osebah so učinki zdravil lahko povečani ali zmanjšani zaradi sprememb v receptorjih za zdravilne učinkovine. Spremembe v farmakokinetiki in farmakodinamiki se lahko odražajo v podaljšanem razpolovnem času, povečanem potencialu za toksičnost zdravil in v večji verjetnosti za pojav neželenih učinkov. Zaradi tega je treba razumeti anatomske in fiziološke spremembe v starejših letih, preden se zdravila predpisujejo.

Ovire pri učinkovitem zdravljenju starejših predstavljajo tudi kognitivne motnje, slab vid, slabši finančni položaj [7]. Razpoznali so s starostjo povezana tveganja zaradi slabšega komuniciranja, polifarmakoterapije, medsebojnega delovanja med zdravilnimi učinkovinami in sprememb v farmakokinetiki, ki prispevajo k težavam pri zdravljenju in neustreznem sprejemanju zdravil in lahko vplivajo na bolnišnične sprejeme. K izboljšanem vodenju zdravljenja prispeva pregled in poenostavitev shem jemanja zdravil. V pomoč so strokovni timi, v katere so vključeni tudi farmacevti. Pomembno je usklajevanje načinov medikamentoznega zdravljenja med različnimi specialisti. Pacienti, ki sočasno jemljejo pet ali več zdravil, potrebujejo usmeritve glede jemanja in ravnanja z zdravili. Varnost zdravljenja se poveča, če je zdravil manj in so obenem bolj učinkovita.

Kljub razpoznanim tveganjem polifarmakoterapije pri starejših osebah, številni pacienti prejemajo zdravljenje, ki je zanje lahko tvegano [8]. Določili so izrecna merila za določitev zdravil, ki so primerna za kronično zdravljenje starejših oseb. Na osnovi znanstvenih spoznanj so določili zdravila, ki za zdravljenje starejših oseb niso primerna.

Vodenje zdravljenja starejših oseb je večinoma zahtevno, zato potrebujejo pomoč strokovnjakov s področja zdravja in svojcev, da zdravila dosežejo pričakovan učinek in so varna.

3.1 Medikamentozno zdravljenje starejših oseb v pogojih pandemije

Zelo zahtevne razmere, tudi glede zdravljenja z zdravili, so v letu 2020 nastale med pandemijo, še posebej za starejše osebe. Dejavnosti v zdravstvenih ustanovah so bile osredotočene na obvladovanje bolezni covid-19, zato je potrebna še večja skrb pri kroničnem zdravljenju starejših oseb z zdravili [9]. Še posebej veliko pozornost bi bilo treba posvetiti medikamentoznemu lajšanju bolečine, zdravljenju duševnih motenj, uravnavanju visokega krvnega pritiska in sladkorne bolezni. Pomemben je nadzor pacientov, ki jemljejo štiri ali več zdravil, zaradi možnih posledic kot so na primer padci. S povečanjem števila zdravil se poveča tveganje neželenih učinkov.

Avtorica [9] predlaga več ukrepov za boljše organiziranje in nadzorovanje zdravljenja starejših oseb z zdravili. Svetuje pripravo navodil zdravnika za pacientovo jemanje zdravil, ki ji sledi priprava odmerkov zdravil na domu. Priporoča se, da se v lekarnah pripravijo posamezni odmerki zdravil za določenega pacienta; na ta način se poveča verjetnost ustreznega dnevnega odmerjanja predpisanih zdravil, ob sočasnem preverjanju s strani družinskih članov. Klinični farmacevt pripomore pri ugotavljanju morebitnih neskladnosti predpisanih zdravil in svetuje pacientom. Tudi v primeru sočasnega jemanja vitaminov oziroma prehranskih dopolnil se svetuje posvet s farmacevtom, da se prepreči morebitna medsebojna učinkovanja oziroma neželene učinke.

4 PISNI VIRI INFORMACIJ O ZDRAVILIH

Kljub objavam strokovnih in znanstvenih člankov je področje informacij o zdravju in zdravilih še premalo raziskano in se v praksi dobre prakse premalo udejanjajo. Zdravilom na recept in zdravilom brez recepta so priložena navodila za uporabo, v katera so vključena bistvena navodila za odmerjanje in način jemanja zdravil ter tudi informacije o možnih tveganjih, povezanih z jemanjem zdravil. V zadnjih letih se v znatnem obsegu uporabljajo prehranska dopolnila. Čeprav prehranska dopolnila sodijo k živilom, je treba njihovo uživanje nadzorovati in paziti na morebitno medsebojno delovanje z zdravilnimi učinkovinami, predvsem ko gre za ranljive skupine oseb.

Pomembno je razumevanje pisnih navodil, ki je bistven pogoj za ustrezno jemanje in ravnanje z zdravili. Razumevanje navodil za uporabo in promocijskih pisnih virov o zdravilih je bolj zahtevno v primeru polifarmakoterapije. Izkušnje kažejo, da je razumevanje informacij o zdravilih izboljšano, če poleg razpoložljivih pisnih virov o zdravilih pacient za nasvet vpraša zdravnika, farmacevta oziroma drugega strokovnjaka, ki pozna farmakoterapijo.

Z ozirom na velik delež starejših oseb, ki se zdravijo z enim ali več zdravili, bi morali izbrati primerne oblike njihovega izobraževanja in informiranja. Poleg objav člankov bi koristil način komuniciranja, ki je pristopen starejšim osebam. Kljub povečanemu trendu digitalnega iskanja informacij je treba upoštevati, da veliko starejših oseb nima hitrega dostopa do računalnika. Prijazen, hiter in preprostejši dostop do informacij je bolj učinkovit.

Medtem ko je v uradno odobrenih pisnih virih vsebina strukturirana in nadzorovana, pa so promocijska gradiva običajno bolj komercialno usmerjena. Na osnovi rezultatov raziskave [10] smo v slovenskih besedilih ugotovili, da apeli o prednostih zdravil brez recepta niso bili uravnoteženi z apeli o tveganjih. Zaradi vpliva zaznavanja in razumevanja apelov je bistveno uravnoteženje apelov o prednostih in možnih tveganjih, povezanih z uporabo zdravil brez recepta. Ker so pisni viri običajno glavni vir informacij o zdravilih brez recepta, je pomembna njihova vsebina, vključno z uravnoteženjem apelov. Ne le zdravila na recept, temveč tudi zdravila brez recepta se mora natančno odmerjati in pozornost nameniti tudi možnim medsebojnim delovanjem med zdravilnimi učinkovinami.

Določanje berljivosti je prav tako pomemben dejavnik pri razumevanju besedil. Medtem ko se v določenih, razvitih državah uporabljajo formule za določanje berljivosti, pa se v Sloveniji to področje še razvija. Ustrezne stopnje berljivosti vodijo v primerno razumljivost besedil o zdravju in zdravilih. Raziskovalca sva ugotovila [11], da stopnje berljivosti izbranih besedil o zdravju in zdravilih ne dosegajo priporočene stopnje.

Pri zdravilih se pojavlja tudi vprašanje sprejemanja zdravljenja s strani pacientov. Med navedbami o učinkovitosti in tveganjih zdravil je tudi z vidika sprejemanja zdravljenja pomembno, katere navedbe v večji meri vplivajo na paciente, da se odločijo za izbor zdravila brez recepta, oziroma za jemanje zdravila na recept. V raziskavi [12] smo ugotovili, da neželenim učinkom zdravil brez recepta osebe pripisujejo večjo pomembnost kot učinkovitosti oziroma določenim drugim lastnostnim, ki se povezujejo s koristmi zdravila. Osebe so kot posebej tvegane opredelile resne neželene učinke. Zaključili smo, da bi bilo v pisnih gradivih za paciente koristno opisati neželene učinke zdravil ter prikazati njihovo dejansko tveganje.

4.1 Pomoč starejšim osebam pri ustreznem razumevanju pisnih virov o zdravilih

S posredovanjem informacij o zdravilih medicinske sestre pripomorejo k informiranju starejših pacientov o uporabi na recept predpisanih zdravil [13]. Prejem pisnih navodil za jemanje zdravil je pomemben za starejše osebe s pogosto oslabljenim fizičnim stanjem. Težave pri jemanju zdravil lahko nastanejo pri starejših osebah z nižjo stopnjo razumevanja besedil o zdravju in zdravilih oziroma izobrazbe ter pri zapletenih režimih odmerjanj zdravil za zdravljenje kroničnih bolezni. Svetuje se uporaba modelov za tvorbo ustreznih pisnih informacij o zdravilih za starejše osebe.

Boljše razumevanje besedil pomeni večjo možnost za ustrezno učinkovitost in varnost zdravljenja z zdravili.

5 ZAKLJUČEK

Staranje populacije in naraščajoč delež starejših oseb se povezuje tudi s spremembami v uporabi zdravil. Predpisovanje zdravil starejšim osebam pogosto zajema polifarmakoterapijo. Jemanje več zdravil hkrati lahko povzroči medsebojno učinkovanje med zdravili in možne neželene učinke. Pregledna predstavitev režima zdravljenja poveča razumljivost navodil in olajša jemanje zdravil. Nasvet strokovnjaka podpira ustrezno jemanje zdravil, ob sočasnih, starejšim osebam prijaznih oblikah pridobivanja informacij o zdravilih in načinih komuniciranja z njimi.

Čeprav se v zdravstvenih sistemih velik pomen pripisuje nadzoru proračuna za zdravljenje, bi morala biti v ospredju predvsem dobrobit ljudi. Posebna skrb bi morala biti namenjena starejšim osebam, ki so ranljiva skupina prebivalcev. Starejše osebe pogosto živijo same, ali pa njihovi svojci zaradi zaposlenosti ne morejo v zadostni meri skrbeti zanje. Starejši ljudje so skrbeli za nas in nas učili v mladosti, poskušajmo sedaj mi poskrbeti zanje, da bo starost kolikor je mogoče prijetna in dostojanstvena. Zaradi obremenitev zdravstvenih delavcev med pandemijo starejše osebe potrebujejo še več pozornosti in skrbi za zdravje.

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Prebivalstvena politika Kitajske po letu 1950: Od začetnih iskanj in socialistične vere v neomejeno rast prebivalstva do politike enega in zatem treh otrok na družino

Population Policy of China Since 1950: From Early Socialist Ideas and Oscillations to the One-child Policy and Recent Two and Three Children Policy per Family

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POVZETEK

Avtor analizira razvoj prebivalstvene politike Kitajske v zadnjih nekaj več kot sedemdesetih letih. V tem obdobju je kitajska prebivalstvena politika doživela velike spremembe, ki so bile povezane z gospodarskimi in družbenimi spremembami in razvojem, različnimi fazami demografskega prehoda in veliko modernizacijo družbe nasploh. Od začetne negotovosti in nihanj je politika prišla v osrednjo fazo, ki jo je zaznamovala politika enega otroka na družino. (Pre)dolgo trajanje te faze bo gotovo otežilo doseganje ciljev prebivalstvene politike Kitajske v naslednjih fazah, namreč politike dveh in zatem treh otrok na družino. Kako uspešna bo kitajska politika pri spodbujanju rodnosti, bo pokazal šele čas.

KLJUČNE BESEDE
prebivalstvena politika, Kitajska, pospešeni demografski prehod.

ABSTRACT

China's population policy has changed tremendously since 1950. The changes have been caused by political, economic and social developments, demographic transition and modernization of the society. From early socialist ideas and oscillations the population policy evolved in one-child per family policy. This central phase ended in 2015, probably too late. Therefore, the goals of the last three children per family policy will be harder to achieve. Generally, it remains to be seen how effective will be pronatalist policy in China.

KEY WORDS

population policy, China, induced demographic transition.

1 UVOD

Prebivalstvo Kitajske je v obdobju po letu 1950 največje prebivalstvo sveta. Leta 1950 je štelo po kitajskih uradnih podatkih 546,8 milijona ter imelo stopnjo natalitete 37,0 ‰, stopnjo smrtnosti 18,0 ‰ in stopnjo celotne rodnosti 5,81 otroka na žensko (Calot, 1984). Na ta način je bilo v zgodnji fazi demografskega prehoda, v kateri se je smrtnost že zniževala, medtem ko se rodnost še ni začela zniževati. V zahodni demografski literaturi so avtorji kritično ocenjevali uradne kitajske demografske podatke. Za obdobje 1953-1980 te ocene ne kažejo večjih razlik pri celotnem prebivalstvu, pri stopnji natalitete in še posebej pri stopnji smrtnosti pa so razlike precej večje. Stopnji natalitete in smrtnosti sta v tem obdobju v kitajskih uradnih podatkih podcenjeni (Banister, 1984). Razlike so še posebej velike v obdobju politike velikega skoka naprej, ki je povzročila lakoto in veliko povečanje smrtnosti.

Ne glede na razlike v omenjenih dveh virih podatkov pa nam ti podatki omogočajo okvirno slediti poteku demografskega prehoda od visokih ravni rodnosti in smrtnosti na nizke ravni teh dveh demografskih procesov v Kitajski. Pri tem je še posebej zanimivo pogledati, kdaj se je začela zniževati rodnost oziroma stopnja natalitete. Po obeh virih podatkov lahko ugotovimo, da se je to zgodilo okrog leta 1970, ko je prebivalstvo Kitajske štelo že 820 milijonov. Do leta 1982, ko je število z 1,008 prvič preseglo milijardo, je stopnja natalitete padla na 21,1 ‰ in stopnja smrtnosti na 7,9 ‰ (kitajski podatek je 6,6 ‰). Ob upoštevanju ocene, da je bilo na Kitajskem leta 1950 550 milijonov ljudi, je bila povprečna letna stopnja rasti prebivalstva v obdobju 1950-1982 1,89 %. Po tej stopnji rasti bi se modelsko prebivalstvo podvojilo v 37 letih. Na osnovi ocen OZN o gibanju osnovnih kazalcev rodnosti in smrtnosti lahko sklenemo, da se je demografski prehod na Kitajskem končal v 1990-ih letih. Stopnja natalitete se je znižala na 18,2 ‰ leta 1990 in na 13,6 ‰ leta 2000. V teh dveh letih je bila stopnja celotne rodnosti zaporedoma 1,92 in 1,70 otroka na žensko. Število prebivalstva pa je bilo leta 2000 1,270 milijarde (UN, 2007). Dodajmo še, da je leta 2021 objavljeni podatek popisa v letu 2020 1,410 milijarde, stopnja celotne rodnosti pa le 1,33. Po teh podatkih je bila povprečna letna stopnja rasti prebivalstva Kitajske v obdobju 1950-2020 1,35 %.

Kitajski demografski prehod je bil izjemno hiter, saj je trajal le okrog 40-50 let. Po trajanju se zelo razlikuje od demografskih prehodov v razvitem delu sveta, kjer so ti trajali 150 do 200 let. Vendar se razlikuje tudi od prehodov v ostalih nerazvitih državah sveta, kjer je praviloma smrtnost prav tako hitro padla, rodnost pa se je prilagajala znižani smrtnosti največkrat veliko počasneje. Tako hiter demografski prehod, še posebej pri rodnosti, je Kitajska dosegla s pomočjo prebivalstvene politike in doslednega izvajanja te politike s strani vladajoče politike, države in celotne družbe.

V tem besedilu bomo analizirali razvoj kitajske prebivalstvene politike v obdobju 1950 – 2021. To obdobje bomo razdelili na tri dele v skladu z osnovnimi značilnostmi kitajske prebivalstvene politike. Prvo obdobje je 1950-1980, ko oblast niha med začetnimi iskanji in potrebo po intervenciji na eni strani in socialistično vero v neomejeno rast prebivalstva na drugi strani. Drugo je obdobje politike enega otroka na družino 1980-2015. Tretje obdobje od leta 2016 naprej pa je obdobje politike dveh in zatem treh otrok na družino.

2 ZGODNJE FAZE DEMOGRAFSKEGA PREHODA TER NIHANJE MED POTREBO PO INTERVENCIJI IN STIHIJNIM RAZVOJEM: 1950 – 1980

Prvo obdobje prebivalstvene politike socialistične Kitajske, ki je nastala s prevzemom oblasti s strani komunistične partije v letu 1949, so zaznamovala velika nihanja v teoriji in praksi med različnimi skrajnostmi (Zheng, Jian idr., 1981). Letom podpore in kampanj načrtovanja družine so sledila leta popolnega zavračanja. Predsednik Mao je že leta 1949 zanikal obstoj kakršnihkoli resnih prebivalstvenih problemov na Kitajskem in zavrnil »absurdno« Malthusovo teorijo, ki so jo zavrgli marksisti in socialistična praksa v Sovjetski zvezi in na Kitajskem (Population Reports, 1982). Vlada je v prvih letih deloma podpirala rojstva, prepovedala sterilizacijo in splav, dajala podporo vladnim uslužbencem za rojstvo otroka ter v propagandi povezovala veliko otrok z novim družbenim sistemom.

S prvim petletnim planom (1953-57) se je odnos vlade začel spreminjati. Podatki popisa prebivalstva leta 1953 in potrebe planskega usklajevanja teh podatkov z ekonomskimi viri so vodili do sproščanja omejitev pri splavu in večje podpore načrtovanju družine. Leta 1956 so prvič začeli kampanjo načrtovanja rojstev. Vodilni politiki so v letih 1954-57 večkrat javno podprli načrtovanje rojstev. Leta 1957 je tudi Mao odredil, da je treba načrtovanje družine spodbujati, sprejeti desetletni program načrtovanja družine in izpolniti njegove cilje (Zheng, Jian idr., 1981).

Vendar je bilo vse to kratkega daha. Že leta 1958 je Mao vpeljal novi ekonomski program znan kot Veliki skok naprej. Načrtovanje družine je bilo izenačeno z maltuzijanizmom. Prevladal je slogan »več ljudi je boljše«. Prebivalstvena vprašanja in teorije so postala tabu. Ironično pa je, da je ravno v teh letih rodnost padla, rast prebivalstva pa se je zmanjšala. V letih 1959-62 se je prebivalstvo celo zmanjšalo. Razlog je bil v hudi lakoti in v drugih ekonomskih težavah, ki jih je povzročila politika Velikega skoka. Že leta 1962 pa je sledila druga kampanja načrtovanja rojstev. Vlada je ustanovila urad za načrtovanje rojstev, uvedla cilje rasti prebivalstva, sprejela milejše zakone o splavu in sterilizaciji, spodbujala uporabo kontracepcije in poznejše poročanje. Politični voditelji so ponovno razglašali, da je načrtovanje družine napredno in po svoji naravi komunistično. Kljub vsemu pa je tudi ta preobrat podrla kulturna revolucija v letu 1966. Načrtovanje družine je bilo ponovno ukinjeno, proizvodnja in prodaja kontracepcijskih sredstev sta bili opuščeni, pa tudi administrativne kontrole pri starosti poročanja ni bilo več. Sledila je hitra rast prebivalstva, pomanjkanje stanovanj in zaposlitev, nazadovanje izobraževalnih in kulturnih standardov ter celo pojav novih nepismenih.

Kulturni revoluciji je sledila vzpostavitev reda v letu 1971 in z njim tretja kampanja načrtovanja rojstev. Slednje je končno dobilo polno veljavo, njegovi cilji pa so bili razglašeni kot »pozno, redko in malo«. Leta 1973 so prvič vgradili prebivalstvene cilje v petletni gospodarski plan, naslednje leto pa je predsednik Mao ponovno poudaril, da je potrebno rast prebivalstva kontrolirati. Po smrti predsednika leta 1976 in obračunu z levičarji (»tolpa štirih«) so novi voditelji razglasili politiko štirih modernizacij (kmetijstvo, industrija, obramba in znanost) in javno poudarili, da je njihov uspeh odvisen od dosega ničelne rasti prebivalstva v bližnji prihodnosti.

To prvo zelo razburkano obdobje v razvoju Kitajske in njene prebivalstvene politike je sklenila sprememba ustave leta 1978. V ustavo so zapisali, da država zagovarja in spodbuja načrtovanje družine. Tudi v pravno formalni obliki je načrtovanje družine postalo osnovna dolžnost državljanov.

3 POLITIKA ENEGA OTROKA NA DRUŽINO: 1980 – 2015

Zelo radikalno in za marsikoga problematično politiko enega otroka na družino so na Kitajskem uvedli leta 1980 s četrto kampanjo načrtovanja rojstev. Tega leta je državni svet objavil poziv ljudem naj imajo samo enega otroka na družino, septembra istega leta pa je CK KP naslovil odprto pismo vsem članom partije z zahtevo, da prevzamejo vodilno vlogo pri uresničevanju tega cilja. Hkrati je voditelj partije in države Hua Guofeng razglasil cilj, da bo Kitajska omejila število prebivalstva na maksimalno 1,2 milijarde do leta 2000. Država je uvedla politiko ideološkega izobraževanja, ki jo je kombinirala z ekonomskimi in administrativnimi ukrepi. Leta 1980 je država sprejela zakon o porokah, ki je dvignil minimalno starost za ženske na 20 in za moške na 22 let. Za uspešnost prebivalstvene politike pa je bilo še bolj pomembno delno sproščanje kolektivizacije v kmetijstvu, ki je spremenila sistem spodbud in s tem povečala ekonomske razlike med ljudmi ter hkrati okrepila ekonomsko vrednost otrok. S tem pa je pomenila novo težavo za prebivalstveno politiko.

Nova politika je bila sprejeta na vrhuncu demografskega prehoda, ko je prebivalstvo zelo hitro naraščalo in s tem grozilo, da bo onemogočilo razvoj države in štiri modernizacije. Popis prebivalstva leta 1982 je pokazal, da je imela Kitajska takrat le 19,5 % urbanega prebivalstva, visoko gostoto v najbolj naseljenih predelih ter izrazito neenakomerno regionalno porazdelitev. Navedimo še, da je tega leta 6,67% prebivalstva pripadalo narodnostnim manjšinam, za katere striktna politika enega otroka na družino ni veljala, vendar je bilo tudi za njih obvezno načrtovanje rojstev in v praksi omejitev na dva otroka na družino.

V zelo strnjeni obliki lahko za politiko enega otroka na družino zapišemo, da se je do neke mere razlikovala med mestnimi in vaškimi območji. V mestih je bilo manj izjem, politika pa je bila bolj stroga. S prevzemom obveze, da bodo imeli le enega otroka, so si pari zagotovili materialno nagrado, podaljšan porodniški dopust, prednost pri zaposlitvi, dodelitvi stanovanja, zdravstveni oskrbi, sprejemu otroka v jasli, vrtec in šolo, pa tudi pravico do dodatka k pokojnini. V vaseh so takšni pari dobili enkratno denarno nagrado, gradbeno parcelo, zagotovilo vaške skupnosti, da bo ta poskrbela zanje v starosti ipd. Zlasti na vasi se je že v 1980ih letih pokazalo, da je uvajanje tržnih elementov gospodarjenja ponovno začelo spodbujati višjo rodnost. Zaradi tega so povečali število primerov, ko so ljudem dovolili rojstvo drugega otroka. Rojstvo treh in več otrok na družino pa je bilo strogo prepovedano (Malačič, 2006).

Z uvedbo politike enega otroka na družino se je neposredni administrativni pritisk na posamezno kitajsko družino s strani kadrov načrtovanja družine in drugih uradnikov, ki je bil prisoten že v 1970ih letih, še znatno okrepil. Tudi sami kadri so namreč pod močnim pritiskom uresničevanja konkretnih ciljev, ki so podrobno razčlenjeni na regionalnih, mestnih in drugih lokalnih ravneh. Pritisk se širi od pogostega obiskovanja uradnikov, strogega izobraževanja in prepričevanja pa vse do odkritega nasilja. Preveč vneti lokalni politiki in aktivisti so posegali tudi po prisili pri sterilizaciji in vstavljanju materničnih vložkov, pa tudi po umetnem prekinjanju nedovoljenih nosečnosti, pogosto tudi v poznih fazah le teh. O tej plati prebivalstvene politike na Kitajskem večinoma molčijo. Ne glede na to pa je možno skleniti, da veliko ljudi na Kitajskem prostovoljno izvaja predpisano politiko, hkrati pa je tudi veliko dokazov, da tako velikega in hitrega znižanja rodnosti ne bi bilo brez odločne administrativne podpore in moči vladajoče partije in države.

Do začetka 21. stoletja je politika enega otroka na družino temeljila bolj na političnih kot pravnih osnovah in sredstvih ter bolj na predpisih in uredbah lokalnih oblasti, ki so bile najbolj odgovorne za izvajanje te politike. Sama politika se v tem obdobju ni bistveno spreminjala, čeprav so se oblasti trudile odpravljati večje zlorabe in korupcijo. Razvoj je bil v tem času v skladu s širšimi spremembami v kitajski družbi in je šel v smeri od političnih improvizacij Maove dobe proti večjemu pomenu prava in zakonov. Vse to je vodilo do tega, da sta CK KP in Državni svet Kitajske leta 2000 sprejela odločitev o okrepitvi politike prebivalstva, načrtovanja družine in ustalitve nizke rodnosti. KP je jasno zapisala, da podpira vse osnovne značilnosti dotedanje politike. S tem je izrazila podporo stabilnosti politike, hkrati pa je predvidela spremembe v prihodnje, ki bi se naj nanašale predvsem na izboljšanje kvalitete prebivalstva in na večji pomen ekonomskih in drugih spodbud. Kvaliteto so pojmovali izrazito zdravstveno, predvsem bi se naj izboljšalo zdravje otrok in žena. Na osnovi te odločitve je bil konec leta 2001 končno sprejet Zakon o prebivalstvu in načrtovanju rojstev, s katerim se je tako dolgo odlašalo (PCR Law on Population, 2002). Ta zakon je po eni strani konkretiziral politično odločitev partije in države, po drugi strani pa je postavil pravne temelje v obliki splošnih načel, vloge planskih aktov, mikro regulacije reprodukcije, ukrepov in aktivnosti na področju spodbud in zdravstvenih storitev, pa vse do legalne odgovornosti (Winkler, 2002). Zakon se je začel izvajati 1. 9. 2002. Zakon je v osnovi zakoličil politiko enega otroka na družino za naslednjih 15 let, hkrati pa je namenoma izpustil nekatere probleme, npr. velikega števila nelegalnih rojstev in s tem Kitajcev, ki nimajo pravnega statusa in pretiranega porušenja spolnega ravnovesja v času trajanja politike, pri drugih pa je pustil precej nejasnosti, ki na lokalni ravni omogočajo še naprej trdo uveljavljanje planskih ciljev.

Tukaj ne moremo podrobneje obravnavati izjem in vseh fines politike enega otroka, ki so postajale številčnejše v kasnejših letih njene veljave, ko je bilo vse več ljudem dovoljeno, da so imeli še drugega otroka. Povejmo pa, da je bilo z leti tudi vse več konkretnih predlogov, kako preiti najprej na dva otroka na družino in kasneje na popolno sprostitev (Yi, 2007). Ob dejstvu, da je Kitajska dosegla raven rodnosti, ki ni več zagotavljala enostavnega obnavljanja prebivalstva že v 1990ih letih, je težko razumeti, zakaj je kitajsko vodstvo (pre)dolgo vztrajalo pri tej politiki. Vmes se je Kitajska hitro razvijala in modernizirala, demografski prehod se je že zdavnaj končal, prebivalstvo se je začelo (pre)hitro starati, politike enega otroka na družino pa niso opustili vse do leta 2015. Odgovor verjetno leži v želji po stabilnosti in strahu pred prehitrim sproščanjem in vrnitvijo starega.

Na koncu te točke povejmo, da je z današnjega vidika težko razumeti, zakaj se je kitajsko politično in državno vodstvo na prehodu iz 1970ih v 1980ta leta odločilo za tako skrajno obliko prebivalstvene politike. Podrobnejša analiza pa pokaže, da so osnovne predpostavke in konstrukcijo »prebivalstvene krize« na Kitajskem povzeli po zahodni znanosti in delovanju povezav, kot je npr. Rimski klub, ki so v tistem času glasno opozarjale na to, da bo prehitra rast prebivalstva ogrozila gospodarski razvoj (Greenhalgh, 2003). Kitajsko prebivalstvo je sredi demografskega prehoda izredno hitro naraščalo. Projekcije na osnovi take hitre rasti pa so kazale skrb zbujajoče visoke številke. V začetku 1980ih se je prebivalstvo podvojilo v 33 letih, ko je leta 1982 po popisu preseglo milijardo. Ob taki rasti bi okrog leta 2010 štelo že dve milijardi in to bi po mnenju kitajskih voditeljev ne le ogrozilo štiri modernizacije ampak razvoj gospodarstva in družbe nasploh. Po drugi strani pa kitajske politike enega otroka na družino ni mogoče povsem reducirati na politiko načrtovanja rojstev oziroma družine. Politika enega otroka in širša prebivalstvena politika se vključujeta v petletne gospodarske plane in sta del državnega vodenja in masovnega izvajanja, ki je bolj ali manj (ne)prostovoljno. Hkrati pa se Kitajska tudi trudi, da bi bila vse bolj del širše politike države blaginje ob tem, da je že sicer del državne socialne in ekonomske politike.

4 POLITIKA DVEH IN ZATEM TREH OTROK NA DRUŽINO: 2016+

Kitajsko politiko in strokovnjake je že dolgo časa skrbelo, kako izpeljati »rahel pristanek« zelo stroge in (pre)dolgo trajajoče politike enega otroka na družino. Postopno sproščanje omejitev je bilo prisotno dalj časa, vendar so politiki odlašali s prehodom na politiko dveh otrok na družino vse do leta 2016 (Xiaoyu, 2021). Od tega leta naprej so se lahko vsi pari, ki so to želeli, odločili za rojstvo dveh otrok. Sprememba politike je bila sprejeta, ko je stopnja celotne rodnosti v državi bila 1,5 otroka na žensko, moderno kontracepcijo je uporabljalo okrog 85 % parov v rodni dobi, 51 % ljudi je živelo v mestih, rodilo se je 116 dečkov na 100 deklic, povprečna letna stopnja rasti prebivalstva je bila 0,43 %, deleža 0-14 let in 65+ let starosti sta bila zaporedoma 18 in 10 %, življenjsko pričakovanje ob rojstvu za moške in ženske je bilo zaporedoma 75 in 78 let, prebivalstvo pa je leta 2015 znašalo 1396,7 milijonov (Asian Data Sheet, 2018). Dodajmo še, da je bruto nacionalni dohodek na prebivalca po kupni moči znašal leta 2014 13.130 ameriških dolarjev (Pison, 2015).

Podobno kot so projekcije v poznih 1970ih letih napovedovale zelo hitro rast prebivalstva, novejše projekcije prebivalstva Kitajske vsaj v zadnjih tridesetih letih napovedujejo zelo hitro staranje prebivalstva. Ker je osnovni vzrok staranja prebivalstva prenizka rodnost, je razumljivo, da je politika enega otroka na družino staranje prebivalstva še posebej pospešila. To pa pomeni, da se bo Kitajska soočala z veliko starega in postopnim zmanjševanjem aktivnega prebivalstva. Prvo skrbi politike zaradi tega, ker nimajo vzdržnega modernega pokojninskega sistema, drugo pa zaradi morebitnega pomanjkanja delovne sile in znižanja konkurenčnosti gospodarstva.

Kar smo navedli v prejšnjem odstavku je skupaj z geopolitičnimi in obrambnimi razmisleki vodilo do tega, da je KP Kitajske 31. maja 2021 sprejela odločitev, da bo kratkoživo politiko dveh otrok na družino zamenjala s politiko treh otrok na družino (Xiaoyu, 2021). Osnovna logika te politike je enaka kot pri ostalih dveh politikah. Ta je, da imajo pari lahko sedaj do tri otroke, ne pa tudi več. Očitno se predlogi nekaterih strokovnjakov, da bi sprostili omejitve in uvedli svobodno odločanje o rojstvih vsaj do tega leta še niso uresničili.

Tako o politiki dveh kot o politiki treh otrok je še težko obširneje pisati, ker sta še čisto sveži. Strokovnjaki in verjetno tudi politiki se zavedajo, da bodo morali ljudi spodbujati, da se bodo odločali za dva ali tri otroke, morali bodo poskrbeti za jasli in vrtce, za otroške dodatke in druge ukrepe, ki bodo znižali stroške družin z otroki. Zelo pomembno pa bo, kako se bo Kitajska spopadla s povsem nasprotnim ciljem, kot je bil pri politiki enega otroka, ko je šlo za zniževanje rodnosti, ki že po naravi pojava poteka hkrati z gospodarskim razvojem. Pri povečevanju rodnosti pa bo treba omenjeni naravni potek preobrniti navzgor. Današnje razvite države pri tem niso bile posebej uspešne, pa tudi ljudje so ukrepe za spodbujanje rodnosti preveč hitro vzeli za samoumevne in jih niso več povezovali s pronatalitetnimi cilji. Kitajska lahko doda že znanim politikam in ukrepom v razvitih državah partijsko disciplino in državni pritisk, ki pa verjetno ne bosta bistveno dvignila stopenj rodnosti.

5 SKLEP

Kitajska politika prebivalstva je prehodila v preteklih malo več kot 70 letih vladavine komunistične partije dolgo pot. V prvih 30 letih je nihala med skrajnostmi popolne stihije in socialistične vere v svetlo prihodnost na eni in zavedanjem, da je družbi potrebna modernizacija in načrtovanje družine na drugi strani. Na vrhuncu demografskega prehoda, ko so matematični modeli projekcij prebivalstva kazali možnost povečanja prebivalstva na 2 milijardi v dobrih 30 letih, so se politični voditelji odločili za strogo politiko enega otroka na družino. V naslednjih 35 letih je bila politika zelo skopa pri dovoljevanju izjem, predvsem pa je politika enega otroka na družino trajala precej dalj, kot bi bilo potrebno. To je privedlo do tega, da sta si sledili politiki dveh in od leta 2021 naprej treh otrok zelo hitro, hkrati pa bo pri slednjih dveh in še posebej zadnji veliko težje uresničevati cilje, kot če bi politiko enega otroka opustili vsaj 10 let prej.

Kitajska je s prikazano politiko uspela pospešiti zniževanje rodnosti in skrajšati demografski prehod, kar nekaterim drugim nerazvitim državam, npr. Indiji, ni uspelo. Uspela je tudi omejiti najvišje število prebivalstva, ki ne bo bistveno preseglo 1,4 milijarde. Za vse to so država in še bolj posamezniki in njihove družine plačali precej visoko ceno. Mnenja o tem, ali je bilo to treba, se bodo verjetno zmeraj razlikovala. Šele prihodnja leta pa bodo pokazala, ali bo Kitajski uspelo tudi dvigniti rodnost in zagotoviti nemoteno obnavljanje prebivalstva z rodnostjo okoli 2,1 otroka na žensko. Razvite države pri tem še niso bile uspešne.

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Precenjenost presežne umrljivosti za Slovenijo v letu 2020

Overestimated excess mortality for Slovenia in 2020

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POVZETEK

Eurostat ter zgledujoč po njem Statistični urad RS in številni drugi izračunavajo presežno umrljivost kot razliko med dejanskim številom umrlih in povprečnim številom umrlih v obdobju 2015-2019. Pri tem ne upoštevajo 1) spreminjanja števila in starostne strukture prebivalstva ter 2) trenda zniževanja umrljivosti v času. V članku upoštevamo ta dva dejavnika in ocenimo, da je v Sloveniji v letu 2020 presežna umrljivost znašala 14,9 %, medtem ko pristop od Eurostata oz. Statističnega urada RS daje oceno 18,8 %.

KLJUČNE BESEDE

Presežna umrljivost, umrljivost, covid-19, staranje prebivalstva, Slovenija

ABSTRACT

Eurostat, and following their example also Statistical Office of the Republic of Slovenia and many others calculate excess mortality as the difference between the actual number of deaths and the average number of deaths between 2015 and 2019. This way they ignore 1) changing number and the age structure of the population and 2) trend of declining mortality over time. In the article we consider these two factors, and we estimate the excess mortality for Slovenia for 2020 to be 14,9 %. In contrast, the approach used by Eurostat and Statistical Office of the Republic of Slovenia estimates the excess mortality to 18,8 %.

KEYWORDS

Excess mortality, mortality, covid-19, population ageing, Slovenia.

1 UVOD

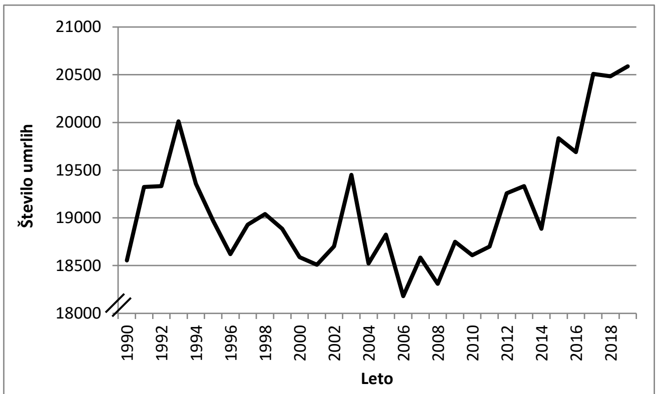
V letu 2020 je virus covid-19 močno spremenil življenje po vsem svetu. Drastični ukrepi v zvezi z omejevanjem širjenja okužb so izhajali iz visoke umrljivosti, ki jo je povzročal ta virus. Eurostat, Statistični urad Republike Slovenije (v nadaljevanju »SURS«) in številni drugi so začeli izračunavati »presežno umrljivost« kot število umrlih v posameznem letu oziroma mesecu minus povprečno število umrlih v preteklem 5-letnem obdobju (2015-2019). Eurostat sicer namesto 5-letnega obdobja v praksi uporablja 4-letno obdobje (2016-2019), saj za 2015 podatki niso na voljo za vse države, želeli pa so zagotoviti enotnost in s tem primerljivost med državami. Prednost tako opredeljenega kazalnika je, da je zelo preprost in nezahteven glede podatkov, potrebnih za njegov izračun. Potrebujemo zgolj podatek o številu umrlih, ki ga tako nacionalni statistični uradi kot Eurostat redno objavljajo. Presežna umrljivost je nov kazalnik, ki se je uvedel iz potrebe spremljanja umrljivosti in učinkov ukrepov v izrednih razmerah virusa covid-19. Za večjo ažurnost se ta kazalnik sedaj izračunava tudi na mesečni ravni.

Metodološko gledano pa tak poenostavljen pristop ne upošteva dveh procesov, ki vplivata na število umrlih. Prvič, število umrlih je odvisno tudi od števila in starostne strukture prebivalstva, ki se v času spreminjata. Število prebivalstva Slovenije se zaradi visokega neto priseljevanja v zadnjih letih povečuje, hkrati pa se hitro stara. Posledično bi se število umrlih povečevalo tudi, če ne bi bilo virusa covid-19. Drugič, umrljivost po posameznih starostnih razredih se v času znižuje, saj živimo vedno dlje in zato bi se ob nespremenjeni zakonitostih umiranja ter nespremenjenem številu in starostni strukturi prebivalstva število umrlih v času zniževalo.

V tem članku bomo ocenili, koliko sta ta dva dejavnika neto vplivala na število umrlih v Sloveniji v letu 2020. Če bi se ta dejavnika, ki vplivata na število umrlih v nasprotni smeri, medsebojno ravno izničila glede na povprečno število umrlih v obdobju 2015-2019, bi dobili povsem enake rezultate o presežni umrljivosti kot s pristopom Eurostata oz. SURS. Če temu ne bo tako, pa bodo naše ocene o presežni umrljivosti ustrezno višje oziroma nižje.

2 METODOLOGIJA IN PODATKI

Preden predstavimo svoje izračune, prikazujemo v Sliki 1 gibanje števila umrlih v zadnjih treh desetletjih, to je od leta 1990 do 2019, torej pred virusom covid-19. V tem obdobju je bil do leta 2006 trend gibanja števila smrti negativen, saj se nam je v Sloveniji pričakovano trajanje življenja hitro podaljševalo in je več kot kompenziralo naraščanje števila prebivalcev v višji starosti, kjer je umrljivost visoka. Nato pa je naraščanje števila starejših prebivalcev prevladalo in kot kažejo projekcije prebivalstva, se bo ta trend še posebej intenzivno nadaljeval v prihodnjem desetletju [1]. V Sliki 1 torej lahko vidimo, da smo že več kot desetletje priča očitnemu trendu naraščanja števila umrlih.



Slika 1: Gibanje števila umrlih v Sloveniji v obdobju 1990-2019 (vir: Statistični urad RS [1])

V letih 2015 do 2019 je v Sloveniji zaporedoma umrlo 19.834, 19.689, 20.509, 20.485 in 20.588 oseb. Povprečje za obdobje 2015-2019 tako znaša 20.221 umrlih in na osnovi te vrednosti Eurostat, SURS in številni drugi izračunavajo presežno umrljivost. Vendar pa bo ob naraščajočem trendu števila umrlih izračunana presežna umrljivost precenjena, če jo bomo definirali kot razliko med dejanskim številom umrlih in povprečnim številom umrlih v preteklih petih letih.

Pri svojih izračunih uporabljamo podatke o številu umrlih [2] in številu prebivalcev na dan 1. 7. (torej sredi leta) [3] v letih 2015 do 2020. Najprej izračunamo starostno specifične stopnje umrljivosti po spolu in starosti za posamezna leta od 2015 do 2019 na sledeči način:

$$m_x = \frac{M_x}{V_x} \qquad (1)$$

pri čemer x označuje starost, M število umrlih, V pa število prebivalcev (včasih se uporablja tudi oznaka P, vendar je črka P v demografiji praviloma uporabljena za označevanje celotnega števila prebivalstva, medtem ko se pri razčlenjevanju prebivalstva po posameznih dimenzijah uporablja črka V).

Za tako dobljene starostno specifične stopnje umrljivosti m_x nato izračunamo trendne vrednosti za leto 2020. Pri tem izhajamo iz obdobja 2015-2019 in uporabimo linearni trend z metodo najmanjših kvadratov. Dejanskih starostno specifičnih stopenj umrljivosti za leto 2020 namreč ne moremo uporabiti, saj so visoke zaradi virusa covid-19, medtem ko mi želimo ugotoviti, kolikšno bi bilo število umrlih v letu 2020, če virusa covid-19 ne bi bilo.

Hkrati želimo upoštevati število in starostno porazdelitev prebivalcev v letu 2020. Tu se lahko odločamo med (Eurostatovimi) projekcijami števila prebivalcev za leto 2020 in dejanskim številom prebivalcev Slovenije sredi leta 2020. Odločili smo se za drugo možnost, saj so podatki o številu prebivalcev sredi leta 2020 medtem že na voljo [2], hkrati pa je bila v prvi polovici leta 2020 umrljivost zaradi virusa covid-19 nizka in je zato vpliv na število prebivalcev sredi leta 2020 zanemarljiv – do 30. 6. 2020 je za virusom covid-19 umrlo skupaj 111 oseb [4]. Tako za število umrlih kot za število prebivalcev uporabljamo podatke po enoletnih starostnih razredih od starosti 0 let pa do starosti 100+.

V naslednjem koraku apliciramo trendne vrednosti starostno specifičnih stopenj umrljivosti (po starosti in spolu) na dejansko število prebivalcev po starosti in spolu sredi leta 2020:

$$M_{2020'} = \sum_{x=0}^{100+} m_x^{lt2020} * V_x^{1.7.2020} \qquad (2)$$

kjer $M_{2020'}$ označuje ocenjeno število umrlih v letu 2020, če ne bi bilo virusa covid-19, x označuje enoletne starostne razrede od 0 do 100+ let, m_x^{lt2020} označuje trendne starostno specifične stopnje umljivosti za 2020 z uporabo linearnega trenda (upoštevaje metodo najmanjših kvadratov), $V_x^{1.7.2020}$ pa označuje število prebivalcev sredi leta 2020 po enoletnih starostnih razredih. Ta izračun naredimo ločeno za moške in ženske in nato rezultata seštejemo v skupno število umrlih v letu 2020.

Rezultat torej pokaže, koliko prebivalcev Slovenije bi umrlo v letu 2020, če bi se nadaljeval trend upadanja umrljivosti v posameznih starostnih razredih iz obdobja 2015-2019, kar pomeni brez učinka virusa covid-19 na umrljivost v posamezni starosti, hkrati pa upoštevaje dejansko število in starostno porazdelitev prebivalstva v letu 2020.

3 REZULTATI

Z uporabo opisanega pristopa smo izračunali, da bi v letu 2020 v Sloveniji umrlo 20.896 oseb, če ne bi bilo virusa covid-19. Ta vrednost je za 675 oseb višja kot znaša povprečje števila umrlih za obdobje 2015-2019 (to je, kot smo že omenili, 20.221 oseb). Ocenjujemo torej, da za toliko oseb rezultati o presežni umrljivosti, ki jih objavljata Eurostat in SURS, precenjujejo presežno umrljivost. Vendar pa tudi naš rezultat ni enoličen, saj smo ga dobili ob predpostavljanju 5-letnega trenda (2015-2019) gibanja starostno specifičnih stopenj umrljivosti v posamezni starosti (ločeno za oba spola). Za 5-letni trend 2015-2019 smo se odločili, ker tudi metoda Eurostata oz. SURS uporablja to obdobje kot referenčno.

Po opisani metodi Eurostata oziroma SURS bi presežno umrljivost za leto 2020 izračunali kot dejansko število umrlih v letu 2020 (24.016 oseb) minus povprečno število umrlih v obdobju 2015-2019 (20.221). Po metodi, ki jo uporabljata Eurostat oz. SURS, je torej presežna umrljivost v Sloveniji v letu 2020 znašala 3.795 oseb. Z našo metodo pa znaša ocenjena presežna umrljivost 3.120 oseb. To pomeni, da je ocena Eurostata oz. SURS o presežni umrljivosti za 21,6 odstotka višja od vrednosti, ki smo jo izračunali mi.

4 ZAKLJUČEK

Natančne vrednosti presežne umrljivosti v letu 2020 iz naslova virusa covid-19 ne bomo nikoli izvedeli, saj ne bomo nikoli vedeli, koliko oseb bi umrlo, če virusa covid-19 ne bi bilo. Eurostat, SURS in številni drugi presežno umrljivost izračunavajo kot razliko med dejanskim številom umrlih v posameznem letu oz. mesecu in povprečnim številom umrlih v 5-letnem predhodnem obdobju (2015-2019). Ta pristop zahteva samo podatke o številu umrlih, tako da lahko izračune naredimo takoj, ko izvemo (letno ali mesečno) število umrlih, brez da bi čakali na podatke o številu prebivalcev v tem obdobju, ki praviloma sledijo s precejšnjim zamikom. S 5-letnim povprečjem se tudi ublaži vpliv slučajnega nihanja števila umrlih, ki je še posebej aktualno v majhnih prebivalstvih.

V tem članku opozarjamo, da ta pristop na eni strani ne upošteva spreminjanja števila in starostne strukture prebivalstva (kar v proučevanem obdobju v Sloveniji prispeva k naraščanju števila umrlih), na drugi strani pa ne upošteva trenda zniževanja umrljivosti v času, zaradi česar število umrlih v času upada. Na število umrlih delujeta torej v nasprotni smeri in empirično vprašanje je, kateri bo prevladal. Gibanje števila umrlih v Slovenji v zadnjem desetletju pokaže, da prevlada prvi izmed teh dveh dejavnikov. V zadnjem desetletju je namreč očiten trend naraščanja števila umrlih. Tudi iz Eurostatovih projekcij prebivalstva [1] izhaja, da bi se brez virusa covid-19 število umrlih v prihodnje hitro povečevalo. To pomeni, da z navedenim poenostavljenim pristopom Eurostat oziroma po njem zgledujoč se SURS precenjujeta presežno umrljivost, saj bi bilo tudi brez virusa covid-19 v letu 2020 število umrlih višje od povprečnega števila umrlih v obdobju 2015-2019. Njihov pristop poda za 21,6 % višjo vrednost presežne umrljivosti kot pa smo jo izračunali mi z našim pristopom. Po metodi Eurostata oz. SURS je namreč presežna umrljivost v Sloveniji v letu 2020 znašala 18,8 % (24.016 dejansko umrlih napram 20.221, kolikor znaša povprečno število umrlih za obdobje 2015-2019), mi pa jo ocenjujemo na 14,9 % (24.016 dejansko umrlih napram 20.896).

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[3] Statistični urad RS (2021a) »Prebivalstvo po starosti in spolu, kohezijski regiji, Slovenija, polletno«. Najdeno 11. septembra 2021 na Podatkovnem portalu SI-STAT: https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/05C1002S.px

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Zaznavanje stresa pri srednješolcih v prvem valu epidemije COVID-19

Stress perception in high school students in the first wave of the COVID-19 epidemic

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POVZETEK

Prvi val epidemije COVID-19 je prinesel veliko negotovosti, saj smo se s tako strogimi ukrepi za omejevanje prenosa okužbe, kot je zaprtje šol, omejitve druženja, nezmožnost opravljanja dela ipd., srečali prvič. Za marsikoga je to predstavljalo velik stres, zato nas je zanimalo, kako so v prvem valu epidemije zaznavali stres slovenski srednješolci? V ta namen smo oblikovali spletno anketo in jo po metodi snežne kepe razširili po srednjih šolah in dijaških domovih. Podatki na vzorcu 1492 srednješolcev kažejo, da je večina dijaške populacije (69,9%) v prvem valu epidemije zaznavala srednje močan stres (kategorije nizek-srednji-visok), dobra šestina dijakov (17,8%) pa visok stres. Več težav s spanjem, razdražljivosti, več močnih in/ali neprijetnih čustev, občutkov nemoči in pomanjkanja energije kot v času pred epidemijo je doživljalo 34 - 44% srednješolcev, tistih, ki so to doživljali občutno bolj kot pred epidemijo, je bilo 8-10%. Raziskava je tudi pokazala, da je stopnja zaznanega stresa statistično pomembno povezana s spolom, programom šolanja, (ne)bivanjem v dijaškem domu in kroničnimi težavami oz. bolezenskimi stanji.

KLJUČNE BESEDE

Zaznavanje stresa, srednješolci, prvi val epidemije, COVID-19, koronavirus.

ABSTRACT

The first wave of the COVID-19 epidemic brought a lot of uncertainty, as it was the first time, we encountered such stringent measures to limit the transmission of the infection, such as school closures, social-distancing, inability to work, etc. and for many, that posed great stress. The aim of this study was to investigate the perceived stress of Slovenian high school students in the first wave of the epidemic. For this purpose, we conducted an online survey sent to secondary schools and student dormitories. Data on a sample of 1492 students show that the majority of the student population (69.9%) perceived moderate stress (low-medium-high categories) in the first wave of the epidemic and a good sixth of students (17.8%) high stress. 34-44% of students had more sleep problems, were more irritable, had stronger and/or unpleasant emotions, more feelings of helplessness and lack of energy than before the epidemic. 8-10% of students experienced it significantly more than before the epidemic. The research also showed that the level of perceived stress is significantly related to gender, school program, (non)staying in the dormitory, and chronic diseases.

KEYWORDS

Stress perception, high school students, the first wave of the epidemic, COVID-19, coronavirus.

1 UVOD

Soočanje z epidemijo in strogimi ukrepi za omejevanje prenosa okužbe je za marsikoga predstavljalo velik stres. Raziskave [1, 2, 3] kažejo, da so nekateri razvili celo simptome, ki so značilni za posttravmatsko stresno motnjo. To so bili predvsem tisti, ki so sami trpeli za resno obliko COVID-19 in jim je grozila smrt; ki so bili kot družinski člani ali kot zdravstveni delavci priča trpljenju in smrti drugih; ki so izvedeli za smrt ali tveganje smrti družinskega člana ali prijatelja; in posamezniki, ki so bili zelo izpostavljeni grozljivim podrobnostim epidemije (npr. novinarji, zdravniki in bolnišnično osebje) [4].

Mladostniki spadajo v manj rizično skupino za okužbo s COVID-19 in jih virus večinoma neposredno ne prizadene. Raziskave tako ugotavljajo, da je epidemija prizadela predvsem starejše generacije, posledice ukrepov za njeno zajezitev pa predvsem mlajše [5]. Na Inštitutu RS za socialno varstvo [6] ugotavljajo, da je epidemija na otroke vplivala predvsem 1.) s psihološko obremenitvijo zaradi neznane situacije in strahu pred tem, da bi zboleli njihovi bližnji; 2.) povečano negotovostjo in večjo možnostjo, da bodo njihovi bližnji izgubili zaposlitev; 3.) z ukrepi, ki so prekinili ustaljeni tok življenja družin in omejili nekatere svoboščine.

Prvi val je s seboj prinesel posebej veliko negotovosti, saj smo se s tako strogimi ukrepi za omejevanje prenosa okužbe, kot je zaprtje šol, omejitve druženja, nezmožnost opravljanja dela ipd., srečali prvič. V raziskavi kitajskih mladostnikov, ki so ostali doma v karanteni v prvem mesecu izbruha COVID-19, jih je kar 12,8% doživljalo stresne simptome, ki so dosegali raven posttravmatske stresne motnje [7]. Kako so v prvem valu epidemije zaznavali stres slovenski srednješolci, pa bomo poskušali odgovoriti s pričujočo raziskavo.

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2 METODOLOGIJA

2.1 Vzorec

V raziskavi je sodelovalo 1492 srednješolcev, od tega je bilo 58,1% (867) dijakinj. 0,9% srednješolcev je obiskovalo nižji poklicni program, 11.3% srednji poklicni program (triletni), 53,8% srednji strokovni program (štiriletni) in 34,0% srednji splošni program (gimnazije). 24,3% (365) srednješolcev je bilo iz dijaških domov, 10,3% srednješolcev pa se je soočalo s kroničnimi težavami oz. bolezenskimi stanji. Geografska zastopanost je predstavljena v **Napaka! Vira sklicevanja ni bilo mogoče najti.**.

Tabela 1: Razporeditev dijakov po pokrajinah

Pokrajina	Frekvenca	Procent
Gorenjska	151	10,0
Osrednjeslovenska	187	12,4
Štajerska	533	35,4
Prekmurje	28	1,9
Koroška	28	1,9
Notranjska	50	3,3
Dolenjska	330	21,9
Primorska	197	13,1

2.2 Instrumenti in postopek

Za namene raziskave smo pripravili spletni vprašalnik z orodjem 1ka. Vključeval je sociodemografska vprašanja, primerjavo življenjskega sloga (preživljanje časa na socialnih omrežjih, prehranjevanje, spanje/nespečnost ipd.) s stanjem pred epidemijo in Lestvico zaznanega stresa (The Perceived Stress Scale – Cohen, Kamarck in Mermelstein, 1983), ki meri, kako pogosto anketiranci zaznavajo svoje življenje kot stresno, nepredvidljivo, preobremenjujoče in nenadzorljivo. Rezultat PSS-ja se razvrsti v eno od treh kategorij, in sicer nizko, srednje in visoko zaznani stres. Z višjim rezultatom se povečuje verjetnost, da stres v posameznikovem življenju presega njegove sposobnosti soočanja z njim.

Zbiranje podatkov je trajalo od 20.-26.4.2020 preko socialnih mrež svetovalnih delavcev v srednjih šolah in vzgojiteljev dijaških domov (t.i. metoda snežne kepe). Analiza podatkov je bila narejena s programom SPSS, uporabili smo deskriptivno statistiko ter hi-kvadrat test in Pearsonov korelacijski koeficient.

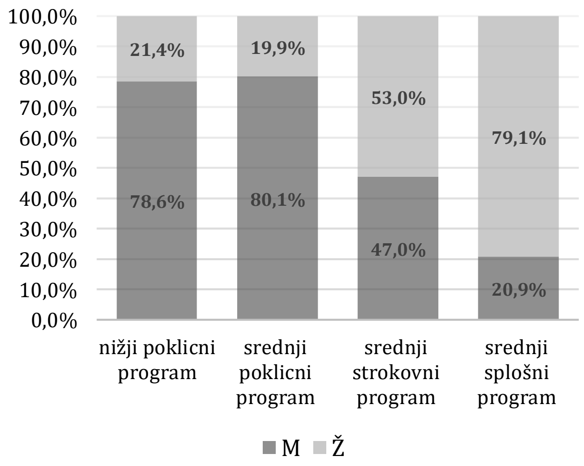
3 REZULTATI

Kot prikazuje Tabela 2 je velika večina srednješolcev (69,9%) v prvem valu epidemije zaznavala srednje močan stres. Visok stres je zaznavalo 23,8% vseh dijakinj in 9,4% dijakov. Dijaki in dijakinje se statistično pomembno razlikujejo v stopnji zaznavanja stresa ($\chi^2(2)=57.816$, $p<0.01$).

Tabela 2: Zaznavanje stresa po spolu in vrsti šolanja

		STRES			
SPOL		nizki	srednji	visoki	SKUPAJ
moški	N	101	465	59	625
	%	16,2%	74,4%	9,4%	100%
ženski	N	83	578	206	867
	%	9,6%	66,7%	23,8%	100%
VRSTA ŠOLANJA					
nižji poklicni program	N	0	12	1	13
	%	0,0%	92,3%	7,7%	100%
srednji poklicni program (triletni)	N	22	139	8	169
	%	13,0%	82,2%	4,7%	100%
srednji strokovni program (štiriletni)	N	99	555	149	803
	%	12,3%	69,1%	18,6%	100%
srednji splošni program (gimnazija)	N	63	337	107	507
	%	12,4%	66,5%	21,1%	100%
SKUPAJ	N	184	1043	265	1492
	%	12,3%	69,9%	17,8%	100%

Statistično pomembna razlika pri zaznavanju stresa se kaže tudi glede na program šolanja ($\chi^2(6)=27.582$, $p<0.01$). Če izvzamemo nižje poklicno izobraževanje, kjer je bil numerus izrazito majhen (0,9% vseh srednješolcev), je delež srednješolcev, ki zaznavajo nizek stres približno enak, in sicer 12,3-13%. Procent visoko zaznanega stresa narašča po zahtevnosti programa (z izjemo nižjega poklicnega programa). Pri tem je potrebno omeniti, da v srednjem strokovnem in splošnem programu prevladujejo ženske (**Slika** 1).



Slika 1: Zastopanost spola po vrsti šolanja

Statistično pomembna razlika v zaznavanju stresa obstaja tudi glede na to, ali se srednješolci soočajo s kroničnimi težavami oz. bolezenskimi stanji ($\chi^2(2)=41.877$, $p<0.01$), pri čemer večina le-teh zaznava srednje močan stres (55,6%).

Stopnja stresa je odvisna tudi od tega, ali srednješolci živijo v dijaškem domu ali ne ($\chi^2(2)=12.772$, $p<0.01$). Najvišja razlika se kaže pri visoko zaznanem stresu, ki ga zaznava 23,1% srednješolcev iz dijaških domov in 16,1% tistih, ki ne živijo v dijaškem domu.

Slika 2 prikazuje procent srednješolcev, ki naštete vidike izkuša oz. opravlja "več" in "občutno več" kot pred epidemijo. Svetleješi stolpci prikazujejo pozitivno spremembo, in sicer več kreativnega udejstvovanja (ustvarjanje, risanje ipd.), neformalnega izobraževanja, več časa zase oz. več umirjenosti ter več telesne aktivnosti kot pred epidemijo.

Slika 2: Vidiki doživljanja in aktivnosti, ki jih srednješolci opravljajo oz. izkušajo več kot pred epidemijo

Po drugi strani je najvišji delež tistih srednješolcev, ki preživljajo več časa na socialnih omrežjih, gledajo TV, serije ipd. Od tega jih je 20,2%, ki to počno občutno več kot pred epidemijo. Preživljanje časa na socialnih omrežjih, z gledanjem serij oz. pred TV se pomembno šibko povezuje s sanjarjenjem oz. zatekanjem v domišljijo ($r=0.202$, $p<0.01$).

37,6% srednješolcev pojé več kot pred epidemijo. Prehranjevanje se statistično pomembno, a neznatno pozitivno povezuje z napetostjo ($r=0.133$, $p<0.01$), tesnobo ($r=0.078$, $p<0.01$), pomanjkanjem energije ($r=0.141$, $p<0.01$), zatekanjem v domišljijo ($r=0.074$, $p<0.01$), gledanjem serij, TVja, preživljanjem časa na socialnih omrežjih ($r=0.154$, $p<0.01$), težavami s koncentracijo ($r=0.111$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r=0.126$, $p<0.01$), negativno pa s telesno aktivnostjo ($r=0.072$, $p<0.01$).

V nadaljevanju izpostavljamo tiste vidike, kjer obstaja pomembna zmerna povezanost:

- razdražljivost, napetost je pozitivno povezana s težavami s spanjem ($r=0.497$, $p<0.01$), nemočjo, pomanjkanjem energije, brezvoljnostjo ($r=0.501$, $p<0.01$), težavami s spominom in/ali koncentracijo ($r=0.406$, $p<0.01$), s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.497$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r=0.572$, $p<0.01$), negativno pa je razdražljivost povezana s časom zase in občutkom umirjenosti ($r=0.413$, $p<0.01$);
- nemoč, pomanjkanje energije in brezvoljnost je pozitivno povezana s težavami s spominom in/ali koncentracijo ($r=0.453$, $p<0.01$), s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.418$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r = 0.488$, $p<0.01$);
- težave s spominom in/ali koncentracijo so že poleg omenjenega pozitivno povezane s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.474$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r = 0.488$, $p<0.01$);

Vidimo, da se štirje vidiki odzivanja med epidemijo 1.) nemoč, pomanjkanje energije, brezvoljnost, 2.) težave s spominom in/ali koncentracijo, 3.) stiskanje v prsih, razbijanje srca, tesnoba in 4.) doživljanje močnih in/ali neprijetnih čustev pomembno zmerno povezujejo med seboj.

Prav tako se medsebojno zmerno povezujejo razdražljivost oz. napetost, stiskanje v prsih, razbijanje srca, tesnoba ter težave s spanjem (srednješolci težko zaspijo, se zbujajo ponoči in/ali težko vstanejo).

4 RAZPRAVA

Raziskava med 1492 srednješolci v času prvega vala epidemije v Sloveniji kaže, da je večina srednješolcev zaznavala srednje intenziven stres. Pri tem želimo opozoriti na dobro šestino srednješolcev, ki je zaznavala visok stres, v 78% so bile to ženske. Zaskrbljujoče povečanje psihične obremenjenosti med dekleti ugotavlja tudi poročilo Inštituta RS za socialno varstvo [6].

Študije mladih iz evropskih, azijskih in ameriških držav ugotavljajo povečanje težav z duševnim zdravjem, kot so razdražljivost, tesnoba, depresivni simptomi, simptomi posttravmatske stresne motnje ipd. [5, 6, 7]. Nemška študija je na reprezentativnem vzorcu pokazala, da je dve tretjini otrok in mladostnikov zaradi pandemije COVID-19 močno obremenjena. Poročali so o bistveno nižji kakovosti življenja, povezani z zdravjem (40% proti 15%), več težavah z duševnim zdravjem (18% proti 10%) in višjo stopnjo tesnobe (24% proti 15%) kot pred pandemijo [11]. V naši raziskavi doživlja težave s spanjem, močna in/ali neprijetna čustva, razdražljivost, občutke nemoči, brezvoljnost in pomanjkanje energije "več" in "občutno več" kot pred epidemijo med 34 in 44% srednješolcev. Tistih, ki so to doživljali občutno bolj kot pred epidemijo in jih v tem pogledu lahko štejemo kot rizične, je bilo 8-10% (že v prvem valu). Na porast duševnih stisk med otroki in mladimi v času prvega vala epidemije kažejo tudi podatki TOM telefona. Čeprav je bilo v letu 2020 skupno število klicev manjše kot v preteklih letih, pa je bilo klicev, ki so poročali o psihičnih težavah, 33% več kot v povprečju zadnjih petih let [12].

Naša raziskava kaže, da je 62% srednješolcev preživljalo čas na socialnih omrežjih, z gledanjem videev, serij ipd. "več" in "občutno več" kot pred epidemijo. Čeprav je bil porast ob ukrepu omejevanju druženja pričakovan, ne gre prezreti ugotovitve Inštituta RS za socialno varstvo, da se je precej povečala ranljivost otrok na ravni aktivnosti, ki vodijo v odvisnost in odtujitev, kot npr. igranje računalniških igric, gledanje videoposnetkov na youtube in televizije [6].

Izpostavili bi še en potencialen način soočanja s stresom oz. prilagoditveni odziv na epidemijo, in sicer v naši raziskavi je 9% srednješolcev označilo, da se prehranjuje "občutno več" kot prej. Raziskave opozarjajo na naraščanje teže pri mladostnikih v času karantene [13], še posebej pri tistih, ki so se že prej soočali s povišano telesno težo [11, 12, 13]. Ta pojav je dobil celo svoje ime – ang. covibesity [17].

V razpravi smo izpostavili predvsem tiste vidike, ki so že ob začetku epidemije nakazovali morebitne kasnejše težave.

Rezultate je namreč potrebno gledati retrospektivno, saj se nanašajo na april 2020, tj. čas prvega zapiranja šol, in jih tako lahko jemljemo kot prikaz, kakšen je bil prvi odziv srednješolcev na ukrepe za omejitev širjenja virusa COVID-19.

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»Podivjajmo Slovenijo« kot nov koncept varovanja okolja

“Rewild Slovenia” - new concept of conservationism

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POVZETEK

Predstavljen je koncept »podivjanja Slovenije«, ki ga nekateri razumejo kot ponovno uvajanje že izumrlih živali v Sloveniji, recimo evropskega bizona. A omenjeni koncept je precej širši in temelji na spremembi odnosa do živali in okolja: vsi državljani naj bi se prilagodili življenju z živalmi, jim omogočili sobivanje, spodbujali naravno okolje, avtohtone rastline in živali in hkrati tudi živali priučili sobivanja s človekom.

KEYWORDS / KLJUČNE BESEDE

Varovanje okolja, podivjajmo, novi pristopi

ABSTRACT

In this paper we introduce “rewilding” as a new concept for conservationism. It is the version that propagates introducing wild species back to Slovenia, e.g. European bison. However, it is much more than that, it builds on the proposition that we humans must learn, adapt and encourage wildlife, whereas wild animals must adapt to human coexistence.

KEYWORDS

Conservation, environment, rewilding

1 UVOD

Medtem ko človeštvo po eni strani še naprej masovno uničuje okolje in živali [1][2] in celo ogroža razvoj civilizacije [3], se med ljudmi širi drugačna, bolj privlačna miselnost. Gre za to, da naredimo sobivanje z divjimi živalmi ne samo znosno, ampak zaželeno in obojestransko uspešno (https://www.zurnal24.si/slovenija/komentarji-in-kolumne/podivjajmo-slovenijo-evropo-svet-371239). Gre za varovanje in ponovno uvajanje živali, ki smo jih iztrebili v Sloveniji. Gre za novo usmeritev v varovanju okolja, ki je predstavljena v [4], naslovnica pa je na Sliki 1.

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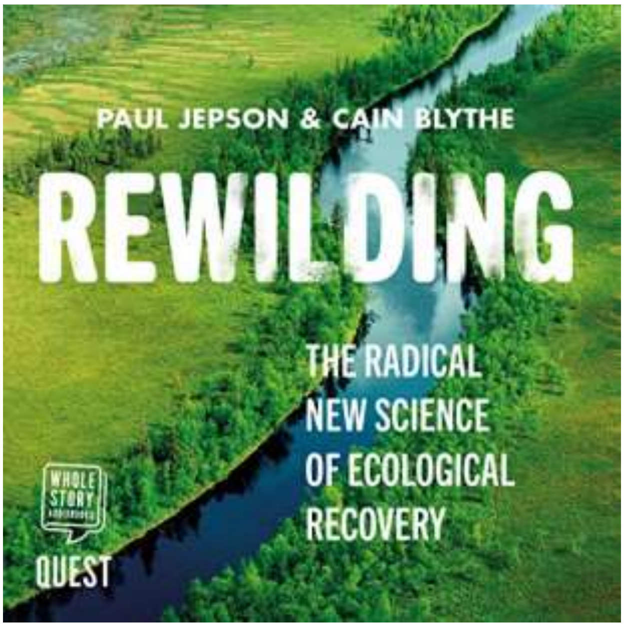

Slika 1: Knjiga Rewilding (slovensko »podivjanje«) je ena izmed ključnih objav za novo ekološko usmeritev s tem imenom. Vir: https://m.media-amazon.com/images/I/618YTln54bL.jpg

A najprej poglejmo osnovno problematiko varovanja okolja in živali. Denimo, da bi v divjini pobili 4% vseh sesalcev na planetu. Koliko divjih sesalcev bi ostalo? Odgovor je – nič! Vseh divjih sesalcev na Zemlji je le 4% skupne teže, ljudje prispevamo 36%, domače živali pa 60%. Poglejte tule: (https://africacheck.org/fact-checks/fbchecks/study-found-60-all-mammal-carbon-mass-livestock-36-people-only-4-wildlife). Slovenija je prva po m2 veletrgovin na glavo v Evropi in med prvimi na svetu. Prav tako je med prvimi na svetu po km zgrajenih avtocest. Avtocesto in fakulteto v vsako slovensko vas! Naši politiki pa bi kar naprej gradili, sekali gozd, uničevali najboljšo zemljo, postavljali reklame ob cestah sredi polj, zapirali reke v betonska korita in potočke v podzemne cevi. Pisali smo že, kako bodo z novo potezo kmetijskega ministrstva zmanjšali število divjih živali. Nekateri mediji pri tem žal premalo pomagajo okolju. Pred leti so vsakodnevno pisali, kako okoljsko škodljive da so sveče. A izračun pokaže, da en zelo velik tovornjak na avtocesti naredi približno toliko škode okolju kot vse sveče v Sloveniji [5], podobno kot vse kremacije. Zakaj torej ne opozarjamo na posledice kremiranja in še bolj – prometa zlasti po avtocestah?

2 PONOVNA NASELITEV ŽIVALI

Če jim damo možnost, se živali vrnejo [6]. Primer je Černobil, kjer je kljub visoki radioaktivnosti odsotnost ljudi povzročila pravi razcvet živali (https://www.unep.org/news-and-stories/story/how-chernobyl-has-become-unexpected-haven-wildlife). Drug primer so evropska mesta, kamor se vračajo lisice, kune, jazbeci, šakali (https://www.amazon.com/Feral-Cities-Adventures-Animals-Jungle/dp/1569760675) in se tako dobro skrivajo pred ljudmi, da jih le redko vidimo, pa tudi ljudje jih ne preganjajo več intenzivno. V Evropi marsikatera mesta namenoma uvajajo spremembe, ki koristijo živalim. Posledično je gostota nekaterih živali večja kot v naravnem okolju, pa tudi živijo dalj. Mesta vsaj malo vračajo naravi bogastvo življenja, ki so ga odvzela.

Ta trend je v visoko civilizirani Evropi čedalje bolj izrazit (https://rewildingeurope.com/rewilding-in-action/wildlife-comeback/large-carnivores/) in se bo slej ko prej razživel tudi v Sloveniji. Ključno je vračanje velikih živali, zlasti plenilcev: medveda, volka, risa, pa tudi divje mačke, kot to poskušajo na Nizozemskem. Evropski bizon je v naravi izumrl, ostalo je le 54 živali v živalskih vrtovih (https://www.dw.com/en/global-ideas-biodiversity-rewilding-conservation-europe/a-18586774), sedaj jih je okoli 3000, manj kot črnih nosorogov. A njihovo število raste in uvajajo jih v čedalje več državah, npr. v Veliki Britaniji. Zakaj ne tudi v Sloveniji? Se še kdo med nami spomni, ko smo v ljubljanskem živalskem vrtu občudovali ogromnega zobra? Podobno uspešno je naseljevanje divjih goved in konj na kar nekaj lokacijah v Evropi. Primer je okoli 200 divjih konjih blizu Livnega na Hrvaškem.

Leta 1908 je iz Slovenije izginil zadnji ris kot največja evropska mačka v velikosti mladega leoparda (https://www.metropolitan.si/aktualno/zgodovina-risa-v-sloveniji-in-usoda-te-cudovite-male-zveri-v-evropi/). V Sloveniji smo ponovno uvedli risa leta 1973, žal je bila prva runda preveč v sorodstvu, tako da je bilo potrebno dodati novo. S Hrvaške se je pred 20 leti sam vrnil bober in sedaj živi ob Savi, Krki, Dravi, Sotli, Muri, Kolpi, Lahinji, Dobličici in nekaterih manjših rečicah. Kozoroga smo ponovno naselili leta 1902. Iztrebili smo tudi svizca, a je ponovno naseljen in živi na območju Grintovca, Ojstrice ter še ponekod.

3 UPRAVLJANJE Z ŽIVALMI

Volkovi se kljub napakam lepo širijo, a hkrati se pojavljajo problemi. Recimo moderna napaka je, da ne odstraniš ali kaznuješ divje živali, recimo napadalnega volka, ampak je »nagrajen« z mesom domačih živali. Podobno, ko pride v bližino ljudi. Živali se učijo in prilagajajo in zato jih moramo sistematično vzgajati, da bodo lahko živele hkrati z nami. Če bodo tiste nevzgojene jezile ljudi, tudi onih sobivajočih ne bo več. Zato je ključnega pomena vzgoja živali, da se prilagodijo ljudem. Seveda naj se tudi ljudje prilagodijo živalim, a za sobivanje je potrebno sodelovanje obeh. Če samo z dekretom uvedemo volkove in nezadostno povračamo škodo, ali zahtevamo, da živinorejci sami nosijo stroške postavitve varnostnih ograj, slej ko prej jezni domačini tako ali drugače škodijo volkovom.

Podobno je z napadalnimi vranami, ki napadajo otroke, ki se približajo gnezdom. Pričakovati, da bodo starši ranjenih otrok imeli posebej dober odnos do okolja in živali, ni posebej realno. Na takih dogodkih se dobiva ali izgublja odnos do okolja in živali. Vran ne primanjkuje in premik gnezda oz. »pouk« napadalnih vran je malenkost v primerjavi z javnim mnenjem.

Naslednja napaka je nekontrolirano širjenje določenih živalskih vrst. Divje svinje, avtohtone v Evropi in Aziji, so se razširile po vsem svetu in ustvarijo toliko izpustov kot milijon avtomobilov, piše prispevek v reviji Global Change Biology (https://onlinelibrary.wiley.com/doi/10.1111/gcb.15769). Podobno je z medvedi pri nas, ki jih je približno dvakrat preveč glede na površino in zato ustvarjajo ekološki in živalski problem. Preštevilčne vrste je potrebno tako ali drugače uravnati na znosno mejo. A prispevek o divjih svinjah je zanimiv tudi po medijski plati: če vse divje svinje po svetu ustvarijo toliko CO2 kot cca milijon avtomobilov, potem obstoječa milijarda avtomobilov ustvari tisočkrat več izpustov CO2 kot divje svinje, tako v Sloveniji kot na svetu, da o drugih škodljivih učinkih ne govorimo: drugi plini, segrevanje okolja zaradi vrtanja do nafte itd. Torej je v primerjavi s škodljivostjo transporta zanemarljivo!

Tretji velik problem so invazivne vrste, ki izrivajo domače. Primer so vodne želve, ki izrivajo domače sklednice. Če bi imeli primeren zakon o invazivnih živalih, ki bi ne samo dovoljeval vsem, ampak celo s kaznijo nalagal lastnikom, da jih odstranjujejo, ne bi imeli polne obale rdečevratk nekaterih jezer celo v Ljubljani. A logika je kruto preprosta: če ne bomo odstranili invazivnih rdečevratk, bodo rdečevratke odstranile sklednice iz Slovenije. Vrsto lahko iztrebiš z neposrednim izlovom, lahko pa enostavno tako, da ne kontroliraš invazivne vrste. In da ne bo pomote: to ni naravno, ker so rdečevratke vnesli ljudje! Pa tudi druga logika je preprosta: dokler ne bo mogoče nobenemu ministrstvu dopovedati zgornjega, se bo težko kaj spremenilo.

4 »Podivjajmo« vrt in tako pomagajmo okolju in živalim

Marsikatera okolica hiše je življenju negostoljubna : beton in morda nekaj malega kratko pokošene trave. Idealna okolica hiše vsebuje grme, drevesa, tolmun, »rezervat« - težko dostopen konček za ljudi in del nepostrižene trate, kjer kraljujejo pašne cvetlice in letajo metulji ali kačji pastirji. Vrt postane poln biodiverzitete tako rastlin kot živali.

A začnimo s podivjanjem vrta: en del vrta nehajte redno kositi. Lahko kupite semena travnih cvetlic, lahko pa le kosite npr. enkrat letno in cvetlice pridejo same od sebe. To je ena izmed modernih eko smernic, ki delajo naše življenje lepše, hkrati pa preprečujejo izumiranje naravnega sveta.

Pred desetletji se je bilo v poletnih mesecih na poti na morje iz Ljubljane potrebno ustaviti, ker se je na avtomobilskem steklu nabralo toliko žuželk. Danes se lahko peljete najmanj desetkrat brez čiščenja stekel, ker je letečih insektov 75% manj kot pred 50 leti. Morda bo kdo rekel: »odlično«, a brez insektov se začne podirati ekološka piramida – manj je ptic, manj je drugih živali in na koncu smo pri nekaj odstotkov divjih živali, izumiranje pa je 100-1000x hitrejše kot naravno, tako so pokazale študije, recimo [1], ali (https://www.nationalgeographic.com/adventure/article/140529-conservation-science-animals-species-endangered-extinction). Nič hudega? Tudi semenčic imajo mladi moški 50% manj kot pred 50 leti. Brez stroke počnemo nove in nove neumnosti.

Junijska številka 2021 revije »National geographic« vsebuje prispevek o spreminjanju džungle v kmetijske površine na mehiškem polotoku Jukatan, gojenju genetsko spremenjenih rastlin in škropljenju z insekticidi. Posledično ne samo izumirajo leteče in druge žuželke, nekoč cvetoče čebelarstvo je skoraj propadlo. Ko je vlada prepovedala genetske spremenjene rastline, so se za nekaj časa razmere izboljšale, a ker ni bilo nadzora, se je nadaljevalo ilegalno izsekavanje džungle in sajenje genetsko spremenjenih poljščin. Za tono medu je bilo pred 20 leti potrebnih 12 panjev, danes 45. Morda se boste vprašali, kaj ima to z nami? Poleg ZDA je glavni uvoznik EU, torej smo mi Evropejci oz. naši politiki soodgovorni za to. Pa tudi mi lahko skoraj prenehamo kupovati hrano, ki je prišla od daleč. Bližja je bolj sveža in bolj ekološka!

5 Napotki iz Bele knjige strokovnega varovanja okolja

Naštejmo nekaj posodobljenih napotkov iz Bele knjige strokovnega varovanja okolja [5]:

a. Prepoved reklamnih panojev v vidnem polju avtocest
b. Prepoved oglaševanja v odprtem prostoru krajine
c. Prenehati prekomerno osvetljevanje in ohranjanje vidnosti zvezdnega neba
d. Omejitev obsega cestne razsvetljave
e. Ne povečevati števila prebivalcev Slovenije [7]
f. Povečati sredstva za znanost, zlasti okoljsko
g. Povečati okoljsko osveščenost/izobraženost občin in občanov
h. Sprejeti nov zakon in spremeniti odnos do invazivnih rastlinskih in živalskih vrst
i. Odstraniti alergene rastline iz javnega sektorja
j. Sprejeti nov zakon za odstranjevanje agresivnih živali
k. Uvajati klimatske naprave-inverterje kot najbolj učinkovito napravo
l. Izvajati financiranje obnovljivih virov
m. Ukiniti termoelektrarne na premog
n. Zgraditi nov blok jedrske elektrarne kot najbolj čiste 24/7 energije
o. Bolje izkoriščati vodne vire – hidroelektrarne, kjer je primerno
p. Uporabljati solarne panele, kjer je primerno
q. Izboljšati varčevanje z energijo
r. Spodbujanje naseljevanja prebivalstva v urbanih okoljih in ne po krajini
s. Otežiti uvoz hrane iz oddaljenih krajev
t. Otežiti prodajo oddaljenih izdelkov
u. Otežiti prodajo kmetijskih površin
v. Obdavčiti vse in posebej nove veletrgovine
w. Uvesti hitre vlake
x. Dodatno kaznovati in nadzirati prehitro vožnjo
y. Dodatno obdavčiti tranzitne tovornjake
z. Omejiti promet izven kategoriziranih cestišč
aa. Prepovedati genetsko spremenjene rastline
bb. Propagirati samo-skrb za okolje
cc. Uvesti bele ali poraščene fasade in strehe
dd. Uvesti ribje steze, kjer je smotrno
ee. Podivjati Slovenijo

Ti predlogi, zbrani s strani okoli 100 strokovnjakov v večletnih razpravah predvsem v Državnem svetu [8], pa tudi v strokovnih združenjih kot Inženirski akademiji Slovenije, predstavljajo osnovno strokovno utemeljeno smer skrbi za okolje v Sloveniji. Utemeljitve za posamezne predloge so v [5]. Recimo omejitve prehitre vožnje so utemeljene s tem, da vsakih dodatnih 10km/h nad 100 km/h prinese 10% dodatnega onesnaževanja. Ali pa prepoved genetsko spremenjene hrane, ki ne temelji na potencialnem strahu pred škodo ljudem, ampak na škodi, ki jo z genetsko vcepljenimi varovali pred žuželkami povzroča preko žuželk celotnemu ekosistemu. Tako ali tako moderno monokulturno kmetijstvo uničuje biodiverziteto, a vseeno manj kot genetsko spremenjena hrana.

6 ZAKLJUČEK

Pri varovanju okolja sta dve ključni smeri: ena pravi, da je treba ljudi odstraniti od narave, naj se ne vtikajo v okolico, naj ne krmijo ptic pozimi in naj ne pomagajo npr. prezeblemu ježku, ki ste ga razkrili v kompostu. Druga smer temelji na sožitju, da sobivamo, da pomagamo naravi, rastlinam in živalim, kolikor moremo. Ljudje so spremenili pol vse planetove površine, živali uničujemo in izrivamo, da prihaja do 6. svetovnega izumiranja (https://www.amazon.com/Sixth-Extinction-Unnatural-History/dp/0805092994; [2]; http://www.allcreation.org/home/understand). To počnemo ali v hlastanju za bogastvom, kapitalom, ali pa zaradi neumnosti. Stroka in ljubitelji lahko pomagajo narediti naše okolje in odnos do rastlin in živali tak, da bomo lahko sobivali in uživali drug ob drugem.

»Podivjanje« uvaja nov, dober odnos do narave, okolja, rastlin in živali. Propagira sobivanje in souživanje darov in pestrosti naravnega sveta. Strokovno je marsikaj opredeljenega v prosto dostopni »Beli knjigo o strokovnem varovanju okolja« (http://library.ijs.si/Stacks/Literature/Bela%20knjiga%20znanost%20o%20okolju%202020.pdf) [5], kjer so zbrani moderni strokovni nasveti, kako varovati okolje. Čeprav so naši politiki realizirali le manjši del napotkov stroke, jih lahko izvajamo državljani sami – npr. odstranjujemo invazivne rastline in živali in podivjamo vrt.

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Involvement of Citizens in Environmental Epidemiology Studies: Some Experience From the CitieS-Health Ljubljana Pilot

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ABSTRACT

In this contribution, a general overview and experience gained in conducting citizen science (CS) activities in the field of environmental epidemiology is presented. The described activities were carried out in Ljubljana, Slovenia, in the frame of the CitieS-Health H2020 project, dealing with the topic of noise, well-being and health in the context of urban environment. Following the project's methodological framework, citizens were actively involved in all phases of the project – problem identification, co-designing of experimental works, as well as data gathering and interpretation. Some preliminary results and lessons learned are summarized for both the main study involving volunteers participating in respective data collection, as well as specific activities carried out with elementary school pupils. The ultimate outcomes and effects of these activities are still to be properly evaluated. The overall preliminary conclusion however is that, while the concept was well received among the engaged citizens and valuable new insights in the topics addressed can be achieved in this way, managing volunteer motivation and expectations which in turn affect their retention and sustainability of the project, can be challenging, especially if conducted in the time of pandemic.

KEYWORDS

Citizen Science, Environmental epidemiology, Urban stressors, Well-being, Health

1 INTRODUCTION

Citizen Science is a term that generally describes lay people involvement in scientific research projects. There are a great deal of approaches on how to connect the public with scientific research, to what extent and in what type of research, but the main objective of CS is that the approach is beneficial for both citizens and researchers.

Even though CS has gained recognition within various scientific and civic communities [1], environmental sciences may especially utilize the collection of large amounts of observations and data classifications public involvement brings to expert research (e.g. [2,3]). In return, citizens get answers on issues concerning them. Froeling et al. [4] argue that the true added benefit of CS in environmental epidemiology is in its ability to democratize epidemiological research, which addresses the content of research, investigates local problems and provides findings that are crucial for changes in citizens' immediate environment.

In this contribution, we present some preliminary results and observation obtained within the EU Horizon 2020 project CitieS-Health (https://citieshealth.eu) which is based on the so-called co-created CS approach, allowing citizens and their concerns to be at the heart of research agenda on environmental epidemiology. Together with the help of researchers, new technologies and customized tools, citizens in five European cities, including Ljubljana, Slovenia, are involved in all stages of research in order to find out how pollution in their living environment is affecting their health.

In the Ljubljana pilot, the public was engaged in co-creating a CS research study on how the quality of living environment (with emphasis on noise) and living habits affect the (mental) health and well-being of individuals. A great deal of studies have discovered the connection between noise pollution and health, resulting in hearing damages, sleep disorders, cardiovascular diseases, lower work productivity etc. [5], but the data on the correlation between noise and health, especially in the multi-stressors context in urban environments, is still scarce.

2 METHODS

Following the CitieS-Health methodological framework [6], citizens were involved in four phases of the project, from identification of their concerns and interests, to co-designing of data protocols, data collection and analysis to action (Figure 1).

Figure 1: CitieS-Health methodological framework (adopted from Toran et al. [6])

2.1 Identification phase

In the identification phase, numerous meetings with interested stakeholders were organized in Ljubljana, Slovenia, to map their perception, interests and concerns related to noise pollution and health issues. In addition to some very specific noise and health-related questions identified during these discussions, the recurring topic was their belief these issues should be addressed in the multi-stressor context of the living environment and habits of an individual. This resulted in a consolidation of the following final overarching research question: *How do the quality of the living environment (with an emphasis on noise) and living habits affect the (mental) health and well-being of individuals?*

2.2 Design phase

As a result of the design phase, we selected and tested sensors and other tools (smartphone apps, noise level meters and similar low-cost devices) to be used by participants. This included the definition of experimental variables, the types of data to be collected and the methods and tools for collecting them. A general Ljubljana Pilot protocol was formulated and submitted to the Republic of Slovenia National Medical Ethics Committee. In the protocol, different levels of involvement were foreseen, depending on the specific interests and willingness of the individual. Each new level adds to the complexity of the involvement and the tools used (Figure 2). The EthicaData platform (ethicadata.com) was chosen as the main tool for managing the study, and through which both volunteers and basic data collection tools are administered: questionnaires on well-being, sleep, living environment characteristics and cognitive tests, as well as time-activity diaries. In addition, NoiseCapture and Fitbit smartphone app were used to measure noise and collect physical activity parameters, respectively. Because of the COVID situation that prevented face-to-face meetings, various short and detailed user guides for the participants were prepared, providing information on the use and installation of the tools.

Figure 2: The tools used and the levels of involvement

2.3 Deployment phase

During the deployment phase, two general types of activities took place. Altogether, 49 volunteers participated in the main study, collecting data on characteristics of their living environment and mental health using the tools described above. Depending on their interest, each of the participants participated 7–14 days. The main study lasted for 6 months, from October 2020 to April 2021. Following the data collection, a report for the participants was prepared. In the spirit of co-creation and co-design, the report was prepared as an interactive web-application enabling individuals to access the raw data, along with basic descriptive statistics, general data on the patterns of movement in space and sleeping habits, pre-processed by researchers, and specific tools for their independent data processing.

Besides the main study, part of the project activities took place in cooperation with various schools in Ljubljana, involving both teachers and students. Activities comprised involvement of students in school research assignments and organization of various tailored events (see section 3.2 for details).

2.4 Action

The action phase will follow in the final stage of the project. In that phase, workshops for participants will be organized to reflect on their own findings, as well as with other stakeholders interested in this topic, including public institutions and civil society.

3 RESULTS

In this section, some preliminary results are shown, to indicate the type of data and outcomes of the activities described above, including observations regarding motivation and general involvement of participants, as well as potential involvement of citizens in such specific research. Overall, data gathered can be processed in two ways. The first approach is evaluation of the results by processing all of the data together at the community level in order to identify general patterns. The second approach comprises an evaluation of data on individual level, preferably as independently as possible by volunteers themselves and with the help of researchers. In the following, a few general examples of the former are given, as well as more details on activities carried out with schools are provided.

3.1 Ljubljana Pilot – main study

Volunteers included in the main study were collecting approximately 75 different variables at each measurement session (through questionnaires, measurements by smartphones and physical activity trackers and meta-data). This resulted in over 50.000 data points, excluding the geo-spatial data. In Figure 3, a heatmap of the density distribution of GPS, and number of measurements of noise levels (in seconds) aggregated in 500 meter cells, collected from all participants combined at the level of the Municipality of Ljubljana. The distribution on both maps shows a relatively even spatial distribution with an emphasis on the densely populated city centre.

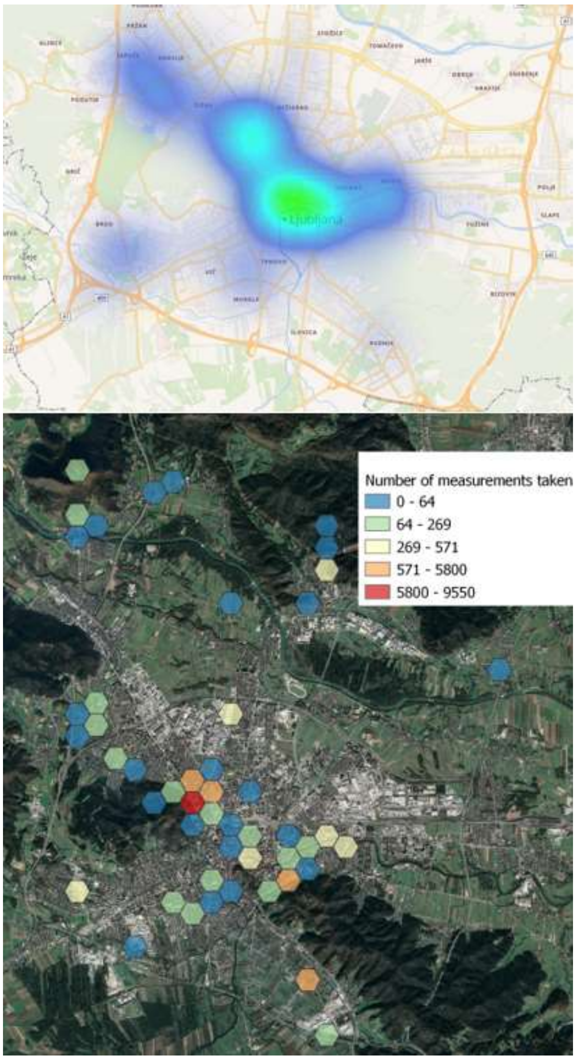

Figure 3: Heatmap of the density distribution (above) and number of measurements of noise levels (below)

Understanding volunteer motivation and expectations helps in retaining their interest in the long-term [7]. Regarding expectations and motivation to participate in this study, most of the volunteers indicated contribution to science and solving the problems as the main drive, followed by an interest in this specific topic, results in general and personal interests (Figure 4).

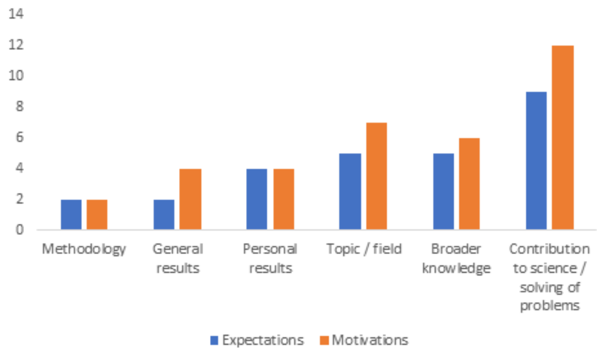

Figure 4: Drivers of motivation to participate

In the main study, participants were, in the morning and afternoon, automatically prompted at random times, to record their own observations, measure noise level and test their cognitive abilities with a Stroop test [8]. A comparison of the average response over time showed that it usually decreased significantly with increasing length of participation, which is typical of studies involving volunteers. Similarly, within a single day, the response rate significantly dropped between 13th and 15th hour of the day as shown in Figure 5, but interestingly the cognitive (Stroop) performance during this time of the day when people are usually busy at work or in school, improved in general. For the later, daily z-score was employed in order to mitigate the learning effect of the participants. Lower values of the score indicate better cognitive performance.

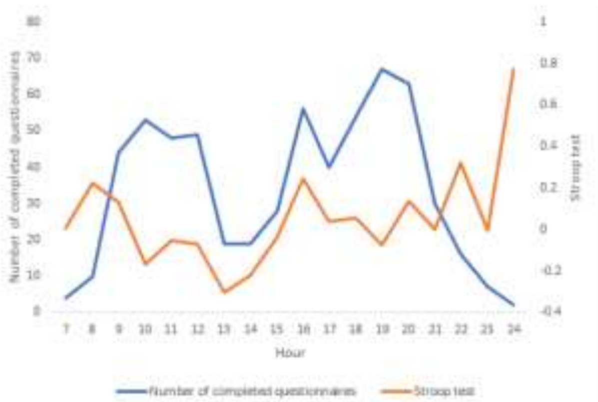

Figure 5: Frequency of data gathering by hour of day and cognitive performance

Other general initial findings show a curve of positive moods leaning towards the weekend, as well as the opposite, with negative moods, both assessed by three different indicators

(Figure 6). Regarding noise, results revealed a considerable adaptability of the perception of sound in humans. While no considerable difference was observed in terms of cognitive performance at a community-level in noisy or silent environments, results indicate that there are differences in cognitive performance driven by specific activities individuals are involved in (Figure 6).

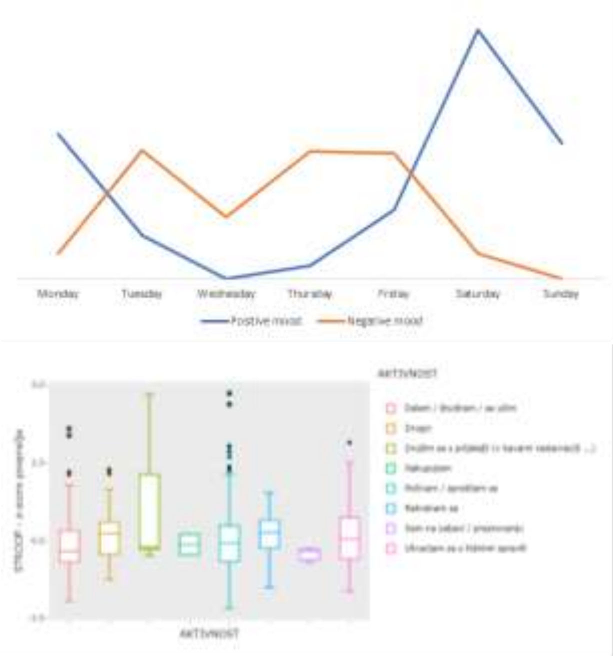

Figure 6: Variation of average community-level mood over a week (above) and relationship between cognitive performance and activity (below)

3.2 School activities

Activities at schools covered different levels of student involvement:

A. School research assignments on the topic of noise and health: Several school research assignments addressing different aspects of noise and health were performed by students, e.g. sound levels in different school environments, spatial distribution of noise at selected locations in their living environment and surrounding the school, using smartphone application for quantitative assessment, as well as by recording their subjective perception. Slightly older students showed interest in the technical aspects of noise level monitoring and developed a sensor unit with a supporting data infrastructure. The outcome of this work was presented at the national level event meetings of young researchers of Slovenia, organized by Association for Technical Culture of Slovenia.

B. Organization of nature day events: Treasure hunts were organized in a protected area of Tivoli, Rožnik and Šišenski Hill landscape park. Locations where pupils had to look for hidden questions on the topic of sound and noise were marked on the map. At each point, we measured the noise level with the help of an application on a smartphone, wrote the data on a census sheet and discussed the results obtained. The aim of the event was to involve pupils in research activities and trigger their curiosity, research in general and their interest in participating in other project activities.

C. Organization of tailored events: Two tailored School Tech-Day Events (STDE) as part of the school's curriculum were prepared and aligned with the project's methodological framework together with teachers. The pupils were initially involved in identifying noise-related issues and translation of selected topics into research questions. Next, together with mentors, they participated in the process of hypothesis formulation and the design of data collection protocols. Finally, they participated in data gathering, as well as data analysis and presentation [9].

Figure 7: Elementary school students performing measurements of noise levels (above) and interpreting results with the help of researchers (below)

4 CONCLUSION

Results and observations presented in this contribution are preliminary ones. While an important phase of the project – evaluation and impact assessment still needs to be performed, some initial conclusions and lessons learned so far can be summarized as follows:

The concept – CitieS-Health methodological framework – was well received among the engaged citizens and valuable new insights in the topics addressed can be achieved following this approach. Most citizens expressed interest in the multi-exposure aspect of living environment, not only noise, which proved to be very useful in the light of potential confounding factors and interpretation of the results. Citizens sometimes, however, have a hard time with the concept of co-design. It was observed that most volunteers prefer to follow a pre-defined schedule of tasks and rarely opt for tasks that are optional. Adjustments had to be made to adjust the number of the former in our study protocol. It turned out that most volunteers needed additional, more detailed instructions, e.g., for using certain application features and storing data on servers. This was especially the case due to the COVID situation, as respective mitigation measures had to be prepared that comprise interaction with volunteers in the on-line mode only, and accordingly tools used were adjusted. To this end, detailed and tailored user guides and info-graphics were prepared to help the volunteers. Time-constrain was the main preventing factor for participation and continuous efforts had to be made to keep volunteers engaged.

The activities organized at the school stimulated the interest of the school staff and attracted them to participate in the main study of the project. Overall, once again, schools proved to be a great environment for the conduct of CS activities, and pupils seemed to enjoy and learn from practical hand-on experience in conducting research. Concept of CS activities has great potential for further ongoing inclusion in the school curriculum, adjusted according to the specifics of the topics addressed [9].

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(Eko)golf igrišča in Natura 2000: Golf in varovanje okolja

(Eco) Golf courses and Natura 2000: Golf and Environmental Protection

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POVZETEK

Golf po vsem svetu igra približno 70 milijonov ljudi, v več kot 200 državah Igralci golfa čutijo in izkoriščajo prednost, ki jih zdravju prinaša ta šport in prisotnost v naravnem okolju. Načrtovanje, gradnja, adaptacija do okolja prijaznih golf igrišč ter nujna pridobitev mednarodnih in domačih eko certifikatov (standardov) v Sloveniji bi Slovenijo uvrstila med privlačne destinacije mehkega turizma.

KLJUČNE BESEDE

(eko)golf igrišča, okoljski standardi,okolje,prostor,Natura 2000

ABSTRACT

Golf is played by around 70 million people worldwide, in more than two hundred countries. Golfers feel and take advantage of the health benefits of the mentioned sport and its presence in the natural environment. Planning, construction, adaptation to environmentally friendly golf courses and the necessary acquisition of international and domestic eco certificates and standards in Slovenia would also mean placing Slovenia among the most attractive destinations of tourism.

KEYWORDS

(eco)golf courses, environmental standards, environment, Natura 2000

1 UVOD

Načrtovanje in gradnja golf igrišča v Sloveniji , tudi na slovenski obali (npr. občina Piran), ta čas še vedno povzroča javno negodovanje nekaterih posameznikov in skupin. Slovenska javnost in prav tako številni odgovorni na ministrstvih, katerih aktivnosti so neposredno povezane tudi z delovanjem golf igrišč, ter s tem možnostjo igranja golfa, so zelo slabo seznanjeni z vplivi načrtovanja, gradnje in vzdrževanja golf igrišč na okolje. Ob pomanjkanju verodostojnih informacij, tako prihajajo do veljave neobjektivni, neresnični in zelo pogosto nestrokovni,predvsem pa neverodostojno argumentirani članki ter izjave kritikov golf igrišč. Potrebno je redno in načrtno pridobivati podatke o okoljskih vplivih, ki jih dejavnosti v zvezi z golf igrišči imajo na okolje, jih kritično ovrednotiti in o izsledkih seznanjati slovensko javnost.

V članstvo Sveta za okolje pri Golf zvezi Slovenije (GZS) nas je (Zvezo ekoloških gibanj Slovenije – ZEG) Golf zveza povabila k sodelovanju že davnega leta 1999.

Skupaj smo načrtovali oglede igrišč in ocenjevanje z vidika okoljsko odgovornega ravnanja slovenskih golf igrišč, promocijo takratne okoljskega Evropskega certifikata Committed to Green, razmišljali in pripravljali smo celo za »Slovenski znak okoljske kakovosti«, kot standard, ki bi naj veljal na vseh golf igriščih v Sloveniji. Posebno delovno skupino (dr. Vladimir Meglič, Bogdan Macarol, Gorazd Nastran in Karel Lipič) v Svetu za okolje sestavljajo tudi številni drugi strokovnjaki, ki se na svojih področjih trudijo za boljše stanje okolja v Sloveniji in njim ni vseeno, kaj se dogaja na področju golf igrišč.

2 GOLF IGRIŠČA V SLOVENIJI

Golf kot igra se je začela v Sloveniji na Bledu že leta 1937, ko so zaključili prvih devet lukenj, kar je sicer polovica običajnega igrišča. Leta 1972 smo dobili tam prvo zaključeno golf igrišče z osemnajstimi luknjami, ki ga je projektiral Donald Harradine, priznani golf arhitekt, ki je imel velik občutek za poudarjanje naravnih danosti.

Drugo golf igrišče v Sloveniji smo dobili leta 1989 v Lipici, sicer spet le polovično – z devetimi luknjami. Tudi tu se je pod projekt podpisal isti arhitekt.

V naslednjih letih se je kar aktivno nadaljeval razvoj golf igrišč. Gradnja golf igrišč v Sloveniji pa je nekako obstala po letu 2006, ko sta bila izgrajena še prvo »Pitch putt« - krajše vadbeno igrišče s šestimi luknjami v Šempetru pri Novi Gorici in igrišče z devetimi luknjami – Trnovo na saniranem odlagališču smeti na Ljubljanskem Barju.

V Sloveniji imamo danes šestnajst golf igrišč z 18. ali več luknjami (Bled, Lipica,Moravske Toplice..) in sedem manjših, s 6. ali 9. luknjami, ki skupno z še 6-imi vadbišči za vadbo udarcev leži na skupni površini , cca 800 ha.

Golf zveza Slovenije je aktivna v prizadevanjih za varstvo okolja že od leta 1996, ko se je njen predstavnik udeležil prvega sestanka tehnične komisije mednarodne neodvisne Fundacije *Committed to Green*, ki je postavljala temelje okoljsko odgovornih principov načrtovanja, gradnje in vzdrževanja golf igrišč v Evropi. V začetku leta 2001 je bil ustanovljen prvi Svet za okolje pri Golf zvezi, ki je že s koncem istega leta, skupaj z Združenjem vzdrževalcev golf igrišč Slovenije, organiziral posvet *Golf in okolje*. Podlaga za posvet so bili podatki zbrani na vseh – takrat osmih igriščih v Sloveniji. Posveta so se aktivno udeležili tako predstavniki golf igrišč, vzdrževalci, nekatere okoljske NVO (ZEG idr.) kot tudi Ministrstvo za okolje in prostor.

Zaključki takratnega posveta so bili tudi:

- upravljanje in vzdrževanje igrišč v Sloveniji je odgovorno do okolja, vendar je potrebno zagotoviti sistem rednega letnega preverjanja, svetovanja in pomoči pri *izvajanju programa;*
- potrebno je vpeljati sistem rednega monitoring-a vseh talnih vodnih virov in podtalnice na golf igriščih; MOP, igrišča;
- v pet letnem obdobju se pregleda vsa slovenska golf igrišča ter se popiše redke ptice, sesalce ter druge redke živali poleg tega pa še avtohtone rastlinske vrste, zaščitene rastline in območja, ter se izda navodilo za zagotavljanje njihovega normalnega življenja; MOP, Agencija RS za varstvo narave;
- potrebno je pripraviti nosilno slovensko okoljsko strategijo za izbiro lokacij, gradnje in vzdrževanje golf igrišč; priprava MOP, Urad za prostorsko planiranje in Agencijo RS za varstvo narave, Ministrstvo za kmetijstvo, gozdarstvo in prehrano, ob pomoči Golf zveze Slovenije in Združenja vzdrževalcev golf igrišč Slovenije, ter drugih; Zveza ekoloških gibanj Slovenije - ZEG.;
- javnost je potrebno redno in dovolj kakovostno obveščati o okoljskih dejavnostih in stanju na slovenskih golfiščih;
- svet za okolje naj v naslednjih letih z dopolnjenimi in popravljenimi vprašalniki nadaljuje delo z ocenjevanjem igrišč in svetovanjem izboljšav;
- potrebna je jasna, nedvoumna zakonska kategorizacija golf igrišč kot celote in njenih sestavnih delov. Določitev je pomembna tudi zaradi razvrstitve in umeščanja v prostor pogostih samostojnih vadbišč, ali manjših vadbenih golf igrišč; MOP, Urad za prostorsko planiranje, Ministrstvo za kmetijstvo, gozdarstvo in prehrano;
- pri pripravi in spremembah zakonodaje s področja golfa, morajo Ministrstva k razpravi povabiti Golf zvezo Slovenije in Združenje vzdrževalcev golf igrišč Slovenije.

V Zvezi ekoloških gibanj Slovenije - ZEG, nevladni okoljski organizaciji (ima status društva v javnem interesu po ZVO) lahko ugotavljamo, da se v vsem tem obdobju (po letu 2001) na nivoju države ni zgodilo nič, kar bi bilo potrebno za izboljšanje pregleda, nadzora in verodostojnega poročanja o stanju in odnosu do okolja Slovenskih golf igrišč. Nič ni bilo narejeno za pripravo podlag za načrtovanje golf igrišč v prostoru, njihovo gradnjo in upravljanje! Edino kar se je zgodilo so bili restriktivni ukrepi v smislu nadzora nad rabo fitofarmacevtskih sredstev.

Sredi leta 2005 je bila ob podpori Evropske Komisije ustanovljena *Golf Environment Europe* – neodvisna fundacija, ki je ob kvalitetnem okoljskem programu ob sprejemu in podpori vseh, ne zgolj le Evropsko v golf vpetih strani, ob velikem interesu v letu 2008 prerasla v *Golf Environment Organization.* Njena vizija je: Golf je lahko vodilni v zagotavljanju trajnostnega razvoja v športu in poslovanju, v najširšem javnem pogledu, pa cenjen po okoljskem in socialnem prispevku!

Spomladi leta 2007 je bil s strani Golf zveze Slovenije pripravljen še en posvet na temo *Golf – Okolje - Prostor*, kateri pa je bil žal odpovedan zaradi premajhne prijave pričakovanih udeležencev; malo iz golfskih sredin, še manj pa iz strani institucij države; ministrstev, uprav, agencij.

V maju 2014 je bila organizirana prva predstavitev golfa v Evropskem parlamentu. Na kratko naj povzamemo nekaj navedenih vidikov tega športa v Evropi:

- ekonomski: prispevek v ekonomiji presega 15 milijard evrov;
- socialni: golf igra v Evropi preko 7,9 milijona ljudi;
- okoljski: obstaja preko 6.000 golf igrišč v Evropi, na področju katerih je vsaj 70% zemljišč mogoče uporabiti in varovati kot posebne in pomembne habitate.

3 V SLOVENIJI NIMAMO GOLF IGRIŠČ V NATURI 2000

V tujini poznamo mnogo primerov, ko golf igrišča izkazujejo najvišje standarde. Eno takih je v Kristianstadu na Švedskem, ki je celo pod zaščito UNESCA, ali pa Hilversumsche golf na Nizozemskem z izredno bogato floro in favno, ki tudi redno gosti European Tour – tekmovanje v golfu na najvišji, profesionalni ravni.

Golfska igrišča lahko ob pravilni zasnovi, načrtovanju, dobrem upravljanju pomembno prispevajo k biotski raznovrstnosti in ohranjanju te pestrosti s široko paleto vsega življenja, ki ga gostijo – od rastlin do ptic, od nevretenčarjev do dvoživk. Pomembno pa je to tudi preverjati in tudi objaviti izsledke! Namen je, da se promovira dobre prakse, da se umakne negativno konotacijo z golfa, obenem pa usmerja upravljalce igrišč in tudi igralce same, k okoljsko odgovornemu vzdrževanju in rabi prostora.So objem narave, hrepenenja po aktivnosti in vpliva zdravega življenja.

Golf zveza Slovenije kot krovna organizacija golfa v Sloveniji je v svojih aktivnostih vedno skrbela za odgovoren odnos do okolja. Čas bi bil, da bi se v te aktivnosti vključile tudi državne inštitucije, ki so neposredno vezane na to področje in to ne le z restriktivnim – omejevalnim pristopom (nadzorom), temveč konstruktivno s svetovalnimi in usmerjevalnimi aktivnostmi. Pred kratkim je bil nov Svet za okolje. Pripravljene so aktivnosti, katerih izvedba je ponovno odvisna od aktivne soudeležbe s strani države. Upam, da bo tokrat več posluha, predvsem pa želje po izboljšanju stanja.Imamo že preko 10.000 golfistov.

Vemo, da je golf kot šport in kot gospodarska aktivnost dobra. Vemo, da je pomemben za okolje na področju igrišč in tudi mnogo širše do koder sežejo vplivi. Vemo pa tudi, da je lahko še boljši, da lahko okolje, njegovo zdravje in pestrost še izboljšamo! Zato pa moramo vsi pridati svoj prispevek in ne le čakati na naslednji vlak!

V Zvezi ekoloških gibanj Slovenije v času še trajajoče javne razprave in iskanja dolgoročnih okoljskih rešitev v Republiki Sloveniji na področju izvajanja podnebne politike (NPVO, NEPN…) prosimo vlado RS in njena resorna ministrstva oz. strokovne službe , da nas seznanijo ali načrtujejo , kakršne koli aktivnosti na tem področju, oz. ali se vam ne zdi, da bi bilo nujno, da bi se slovenska golf igrišča priključila Evropskemu programu certificiranja (GEO) primernosti okoljskega ravnanja kot ga pozna cela Evropa?

Golf zveza Slovenije in lastniki vseh golf igrišč bi morali pogosteje dokazovati svojo okoljsko neoporečno ravnanje, saj se v javnosti sliši mnogo opazk na neustrezno in neodgovorno ravnanje na področju kemizacije tal.

V ZEG-u predlagamo, da se v te aktivnosti morajo nujno vključiti resorna ministrstva (MOP, MKGP, Ministrstvo za infrastrukturo, MGT…) in vlada.

Mnenja smo, da bi morala slovenska golf igrišča izdelovati naslednja letna poročila:

- skupne površine golf igrišča, gnojene površine, količine in vrste porabljenega gnojila;
- uporabljena vsa fito farmacevtska sredstva in na koliko površin (katerih) so bila uporabljena;
- količine in viri vode uporabljeni za vzdrževanje,
- količine porabljenih maziv in olj ter potrdila o varnem odstranjevanju;
- količine komunalnih in biološko razgradljivih odpadkov.

Golf zvezi Slovenije in Svetu za okolje pri GZS predlagamo, da:

- ponovno pripravi in dodela vprašalnik o okoljskih vplivih slovenskih golf igrišč;
- pridobitev vseh potrebnih podatkov na golf igriščih do meseca junija 2022;
- skupaj z Združenjem vzdrževalcev golf igrišč Slovenije pripravi letni zbir vseh potrebnih,variabilnih podatkov o vzdrževanju golf igrišč;
- pripravi več sestankov v širši slovenski politiki in javnosti s ciljem seznanjanja in izboljšanja medsebojnega odnosa in sodelovanja;
- nudi pomoč pri nastajanju novih golf igrišč z nasveti oz. pomoč pri implementaciji okoljskega programa *Zavezani okolju* (Committed to Green) zainteresiranim golf igriščem v Sloveniji in tujini;
- pripravi predlog za sklic slovenskega posveta na temo »GOLF IN OKOLJE« v letu 2022 ter izdela zgibanko oz. TV oglas za seznanjanje javnosti o odnosu golf igrišč do okolja.

Slovenska javnost zahteva dokaze (če so?), da slovenska golf igrišča res ne onesnažujejo okolja in da so lahko pomemben člen Nature 2000, varovanja okolja ter rekreacije ljudi v naravi.

4 ZAKLJUČEK

V Zvezi ekoloških gibanj Slovenije - ZEG, nevladni okoljski organizaciji po dvajsetih letih stalnih prizadevanj pričakujemo večje strokovno vključevanje Golf zveze Slovenije v načrtovanje eko golf igrišč.

Od pristojnih državnih institucij in ministrstev pa korenite okoljske spremembe v praksi, da vključijo te igralne površine v zavarovana območja. Ob dobrem okoljskem upravljanju lastnikov igrišč, le-te lahko pomembno prispevajo k biotski raznovrstnosti države.

5 VIRI

- lastni viri, arhiv in dokumentacija ZEG
- medijski strokovni članki o golf igriščih
- zapisi skupnih sestankov na GZS in Združenju vzdrževalcev golf igrišč Slovenije (med leti 2000-2015)
- Matjaž Gams

Gospodarska in podnebna negotovost v Združenih državah Amerike

Economic and climate uncertainty in the United States

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POVZETEK

Gospodarske in podnebne razmere se spreminjajo, kar med gospodarskimi enotami povzroča potrebo po prilagajanju. V tem prispevku analiziram gospodarsko in podnebno negotovost v ZDA. Ugotovil sem, da se je zaradi gospodarske in podnebne krize povečala gospodarska oz. podnebna negotovost v ZDA.

KLJUČNE BESEDE

gospodarstvo, podnebje, politika, negotovost, ZDA

ABSTRACT

Economic and climate conditions are changing, leading to the need among economic units for adaptation. In this paper, I analyse the economic and climate uncertainty in the US. I found that economic and climate uncertainty in the US have increased due to the economic and climate crisis, respectively.

KEYWORDS

economy, climate, policy, uncertainty, US

1 UVOD

Gospodarske in podnebne razmere se spreminjajo, kar med gospodarskimi enotami povzroča potrebo po prilagajanju. Od njihove sposobnosti prilagajanja je odvisno, kakšen bo njihov jutri.

Zadnje leto in pol se v medijih veliko govori in piše o negotovosti, ki jo zaradi gospodarske, družbene in zdravstvene krize na eni in podnebne krize na drugi strani čutimo na vsakem koraku. To med gospodarskimi enotami povzroča potrebo po ukrepanju. Znano je, da pandemija covida-19 spreminja naš način življenja: vprašanje je, ali na boljše ali na slabše.

V tem prispevku analiziram gospodarsko negotovost, ki jo na kratko definiram v poglavju 2, in podnebno negotovost, ki jo na kratko definiram v poglavju 4, pri čemer se omejujem na ZDA, ki se zadnje leto in pol soočajo s hudimi posledicami gospodarske, družbene in zdravstvene krize na eni in podnebne krize na drugi strani. Izkazalo se je, da ZDA niso odporne proti gospodarskim, družbenim in zdravstvenim šokom na eni in podnebnim šokom na drugi strani, kar ameriškim oblikovalcem politike povzroča težave.

Dejstvo je, da je negotovost zanimiva tema, ki med drugim zanima tudi ekonomiste. Raziskave kažejo, da negotovost negativno vpliva na gospodarstvo in družbo.

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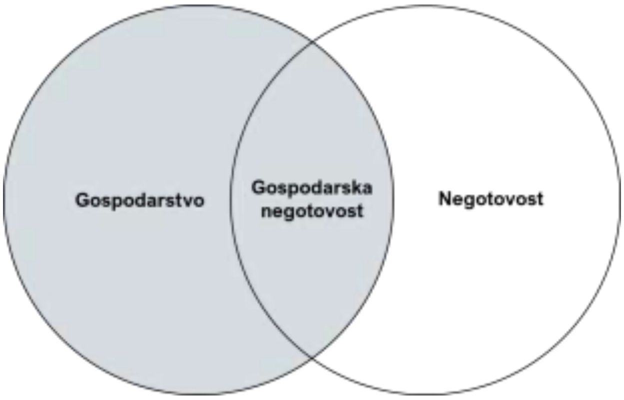
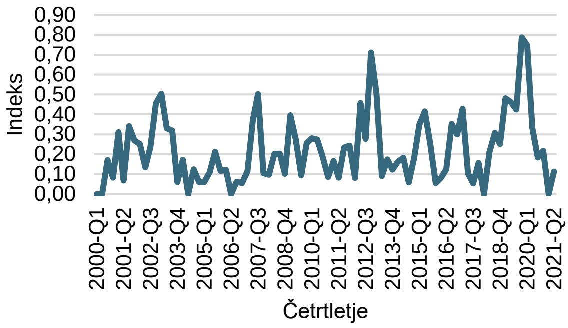
2 GOSPODARSKA NEGOTOVOST

Pandemija covida-19 je v ZDA povzročila gospodarsko recesijo, ki je trajala od marca do aprila 2020 [1]. Zaradi gospodarske krize (recesijskega pritiska v gospodarstvu) se je v ZDA povečala gospodarska negotovost [2, 3, 4, 5, 6], ki jo obravnavam v prvem delu tega prispevka. Slika 1 kaže odnos med »gospodarstvom« na eni in »negotovostjo« na drugi strani, pri čemer je presek obeh krogov »gospodarska negotovost«, ki jo lahko na kratko definiramo kot negotovost glede gospodarskih razmer.

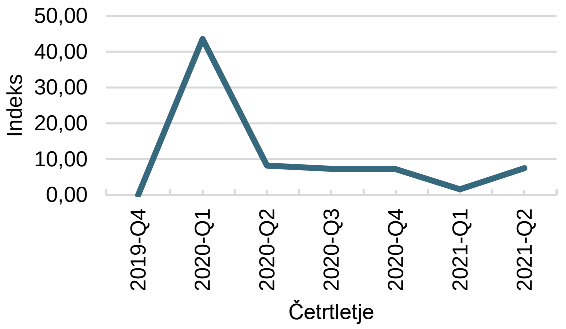


Slika 1: Odnos med »gospodarstvom« in »negotovostjo«

Raziskave kažejo, da je pandemija covida-19 prispevala k povečanju negotovosti v ZDA [2, 3, 4, 5, 6]. Slika 2 kaže gibanje indeksa negotovosti za ZDA v obdobju od prvega četrtletja 2000 do drugega četrtletja 2021, slika 3 pa gibanje indeksa pandemične negotovosti za ZDA v obdobju od zadnjega četrtletja 2019 do drugega četrtletja 2021. Iz slik je razvidno, da sta indeksa svoj vrh dosegla v prvem četrtletju 2020, tj. v prvem valu okužb s koronavirusom SARS-CoV-2.



Slika 2: Negotovost v ZDA v obdobju od prvega četrtletja 2000 do drugega četrtletja 2021 [7, https://worlduncertaintyindex.com/]



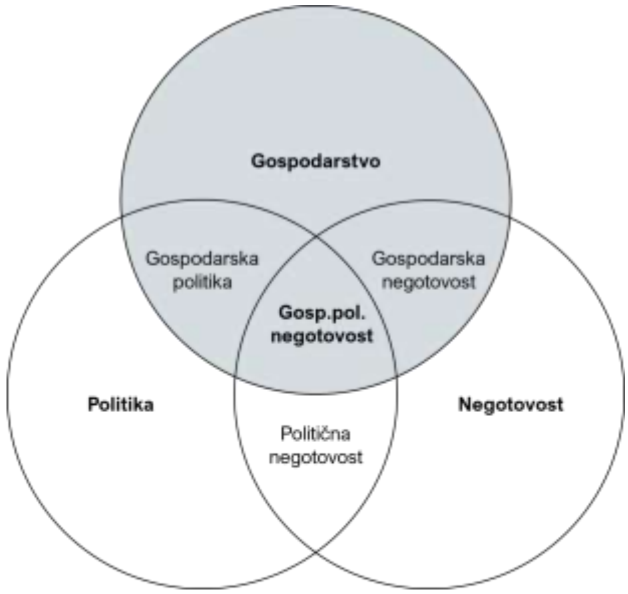
Slika 3: Pandemična negotovost v ZDA v obdobju od zadnjega četrtletja 2019 do drugega četrtletja 2021 [7, https://worlduncertaintyindex.com/]

Dejstvo je, da so bile na začetku krize (šoka) gospodarske enote v negotovosti (negotovem položaju) glede gospodarskih razmer doma in po svetu, zaradi česar so odlašale z odločitvami glede novih investicij in zaposlitev.

3 GOSPODARSKOPOLITIČNA NEGOTOVOST

Raziskave kažejo, da je pandemija covida-19 prispevala tudi k povečanju gospodarskopolitične negotovosti v ZDA [2, 5]. Na začetku gospodarske krize še ni bilo znano, katere ukrepe za oživitev gospodarske dejavnosti v ZDA bo na primer sprejela ameriška vlada pod vodstvom Donalda J. Trumpa ml., kar je v ZDA povzročilo gospodarskopolitično negotovost, ki jo obravnavam v nadaljevanju tega poglavja.

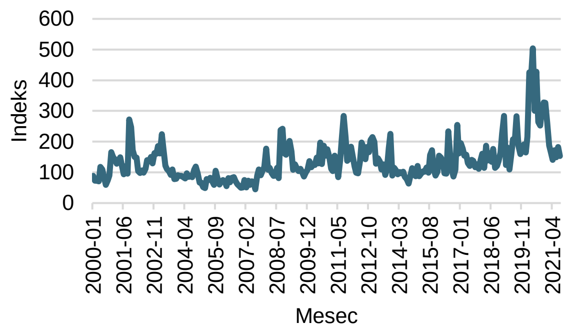
Slika 4 kaže odnos med »gospodarstvom« na eni, »politiko« na drugi in »negotovostjo« na tretji strani, pri čemer je presek vseh treh krogov »gospodarskopolitična negotovost«, ki jo lahko na kratko definiramo kot negotovost glede gospodarske politike, prim. [8].



Slika 4: Odnos med »gospodarstvom«, »politiko« in »negotovostjo«

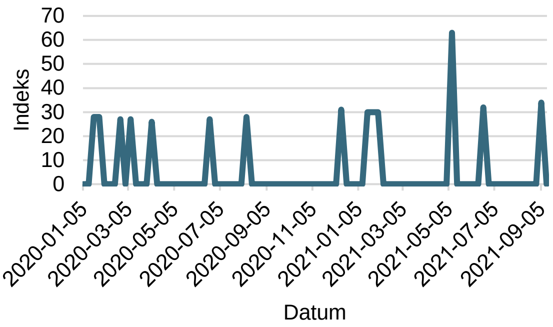
Dejstvo je, da obstaja potreba po opazovanju in spremljanju gospodarskopolitične negotovosti v ZDA. V ta namen so Baker idr. [8] razvili indeks gospodarskopolitične negotovosti za ZDA, ki med drugim temelji na številu člankov, objavljenih v desetih ameriških časopisih. Da se članek upošteva, mora vsebovati besedo »ECONOMIC« ali »ECONOMY«, besedo »CONGRESS« ali »DEFICIT« ali »FEDERAL RESERVE« ali »LEGISLATION« ali »REGULATION« ali »WHITE HOUSE« in besedo »UNCERTAIN« ali »UNCERTAINTY«.

Slika 5 kaže gibanje indeksa gospodarskopolitične negotovosti za ZDA v obdobju od januarja 2000 do avgusta 2021. Iz slike je razvidno, da je bila gospodarskopolitična negotovost v ZDA največja maja 2020, prim. [5].



Slika 5: Gospodarskopolitična negotovost v ZDA v obdobju od januarja 2000 do avgusta 2021 [8, https://www.policyuncertainty.com/]

Slika 6 kaže zanimanje za gospodarskopolitično negotovost v ZDA od 5. januarja 2000 do 29. avgusta 2021. Iz slike je razvidno, da je bilo zanimanje za gospodarskopolitično negotovost v ZDA največje maja 2020, ko je bila tudi gospodarskopolitična negotovost v ZDA največja.



Slika 6: Zanimanje za gospodarskopolitično negotovost v ZDA od 5. januarja 2000 do 29. avgusta 2021 (Google Trendi) [https://trends.google.com/trends/]

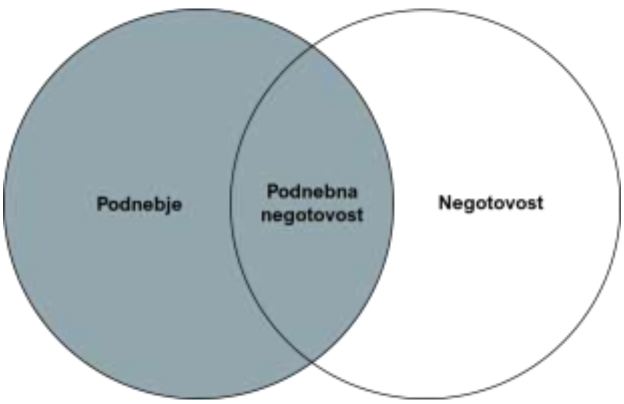
Raziskave kažejo, da gospodarskopolitična negotovost negativno vpliva na gospodarstvo [2]. Zato je naloga oblikovalcev politike in politikov, da preprečujejo nastajanje gospodarskopolitične negotovosti.

4 PODNEBNA NEGOTOVOST

Podnebne spremembe povzročajo podnebno krizo, o kateri se v ameriških medijih premalo govori in piše. Znano je, da je odnos ameriških gospodarskih enot do vprašanja podnebnih sprememb odvisen od strankarske pripadnosti [9, 10]. Donald J. Trump ml. (ki je pripadnik politične desnice) na primer v nasprotju z Josephom R. Bidnom ml. (ki je pripadnik politične levice) ne verjame v podnebne spremembe.

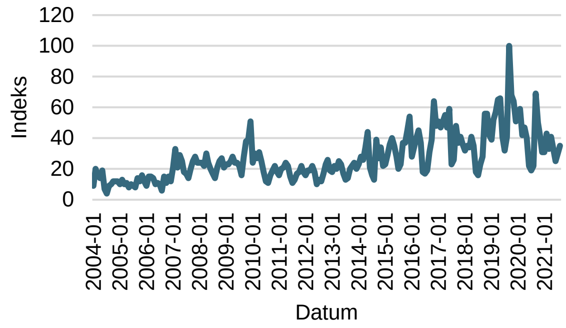
Zaradi podnebne krize se je v ZDA povečala podnebna negotovost., ki jo obravnavam v nadaljevanju tega poglavja.

Slika 7 kaže odnos med »podnebjem« na eni in »negotovostjo« na drugi strani, pri čemer je presek obeh krogov »podnebna negotovost«, ki jo lahko na kratko definiramo kot negotovost glede podnebnih razmer.



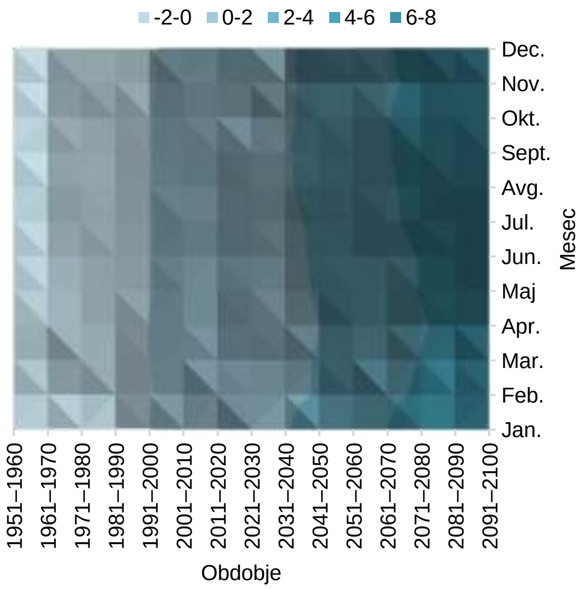
Slika 7: Odnos med »podnebjem« in »negotovostjo«

Slika 8 kaže zanimanje za podnebne spremembe v ZDA od januarja 2004 do avgusta 2021. Iz slike je razvidno, da se zanimanje za podnebne spremembe v ZDA povečuje.



Slika 8: Zanimanje za podnebne spremembe v ZDA od januarja 2004 do avgusta 2021 (Google Trendi) [https://trends.google.com/trends/]

Dejstvo je, da se ZDA zaradi podnebnih sprememb ne piše dobro, kar je razvidno iz slike 9, ki kaže odstopanje povprečne mesečne temperature v ZDA glede na referenčno obdobje 1986–2005 (scenarij: visoke emisije).



Slika 9: Odstopanje povprečne mesečne temperature glede na referenčno obdobje 1986–2005 v ZDA po mesecih in obdobjih [https://climateknowledgeportal.worldbank.org/download-data]

Raziskava, ki so jo marca 2021 opravili Leiserowitz, Maibach, Rosenthal, Kotcher, Carman, Wang, Marlon idr. [11] na vzorcu 1037 odraslih Američanov, med drugim kaže:

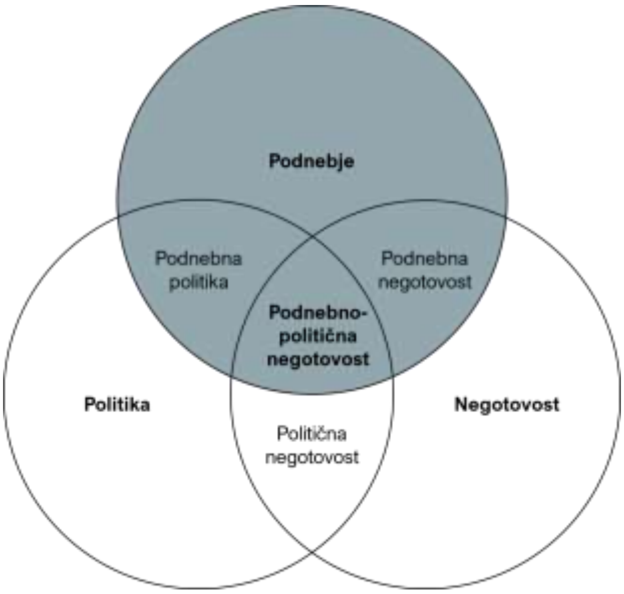
- da jih 70 odstotkov meni, da prihaja do globalnega segrevanja;
- da jih 57 odstotkov meni, da prihaja do globalnega segrevanja zaradi človekovega delovanja;
- da jih je 64 odstotkov zaskrbljenih zaradi globalnega segrevanja;
- da jih 57 odstotkov meni, da globalno segrevanje negativno vpliva nanje;

- da jih 45 odstotkov meni, da globalno segrevanje negativno vpliva na druge,
- da jih 64 odstotkov čuti (so)odgovornost za globalno segrevanje;
- da jih 61 odstotkov meni, da globalno segrevanje negativno vpliva na vreme v ZDA.

5 PODNEBNOPOLITIČNA NEGOTOVOST

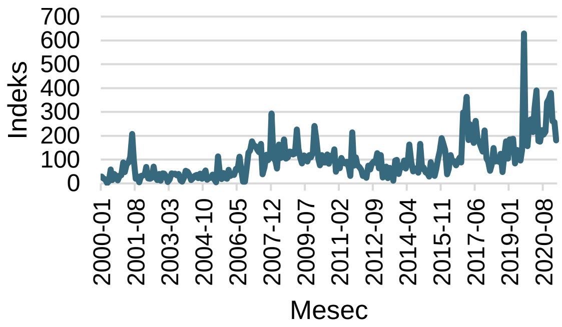
Logično je, da lahko k zmanjšanju politične negotovosti največ prispevajo politiki sami. Lep primer za to je Joseph R. Biden ml., ki se po načinu vodenja precej razlikuje od svojega predhodnika. Ta je na primer z izjavo, da bodo ZDA odstopile od Pariškega sporazuma o podnebnih spremembah (Paris Agreement on Climate Change), ki jo je dal 1. junija 2017, prispeval k povečanju politične negotovosti v ZDA.

V tem poglavju obravnavam podnebnopolitično negotovost, ki je tako kot gospodarskopolitična negotovost zanimiva tema. Slika 10 kaže odnos med »podnebjem« na eni, »politiko« na drugi in »negotovostjo« na tretji strani, pri čemer je presek vseh treh krogov »podnebnopolitična negotovost«, ki jo lahko na kratko definiramo kot negotovost glede podnebne politike.



Slika 10: Odnos med »podnebjem«, »politiko« in »negotovostjo«

Tako kot obstaja potreba po opazovanju in spremljanju gospodarskopolitične negotovosti v ZDA, obstaja tudi potreba po opazovanju in spremljanju podnebnopolitične negotovosti v ZDA. V ta namen je Gavriilidis [12] razvil indeks podnebnopolitične negotovosti za ZDA, ki temelji na številu člankov, objavljenih v osmih ameriških časopisih. Da se članek upošteva, mora vsebovati besedo »CARBON DIOXIDE« ali »CLIMATE« ali »CLIMATE CHANGE« ali »CLIMATE RISK« ali »CO_2« ali »EMISSIONS« ali »ENVIRONMENTAL« ali »GLOBAL WARMING« ali »GREEN ENERGY« ali »GREENHOUSE« ali »GREENHOUSE GAS EMISSIONS« ali »RENEWABLE ENERGY«, besedo »CONGRESS« ali »EPA« ali »LAW« ali »LEGISLATION« ali »POLICY« ali »REGULATION« ali »WHITE HOUSE« in besedo »UNCERTAIN« ali »UNCERTAINTY«. Podatki za obdobje od januarja 2000 do marca 2021 kažejo, da je indeks podnebnopolitične negotovosti za ZDA svoj vrh dosegel septembra 2019, ko je v New Yorku potekala Konferenca o podnebnih spremembah (Climate Action Summit 2019) (gl. sliko 11).



Slika 11: Podnebnopolitična negotovost v ZDA v obdobju od januarja 2000 do marca 2021 [12, https://www.policyuncertainty.com/]

6 SKLEP

Dejstvo je, da se ZDA (tako kot druge svetovne države) zaradi gospodarske, družbene in zdravstvene krize na eni in podnebne krize na drugi strani soočajo z novimi težavami, ki so izziv za ameriške oblikovalce politike. Za gospodarske enote velja, da se morajo prilagajati razmeram doma in v svetu.

Zaradi pandemije covida-19 se je v ZDA povečala negotovost, ki jo analiziram v tem prispevku. Ugotovil sem, da se je le-ta povečala na začetku pandemije, ko še na primer ni bilo cepiva proti koronavirusu SARS-CoV-2. Negotovost pa se v ZDA ni povečala samo zaradi gospodarske, družbene in zdravstvene krize, ampak tudi zaradi podnebne, katere posledice čutimo na lastni koži.

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Ponovna raba vode v urbanih okoljih kot pristop odgovornega življenja

Water Reuse in Urban Environments as an Approach to a Responsible Life

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POVZETEK

Naravni viri so vsebolj omejeni in zlasti mesta že občutijo na eni strani pomanjkanje vode zlasti v sušnih delih leta in na drugi strani viške vode v času močnih nalivov. Pozidva in neprepustne površine onemogočajo ponikanje vode in ponovno izhlapevanje, zato se uvajajo sistemi za zadrževanje in ponovno rabo vode. V prispevku so predstavljeni izzivi urbanih območij v smeri prilagajanja na podnebne spremembe s poudarkom na krožni rabi vode ter uporabi zelenih sistemov, s pomočjo katerih zadržujemo deževnico in povečujemo ponikovalno in zadrževalno sposobnost tal in stavb ter neprepustnih površin, ki jih opremljamo z zelenimi sistemi in tehnologijami

KLJUČNE BESEDE

Urbana območja, deževnica, krožno gospodarjenje, zeleni sistemi.

ABSTRACT

Natural resources are increasingly limited and cities in particular are already experiencing water shortages on the one hand, especially in dry parts of the year, and on the other hand, excess water during heavy rains. Sealing and impermeable surfaces prevent water from sinking and re-evaporating, so water retention and reuse systems are being introduced. The paper presents the challenges of urban areas in adapting to climate change with an emphasis on circulating water use and the use of green systems to contain rainwater and increase the sinking and retention capacity of floors and buildings and impermeable surfaces equipped with green systems and technologies.

KEYWORDS

Urban areas, rainwater, circular management, green systems.

1 UVOD

Z rastjo prebivalstva, urbanizacijo in gospodarskim razvojem, se povečujejo potrebe po sladki vodi v mestih po vsej Evropi. Hkrati podnebne spremembe in onesnaževanje prav tako vplivajo na razpoložljivost vode za prebivalstvo v mestih. Voda v mestih postaja vse večji izziv, tako količina, kvaliteta, razpoložljivost, dosegljivost, preobremenjenost oskrbe kot tudi poškodbe kanalizacijskih sistemov. Zato so potrebni inovativni predlogi kako bodo lahko mesta še naprej zagotavljala sladko vodo svojim prebivalcem ter dolgoročno skrbeli za ohranjanje zelenih površin, ki postajajo v mestih vse bolj pomembne tudi zaradi drugačnih potovalnih navad in omejitev gibanja, ki jih poznamo izpred nekaj časa zaradi korone [2].

2 ZBIRANJE IN ZADRŽEVANJE VODE

Pametno vodno gospodarstvo in družba bi morala upravljati z vsemi razpoložljivimi vodnimi viri (vključno s površinskimi, podzemnimi, odpadnimi in prečiščenimi vodami). S tem bi se izognili pomanjkanju vode in onesnaževanju, povečali bi odpornost na podnebne spremembe, ustrezno obvladali tveganja, povezana z vodo, in zagotovili, da se pridobijo vse koristne snovi, ki jih je mogoče pridobivati iz postopkov čiščenja odpadne vode ali so integrirane v vodne tokove. Preizkušeni ukrepi za zadrževanje vode v urbanih območjih so zbiranje deževnice (zbiranje deževnice iz streh, parkirišč), ki prinaša številne prednosti, kot so zmanjšanje močnih deževnih vplivov in prispevanje k ohranjanju vode. V krožnem gospodarstvu ima tudi ponovna uporaba vode ključno vlogo, ki prinaša pomembne okoljske, socialne in gospodarske koristi. Poleg tega se lahko siva voda (odpadna voda iz kopalnic, pranja perila in kuhinj) ki so 50 do 80 % stanovanjskih odpadnih voda, široko uporablja za namakanje v mestnem okolju in za domače namene (kot je toaletna voda), kot tudi deževnica. Tudi v Vodni direktivi so predvideni ukrepi za ponovno rabo vode [3], zlasti za urbana območja.

Slika 1: Zeleni sistemi zbiranja vode v urbanih območjih [1]

3 KROŽNO UPRAVLJANJE Z VODO

V mestih se vse večja pozornost daje krožnemu upravljanju z vodami. Poznamo šest ciljev upravljanja z vodami, to so:

1. reciklirati in ponovno uporabiti odpadno vodo;
2. povečati učinkovitost uporabe in distribucije vode;
3. zagotoviti dobro kakovost vodnih teles;
4. zbiranje vode;
5. spodbujati večkratno uporabo vode in trajnost voda;
6. ohraniti pretok v vodnih telesih.

V urbanih okoljih je pogosta težava preobremenitev kanalizacije, saj vse več padavin pade v zelo kratkem času. Prelivi kanalizacije povzročajo negativne vplive na rastlinstvo in živalstvo, pa tudi umrljivost rib.

Če voda steče v kanalizacijo brez zadrževanja, se iz prometnih površin izperejo mikroplastika in težke kovine. Tak odtok tudi vzpostavlja nenaravno vodno bilanco, saj se zmanjšuje proces lokalnega izhlapevanja in lokalnega polnjenja podzemne vode.

Zato so pomembni centralizirani izpusti deževnice z zadrževalnimi filtri v zemlji, ki blažijo izhlapevanje in odtok v kanalizacijo.

Slika 2: Trajnostni pristopi v urbanih okoljih za blaženje podnebnih sprememb [1]

4 VEČSTRANSKE KORISTI DEŽEVNICE

Urbana območja so razvila prioritete pri upravljanju deževnice in to so:

1. izogibanje novim pozidavam inširjenju mestnih površin;
2. zbiranje in uporaba deževnice na kraju samem;
3. zadrževanje deževnice;
4. infiltracija (polnjenje podzemne vode);
5. puščanje deževnice v vodno telo.

Za čiščenje deževnice se uporabljajo razni filtri, od mehanskih sesalnih filtrov, do navpičnih cevi za hitro preusmeritev v rezervoar. Plavajoči fini sesalni filtri zagotavljajo, da se deževnica črpa iz najbolj čistega nivoja rezervoarja in ne vsebuje mehanskih delcev.

Sicer je na razpolago veliko različnih sistemov za zbiranje deževnice, od različno velikih posod, do betonskih podzemnih zbiralnikov. Za manjše uporabnike se uporablja večinoma vkop plastičnih ali betonskih podzemnih zbiralnikov.

Uporaba deževnice je vse bolj prioriteta za hlajenje z izhlapevanjem v gosto naseljenih urbanih območjih. Zlasti vlagoljubno rastlinstvo zadržuje veliko vode in količina tako izhlapele vode v enem poletnem mesecu je podobna, kot je izhlapi iz drevesa, zato je umeščanje vlagoljubnih rastlin vse bolj pomemben blažilni ukrep [4].

Koristi zbiranja deževnice so večdimenzionalne:

- deževnica je razmeroma čista in njena kakovost je običajno dovolj za številno uporabo z malo ali celo brez čiščenja;
- deževnica ima nizko slanost in jo je mogoče ponovno uporabiti kjerkoli, kjer ej potrebna mehka voda, kot je za pranje perila, hlajenje in v industriji;
- z deževnico lahko prihranimo do 50 % potrebe po vodi v gospodinjstvu;
- uporaba deževnice zmanjša stroške energije za hlajenje, saj 1 m3 deževnice, ki izhlapi, sprosti 680 kWh energije;
- zbiranje deževnice pomembno zmanjša obremenitev odtokov na kanalizacijo in poplave v mestnih območjih;
- zbiranje deževnice je prilagodljiva tehnologija, ki jo je mogoče zasnovati tako, da izpolnjuje skoraj vse zahteve;
- prispeva k samooskrbi z vodo.

S ciljem, da bi se urbana območja odločala za tovrstne projekte, smo pripravili v letu 2020 zbornik projektov za Mestno občino Maribor.[1]
V letu 2021 pripravljamo digitalno monografijo s z naslovom Inovativni predlogi za ponovno rabo vode v urbanih območjih, kjer nadgrajujemo ideje o možnostih odgovornega življenja v mestih.

5 ZAKLJUČEK

Za implementacijo navedenih idej bi bilo potrebno narediti več sprememb tako v načrtovalnih kot v izvedbenih postopkih. Seznami projektov, ki jih financirajo mestne občine v Sloveniji večinoma niso usklajeni z zahtevami po krožnem gospodarstvu in po trajnostno naravanih ukrepih z večfunkcijskimi učinki, ne samo na infrastrukturo in ekonomijo, ampak na kvaliteto bivanja. Že prisotne podnebne spremembe bodo vse bolj zahtevale opisane spremembe, zato bi se morala znanost bolj vključiti v načtovanje strategij razvoja, kjer se načrtujejo tovrstni projekti.

6 ZAHVALA

Mestni občini Maribor se zahvaljujemo za izvajanje projekta Voda in podnebne spremembe ter Ponovna raba vode v urbanih območjih v letih 2020 in 2021.

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Uporaba programske opreme v zanki za izdelavo digitalnega dvojčka proizvodnega procesa

Using Hardware in the Loop for Making a Digital Twin of Production Process

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POVZETEK

Programska oprema v zanki oz. 'hardware in the loop' se v zadnjem času vse pogosteje uporablja v simulacijske namene, kjer samo z enim programskim orodjem ne moremo simulirati realno-fizikalnega modela proizvodnega procesa. Gre za integracijo programske opreme, istih, kot tudi različnih proizvajalcev, v eno simulacijo. Programski paketi tako komunicirajo med seboj in si izmenjujejo podatke. V nadaljevanju bo predstavljena programska oprema v zanki za namene načrtovanja in vodenja industrijskega procesa kontrole kakovosti pečice s pomočjo kolaborativnega robota in industrijskega krmilnika. Programska oprema v zanki tako predstavlja digitalni dvojček proizvodnega procesa.

KLJUČNE BESEDE

Programska oprema v zanki, proizvodni proces, SIMIT, TIA, PLCSim, NX MCD, URSim, WinCC

ABSTRACT

Using hardware in the loop is gaining on popularity for simulation purposes where only one hardware is not enough to simulate the real-world physics of the automation process. Hardware in the loop is used to integrate software or program packages of the same or different producers into one simulation. Program packages are integrated into the hardware in the loop for the purpose of planning and control of the automation process for quality control of the oven production line with the collaborative robot and industrial controller. Hardware in the loop represents the digital twin of the production process.

KEYWORDS

Hardware in the loop, production process, SIMIT, TIA, PLCSim, NX MCD, URSim, WinCC

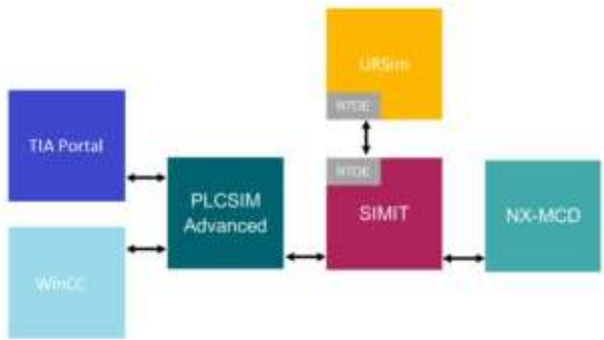
1 UVOD

Napredek človeškega razvoja temelji na razvoju metod, ki olajšujejo potrebno delo za opravljanje nalog. Digitalni dvojček, z uporabo programske opreme v zanki, je ena izmed pomembnejših metod digitalnega razvoja, ki omogoča bistven napredek v razvoju procesov in končnih produktov, lažjimi implementacijami idej ter manjšimi stroški testiranj razvitih sistemov v dobi tako imenovane industrije 4.0.

Eno močnejših podjetij za namene načrtovanj in vodenj digitalnih proizvodnih procesov je nemški SIEMENS, ki glede na zahteve in obsežnost sistemov omogoča več programskih rešitev. Uporaba robotskih sistemov v avtomatizaciji proizvodnih procesov v industriji 4.0 se v splošnem zdi nepogrešljiva, kar zahteva predvsem potrebo po kolaboraciji med programskimi okolji različnih proizvajalcev. V omenjenem proizvodnem procesu kontrole kakovosti pečice s pomočjo robota in industrijskega krmilnika se uporabljajo programska okolja podjetja SIEMENS in UNIVERSAL ROBOTS.

1.1 UPORABA PROGRAMSKE OPREME

Trenutno bistvo programske opreme v zanki je uporaba več specializiranih programov, kjer vsak program opravlja svojo dotično nalogo in si ob tem izmenjuje podatke z ostalimi okolji za celovito delovanje digitalnega sistema, saj trenutno še ne poznamo programskega okolja, oziroma še ni toliko razširjen, ki bi omogočal gnezdene funkcije vse do sedaj potrebne programske opreme.



Slika 1: Primer uporabe programskih okolij digitalnega dvojčka [1]

Slika 1 prikazuje primer uporabljene programske opreme v zanki za medsebojno komunikacijsko izmenjavo podatkov. Komunikacija poteka v realnem času med okolji za načrtovanje in avtomatizacijsko vodenje sistema (NX – MCD, SIMIT, PLCSIM, TIA Portal in WinCC) ter simulacijskim okoljem za programiranje industrijskega robota podjetja UR (URsim).

1.1.1 NX – MCD. Je ena izmed razširitev programskega okolja NX, ki se uporablja za simuliranje kompleksnih elektromehanskih sistemov in omogoča mehatronski pristop razvoja sistemov.

V enem orodju razvijamo sistem s podporo mehanskih, elektro in avtomatizacijskih sklopov. Vključuje fizikalni vmesnik, podobno kot pri računalniških igrah, ki omogoča simulacijo fizikalnih pojavov, ki so primerljivi realnemu svetu.

1.1.2 SIMIT. Je platforma, na kateri lahko izvajamo simulacije, ki omogočajo celovite teste avtomatizacije projektov, kot tudi virtualno zaganjanje sistemov, strojev in procesov. Simulacijsko platformo uporabljamo tudi za usposabljanje operativnega osebja v realističnih okoljih. [1]

1.1.3 S7 – PLCSIM. Programsko okolje PLCSIM Advanced je platforma za simulacijo programirljivega logičnega krmilnika (PLK) S7-1500 in ET 200SP. Omogoča virtualno testiranje in upravljanje vseh funkcij realnega programirljivega logičnega krmilnika.

1.1.4 TIA Portal. Oziroma angl. »Totally Integrated Automation Portal« (prevedeno kot popolnoma integriran avtomatizacijski portal) nam združuje celotno avtomatizacijo stroja, od digitalnega načrtovanja elementov do konfiguracije vseh naprav, v enotni sistem.

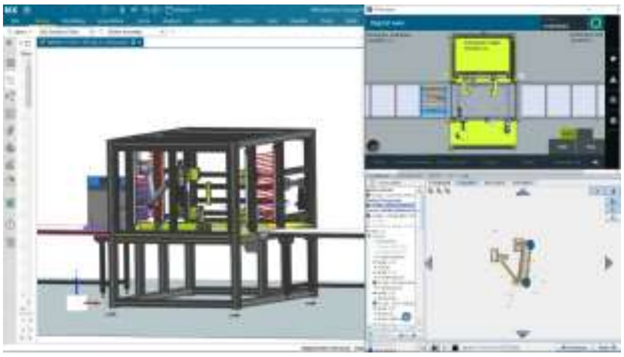
1.1.5 URsim. Je simulacijsko okolje za programiranje industrijskih robotov podjetja UNIVERSAL ROBOTS (UR). Omogoča kreiranje programov gibanja, simuliranje in testiranje sistemov z industrijskim robotom v 3D okolju.

2 PROGRAMSKA OPREMA V ZANKI

Za izvajanje simulacij režima digitalnega dvojčka lahko izpostavimo eno izmed možnih konfiguracij uporabe programske opreme v zanki.
Grafični prikaz virtualnega okolja kot tudi približek realnemu okolju se definira v programu NX MCD, kjer se uvoženi CAD modeli definirajo kot telesa. Tukaj se jim priredijo fizikalne lastnosti (kinematika in dinamika) in se jih sintetizira v celico z vsemi transportnimi in manipulacijskimi elementi. Aktivnim elementom se priredijo krmilni signali za komunikacijo z eksternimi okolji.
Platforma SIMIT se opredeli kot komunikacijski most med grafičnim prikazom MCD okolja, virtualnim krmilnikom PLCSIM Advance z algoritmom vodenja in okoljem za programiranje robotskih rok UR – URsim. SIMIT deluje tudi kot simulacijska platforma naprav (primer: motorni pogoni).
S7-PLCSIM deluje kot virtualni krmilnik na katerega se naloži programski algoritem razviti v programskem okolju TIA Portal. Za programiranje robotske roke se v dotičnem problemu uporabi okolje URsim, kjer se izdela algoritem izvajanja gibanja. Za doseganje vključitve človeka v času izvajanja virtualnega avtomatiziranega procesa se izdela vmesnik HMI.

3 IZVAJANJE SIMULACIJ IN REZULTATI

Opisano konfiguracijo virtualno poženemo v programskem okolju SIMIT, kar sproži simultan zagon vseh programov digitalnega dvojčka. Na Slika 2 so razvidna delovna okna programskih okolij. Pri tem je smisel okolja MCD grafični prikaz virtualnega delovnega okolja (čim bolj primerljivo realnemu), UR sim okolje predstavlja grafični prikaz izvajanja gibov robotske roke in prikazan HMI vmesnik prikazuje definirane parametre, ki so potrebni ob izvajanju. Vse izvršbe funkcij se izvajajo v realnem času.



Slika 2: Digitalni dvojček v času simulacije.

Celoten proizvodni proces digitalnega dvojčka se izvaja po diagramu poteka, kot je prikazano na sliki 3.

Slika 4: Diagram poteka izvajanja kontrole pečice.

4 DISKUSIJA

Digitalni dvojčki, z uporabo programskih paketov v zanki, omogočajo naslednji korak v digitalizaciji postopkov razvojev novodobnih industrijskih rešitev, ki zahtevajo fleksibilnost, strateško okretnost ob iskanju rešitev in pogojem nizkih tržnih cen. Tako lahko podjetje že v fazi digitalnega načrtovanja popolnoma pripravi projekt na lastno zmožnost in ob tem predvidi in odpravi tako imenovane porodne krče, ki se pojavijo ob razvoju in realizaciji novih produktov oziroma sistemov.
Vendar je potrebno izpostaviti, da so rezultati digitalnih dvojčkov pogojeni z optimizacijo in dovršenostjo modelov

predstavljenega sistema, saj je odzivnost in kooperativnost programskih paketov odvisna od najmanjših podrobnosti, ki lahko v fizičnem svetu doprinesejo velik preobrat v odzivanju sistema. Večja dovršenost sistema ob tem zahteva tudi svoj davek v potrebni procesorski moči računalnika, kar pa se z razvojem naprednih in zmogljivih računalniških sistemov omili.

Razviti koncept digitalnega dvojčka robotizirane demonstracijske celice v sklopu projekta ROBKONCEL je omogočil vpogled v zmožnosti in prednosti uporabe tehnologij virtualnih simulacij industrijskih sistemov. S tem se je modelirana robotizirana celica virtualno razvila v delujoč sistem, ki potrjuje ustreznost razvitih elementov in ustreznost izbrane robotske roke glede na zahteve projekta.

Brez pomisleka lahko trdimo, da so sistemi digitalnih dvojčkov tehnologija prihodnosti, ki ne bo ostala le na zaslonih računalnikov.

ZAHVALA

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VIRI

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Ocena tveganja in ukrepi za varno delo v sodelovalni robotiki

Risk Assessment and Safe Working Measures in Collaborative Robotics

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POVZETEK

Postopek ocene tveganja je namenjen zaščiti delavcev v industrijskem okolju. V prispevku sta predstavljena postopka ocene tveganja v sodelovalnih robotskih celicah v primeru uporabe običajnega (industrijskega) robota in robota z omejeno močjo in silo (sodelujočega robota). Celovito opravljen postopek ocene tveganja in ustrezna uporaba zunanjih varnostnih naprav omogočata uvajanje tako sodelujočih, kot tudi industrijskih robotov v sodelovalne robotske aplikacije.

KLJUČNE BESEDE

Ocena tveganja, varnostni standardi, sodelujoči roboti

ABSTRACT

The risk assessment procedure is designed to protect workers in an industrial environment. This paper presents the risk assessment in collaborative robotic cells in the case of a conventional (industrial) robot and a power and force limited robot (collaborative robot). A comprehensive risk assessment procedure and the appropriate use of external safety devices allow the deployment of both collaborative and industrial robots in collaborative robotic applications.

KEYWORDS

Risk Assessment, Safety Standards, Collaborative Robots

1 UVOD

Sodelovanje med človekom in robotom je odgovor na vse večjo potrebo po prilagodljivi proizvodnji. Namen sodelovanja je združitev najboljših lastnosti ljudi in robotov v cilju zmanjševanja stroškov in časa proizvodnje. Z uporabo sodelovalnih aplikacij je mogoče izkoristiti prednosti človeka in robota za izboljšanje učinkovitosti, kakovosti, zmogljivosti, okolja zaposlenih, stroškov in časa proizvodnega cikla. Eno ključnih vprašanj na tem področju je varnost.

Sodelujoči roboti, ki lahko "čutijo" svojo okolico, ustvarjajo revolucijo ne le v svetu industrijske proizvodnje, temveč tudi v varnostnih zahtevah, povezanih z uporabo robotov. Čeprav so tovrstni roboti vse bolj priljubljeni in se tržijo kot varni, to še ne zmanjšuje varnostnih pomislekov, ki so povezani z uvedbo teh robotov v industrijsko okolje.

2 SPLOŠNA VARNOST ROBOTSKIH PROIZVODNIH SISTEMOV

Škoda, ki jo povzroči nesreča v delovnem okolju, ni omejena le na poškodbe delavca, ampak ima tudi finančne posledice v obliki stroškov zavarovanja, izgub v proizvodnji, poškodovanega stroja, izgubljenih kupcev in celo izgube ugleda podjetja.

Kadar je robot v istem okolju kot delavec vedno obstaja določena stopnja tveganja, ki se šteje za sprejemljivo. To raven določajo različni parametri, povezani s stopnjo in verjetnostjo nastanka poškodbe delavca. Način, da ugotovimo, če je potencialna nevarnost presegla sprejemljive varnostne standarde, je izvedba ocene tveganja. Postopek ocene tveganja je sestavljen iz definiranja obsega sistema, ugotavljanja virov tveganja, ocenjevanja in vrednotenja tveganja ter izvedbe postopka zmanjševanja tveganja.

2.1 Varnostni standardi v robotiki

Varnostne standarde lahko opredelimo kot "standarde, ki so zasnovani tako, da zagotavljajo ukrepe, ki so potrebni ali primerni za preprečevanje nesreč in poškodb, pa tudi za zaščito pred izpostavljenostjo nezdravim okoljskim in poklicnim dejavnikom" [1].

Ena od organizacij, ki določa varnostne standarde, je Mednarodna organizacija za standardizacijo (ang. International Organization for Standardization - ISO). Varnostni ISO standardi so sestavljeni tako, da je standard najvišje ravni prva referenca (raven A varnostnih standardov). Z nižanjem ravni standarda (varnostni standardi ravni B in C) pridemo do najbolj specifičnega varnostnega standarda, ki v tem primeru velja za robote ali robotske naprave.

Standard ISO 12100 (raven A) opredeljuje splošna načela, kot sta ocena tveganja in zmanjšanje tveganja za vse vrste strojev. Standard ISO 13849 (raven B) opredeljuje z varnostno povezane dele krmilnih sistemov. Standard ISO 10218 (raven C) pa je napisan za varnost na področju industrijske robotike. Ker je bil prvotni standard ISO 10218 prilagojen za industrijske robote, ta standard ni upošteval posebnosti sodelujočih robotov. Leta 2016

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je odbor Mednarodne organizacije za standardizacijo poleg revidiranih delov standarda ISO 10218 izdal tudi tehnično specifikacijo ISO/TS 15066. Ta tehnična specifikacija se osredotoča na aplikacije sodelujočih robotov in predstavlja smernice za različne meritve hitrosti, sile in pritiska, ki so dovoljene med neposrednim sodelovanjem človeka z robotom.

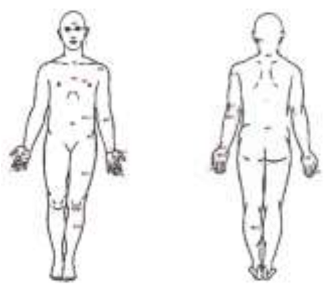
Dejstvo, da je sodelujoči robot certificiran kot varno orodje ne pomeni, da je celotna celica samodejno varna. To pomeni, da mora ocena tveganja zajemati tudi celotno industrijsko delovno mesto, v katerega poleg robota sodijo tudi robotska prijemalka, predmeti manipulacije in ostale potrebne naprave in stroji. Osnova za takšno oceno tveganja so poleg tehnične specifikacije ISO/TS 150066 tudi standardi ISO 10218 (del 1 in 2), standard ISO 12100 in Direktiva o strojih 2006/42/EC.

3 OCENA TVEGANJA V SODELOVALNIH ROBOTSKIH CELICAH

Ko večina ljudi govori o "sodelujočih robotih" (ang. Collaborative Robots) ali kobotih (ang. Cobots), imajo v mislih to, kar ISO/TS 15066 imenuje "roboti z omejeno močjo in silo" (ang. Power and Force Limited Robots) [2]. Roboti z omejeno močjo in silo so posebej zasnovani za skupno delo z ljudmi. Sila in navor se spremljata in v primeru stika se robot ustavi. Sodelujoči roboti so zasnovani tako, da delajo skupaj s človekom, vendar to niso nujno roboti z omejeno močjo in silo. Pri tem se upoštevajo tudi aplikacije, pri katerih z uporabo zunanjih varnostnih naprav ali tehnologij, standardni industrijski robot postane sodelujoči.

Oceno tveganja lahko opredelimo kot proces ugotavljanja, vrednotenja in ocenjevanja ravni tveganja v določeni situaciji, njihove primerjave z merili in standardi ter določanja sprejemljive ravni tveganja [3]. Osnova za oceno tveganja so poleg tehnične specifikacije ISO/TS 150066 tudi standardi ISO 10218 (del 1 in 2), standard ISO 12100 in Direktiva o strojih 2006/42/EC.

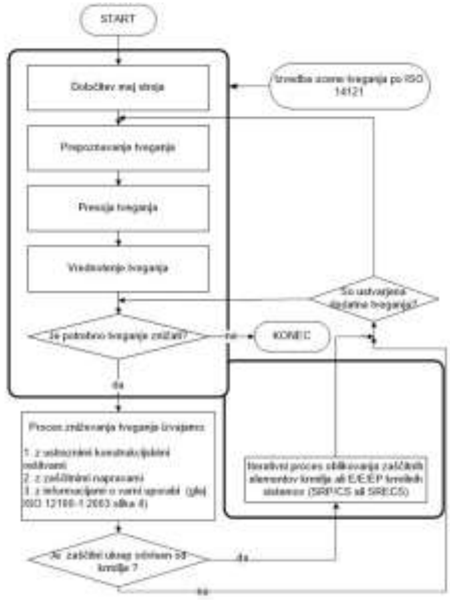
Tehnična specifikacija ISO/TS 15066 določa sodelovalno varnost s podrobnejšimi informacijami o oblikovanju sodelujočega robotskega sistema. Na Univerzi v Mainzu v Nemčiji so testirali tudi biomehanske omejitve človeka, rezultati pa zajemajo omejitve največje sile in pritiska za 29 delov telesa (Slika 1).



Slika 1: Model telesa, vir [4]

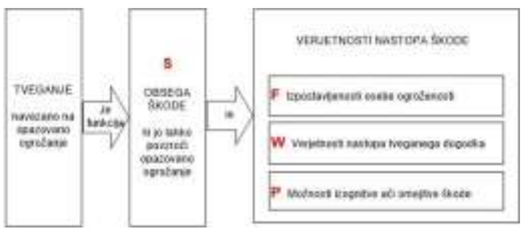
3.1 Postopek ocene tveganja

Da zagotovimo varnost delavcev, moramo pri načrtovanju in integraciji robotske celice upoštevati predpisane ISO standarde s področja robotike. Proizvajalci robotov skozi postopek certificiranja zagotavljajo ustrezno raven varnosti svojih naprav, vendar to še vedno ne pomeni, da je ta varen glede na okolje, v katerem obratuje. Zlasti pri industrijskih aplikacijah je uporaba tako raznolika, da je nemogoče, da bi proizvajalec robotov odobril vsak posamezen postopek. Tu pride na vrsto ocena tveganja, s pomočjo katere ocenjujemo varnost industrijske aplikacije kot celote in ne vsake naprave posebej. Postopek ocene tveganja je prikazan na sliki 2.



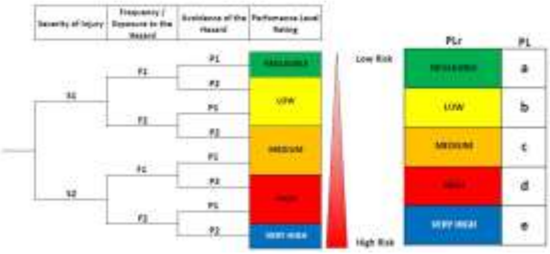
Slika 2: Postopek ocene tveganja, vir [5]

Določitev mej stroja oz. področja uporabe robotskega sistema je opis konteksta uporabe stroja, ki zajema informacije o tipu robotske roke, orodij in ostalih naprav celice. Vse postopke, ki vključujejo kakršno koli nevarnost definiramo v koraku prepoznavanja tveganja. Tako bodo v postopku ocene tveganja analizirani različni gibi robota in ostalih naprav v sistemu pri opravljanju nalog glede na potencialna tveganja. Na podlagi opravljene analize prepoznavanja tveganj je potrebno za vsako prepoznano tveganje določiti stopnjo izpostavljenosti tveganju oz. zahtevani nivo zanesljivosti delovanja varnostnih krmilnih elementov (PLr – ang. performance level rating). Na podlagi standarda ISO 13849-1, ta analiza uporablja tri različne parametre oz. elemente tveganja: resnost poškodb (S – ang. severity), pogostost izpostavljenosti nevarnosti (F – ang. frequency) in možnost izogibanja nevarnosti (P – ang. possibility). Slika 3 prikazuje omenjene elemente tveganja.



Slika 3: Elementi tveganja, vir [5]

Postopek določanja stopnje izpostavljenosti tveganju vsebuje ocenjevanje vsakega od treh parametrov s pomočjo diagrama, ki je prikazan na sliki 4 levo.



Slika 4: Diagram za določanje stopnje izpostavljenosti tveganju in nivoja zanesljivosti, vir [5]

Nivo zanesljivosti delovanja varnostnih krmilnih elementov (PL – ang. performance level) je vrednost, ki se uporablja za opredelitev zanesljivosti z varnostjo povezanih delov krmilnega sistema, da izvajajo varnostno funkcijo v predvidljivih pogojih. Med zahtevanim nivojem zanesljivosti delovanja varnostnih krmilnih elementov (PLr) in nivojem zanesljivosti (PL – ang. performance level) obstaja povezava, ki je prikazana na sliki 4 desno. To pomeni, da če je ocenjena stopnja izpostavljenosti tveganju v celici visoka (PLr = high), moramo zagotoviti, da je nivo zanesljivosti delovanja varnostnih krmilnih elementov enak ali višji od d (v tem primeru d ali e).

V naslednjem koraku postopka ocene tveganja je pomembno, da se zastavi vprašanje: Ali je tveganje sprejemljivo? V večini primerov je zaželeno biti v kategoriji nizkih (ang. low) ali zanemarljivih (ang. negligible) vrednostih tveganja, da se zagotovi varnost delavcev. Če je ocenjena vrednost tveganja v zaželenih kategorijah, potem je postopek ocene tveganja končan. Če ocenjena vrednost tveganja ni v zaželenih kategorijah, so potrebni nadaljnji koraki. Če je tveganje visoko (ang. high) se je potrebno osredotočiti na tveganja in jih zmanjšati ali odpraviti. To pomeni, da je potrebno v robotsko celico vključiti varnostne ukrepe ali opraviti neko konstrukcijsko spremembo, da ta postane varna oz. manj tvegana. Ko se tveganja zmanjšajo, se je potrebno vrniti v postopek ocene tveganj in ponovno dokončati celoten postopek, da se zagotovi, da pravkar zmanjšano tveganje ne bo povzročilo novega tveganja. Ta postopek je ponavljajoč in ga je treba izvesti zelo previdno, pri čemer je treba preučiti in ponovno pretehtati vsako morebitno tveganje.

3.2 Varnostne metode sodelovalnih operacij

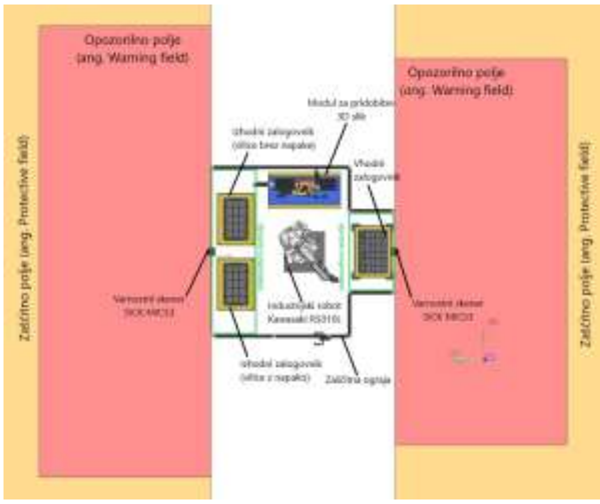
V tehnični specifikaciji ISO/TS 15066 so navedene 4 različne metode za zagotavljanje varnosti med sodelovanjem: varnostno nadzorovano ustavljanje (ang. safety-rated monitored stop), ročno vodenje (ang. hand-guiding), nadzor hitrosti in ločevanja (ang. speed and separation monitoring) ter omejevanje moči in sile (ang. power and force limiting). Metode se lahko uporabljajo ločeno ali pa je rešitev sestavljena iz kombinacije teh metod. Če je robot sodelovalen, to še ne pomeni, da je sodelovalna tudi celotna celica in obratno. Dejansko se lahko za številne sodelovalne aplikacije uporabljajo običajni (industrijski) roboti.

4 OCENA TVEGANJA IN UKREPI ZA VARNO DELO V SODELOVALNI ROBOTSKI CELICI Z INDUSTRIJSKIM ROBOTOM

V prvem primeru izvajanja postopka ocene tveganja je prikazana sodelovalna robotska celica z industrijskim robotom. Predstavljena robotska celica se uporablja v procesu kontrole mehansko obdelanih odkovkov. Zaradi enostavnosti in preglednosti so v nadaljevanju prikazane le osnovne informacije posameznih korakov postopka ocene tveganja.

4.1 Sodelovalna robotska celica z industrijskim robotom – Splošne informacije

Tloris postavitve sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov je prikazan na sliki 5.



Slika 5: Tloris postavitve sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov

Osnovni gradniki sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov so:

- industrijski robot,
- robotsko prijemalo z namensko oblikovanimi prsti,
- vhodni zalogovnik izdelkov, ki je postavljen na natančno določeno pozicijo na vhodni mizi,
- izhodni zalogovnik za izdelke brez napak, ki je postavljen na natančno določeno pozicijo na izhodni mizi,
- izhodni zalogovnik za izdelke z napako, ki je postavljen na natančno določeno pozicijo na izhodni mizi,
- kontrolni modul (3D sistem strojnega vida),
- zaščitna ograja,
- varnostna skenerja.

Zaporedje robotskih operacij v celici poteka po naslednjih korakih:

- robot pobere izdelek iz vhodnega zalogovnika,
- robot nato izdelek premakne do kontrolnega modula, v katerem se opravi kontrola izdelka, robot pri tem opravlja ustrezno pozicioniranje izdelka,
- če se v kontrolnem modulu zazna napaka na izdelku, robot odloži izdelek v zalogovnik za izdelke z napako, v nasprotnem primeru robot odloži izdelek v zalogovnik za izdelke brez napake.

Naloga delavca v sodelovalni robotski celici je ročna zamenjava zalogovnikov v sodelovalnih območjih. V robotski celici obstajata dve sodelovalni področji (obkroženo z zeleno barvo na sliki 5): področje vhodnega zalogovnika in področje izhodnih zalogovnikov. Omenjeni področji sta opredeljeni tudi kot nevarni območji, če se v njiju istočasno nahajata delavec in robot. Zaradi tega se za preprečevanje dostopa do nevarnih območij uporabljajo zaščitna ograja (nepomično varovalo) in varnostna laserska skenerja (varovalne naprave).

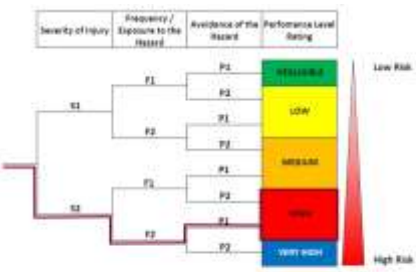
4.2 Opredelitev virov tveganja

V sodelovalni robotski celici za kontrolo mehansko obdelanih odkovkov lahko kot vir tveganja opredelimo možnost, da se delavec hitro približa nevarnemu območju in stopi na pot premikajočemu se robotu, kot je prikazano na sliki 6.

Slika 6: Opredelitev vira tveganja

4.3 Ocena tveganja in merila za vrednotenje

Kot merilo za vrednotenje pri oceni tveganja se lahko uporabi diagram za določanje stopnje izpostavljenosti tveganju iz standarda ISO 13849-1 (Slika 4 levo). Postopek določanja stopnje izpostavljenosti tveganju z uporabo diagrama za določanje stopnje izpostavljenosti tveganju iz standarda ISO 13849-1 je prikazan na sliki 7.



Slika 7: Postopek določanja stopnje izpostavljenosti tveganju

Po opravljenem postopku določanja stopnje izpostavljenosti tveganju je ugotovljena visoka vrednost tveganja. Nivo zahtevane zanesljivosti za opisani primer je d. To pomeni, da se mora v danem primeru opraviti še postopek zmanjševanja tveganja.

4.4 Postopek zmanjševanja tveganja

Za zmanjševanje tveganja se lahko uporabi ukrep b iz poglavja 4.3.4 standarda ISO/TS 15066, ki se glasi: »Zaščitni ukrepi, ki preprečujejo dostop osebja do nevarnih območij ali nadzorujejo nevarnosti tako, da jih omejijo do nivoja sprejemljivega tveganja (npr. zaustavitev, omejitev sil, omejitev hitrosti ipd.) preden je delavec izpostavljen nevarnosti«. Da lahko dosežemo zahtevani nivo sprejemljivega tveganja je treba izračunati čas ustavitve sistema in vrednost varnostne razdalje opozorilnih območij varnostnih skenerjev.

V obravnavanem primeru čas ustavitve sistema znaša 0,66 s, kar vpliva na vrednost varnostne razdalje, ki znaša 2551mm.

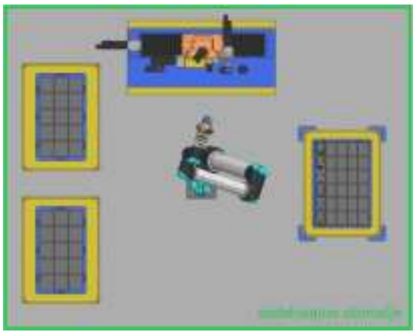
Na podlagi opravljene analize sklepamo, da lahko varnostni laserski skener MISC3 proizvajalca SICK (PL d) [6] uporabimo za preprečevanje hitrega približevanja nevarnemu območju celice, saj najdaljša razdalja zaznavanja zaščitnega polja znaša 9 m.

5 OCENA TVEGANJA IN UKREPI ZA VARNO DELO V SODELOVALNI ROBOTSKI CELICI S SODELUJOČIM ROBOTOM

V drugem primeru izvajanja postopka ocene tveganja je prikazana sodelovalna robotska celica s sodelujočim robotom. Namen uporabe te robotske celice je enak kot v prvem primeru.

5.1 Sodelovalna robotska celica s sodelujočim robotom – Splošne informacije

Tloris postavitve sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov je prikazan na sliki 8.



Slika 8: Tloris postavitve sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov

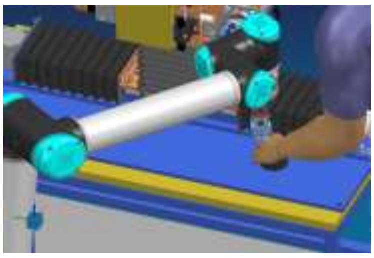
Osnovni gradniki sodelovalne robotske celice za kontrolo mehansko obdelanih odkovkov so:

- sodelujoči robot,
- robotsko prijemalo z namensko oblikovanimi prsti,
- vhodni zalogovnik izdelkov, ki je postavljen na natančno določeno pozicijo na vhodni mizi,
- izhodni zalogovnik za izdelke brez napak, ki je postavljen na natančno določeno pozicijo na izhodni mizi,
- izhodni zalogovnik za izdelke z napako, ki je postavljen na natančno določeno pozicijo na izhodni mizi,
- kontrolni modul (3D sistem strojnega vida).

Zaporedje robotskih operacij je podobno kot v prvem primeru. Naloga delavca ostaja enaka kot v prvem primeru. Za razliko od prvega primera je sedaj celotno delovno območje robotske celice opredeljeno kod sodelovalno območje. To je doseženo zaradi integracije robota z omejeno silo in močjo v robotsko celico. V danem primeru ni več posebno opredeljenih nevarnih območij, za katera bi bilo treba implementirati dodatne ukrepe za preprečevanje dostopa delavca. To še vedno ne pomeni, da je robotska celica varna. Tudi v tem primeru je potrebno opraviti postopek ocene tveganja. Zaradi enostavnosti in preglednosti so v nadaljevanju prikazane le osnovne informacije posameznih korakov postopka ocene tveganja.

5.2 Opredelitev virov tveganja

V sodelovalni robotski celici za kontrolo mehansko obdelanih odkovkov lahko kot vir tveganja opredelimo možnost, da delavec nehote postavi roko na pot premikajočemu se robotu v operaciji odlaganja vilic na podstavek, kot je prikazano na sliki 9. Takšno tveganje lahko povzroči kvazistatični udarec ali zdrobitev.

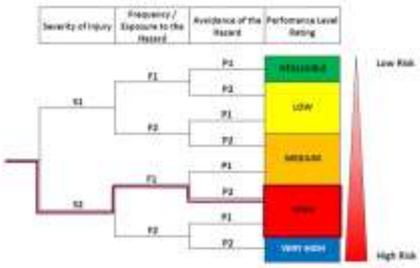


Slika 9: Opredelitev vira tveganja

5.3 Ocena tveganja in merila za vrednotenje

Za izvedbo naloge preprijemanja izdelka mora robot najprej odložiti izdelek na podstavek na mizi. Pri tej operaciji robot deluje s hitrostjo 2000 mm/s in ima največjo omejeno silo 250 N. Spodnja površina izdelka znaša 2,15 cm^2, kar lahko ustvari pritisk 116 N/cm^2. Za razliko od sile, pritisk pri tej nalogi ni omejujoči dejavnik. Ker je sila od 250 N za 80 % višja od mejne vrednosti (140 N), določene v tehnični specifikaciji ISO/TS 15066, domnevamo, da lahko v tem primeru pride do poškodb zaradi prevelike sile.

Kot merilo za vrednotenje pri oceni tveganja se lahko uporabi diagram za določanje stopnje izpostavljenosti tveganju iz standarda ISO 13849-1 (Slika 4 levo). Postopek določanja stopnje izpostavljenosti tveganju z uporabo diagrama za določanje stopnje izpostavljenosti tveganju iz standarda ISO 13849-1 je prikazan na sliki 10.

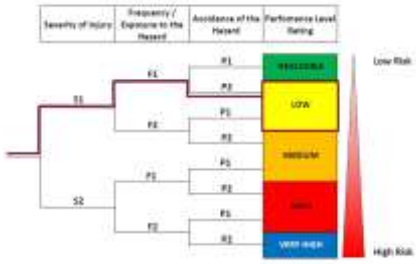


Slika 10: Postopek določanja stopnje izpostavljenosti tveganju

Po opravljenem postopku določanja stopnje izpostavljenosti tveganju je ugotovljena visoka vrednost tveganja. To pomeni, da se mora v danem primeru opraviti še postopek zmanjševanja tveganja.

5.4 Postopek zmanjševanja tveganja

Da lahko dosežemo zahtevani nivo sprejemljivega tveganja je treba zmanjšati največjo silo, ki jo uporablja robot. To silo lahko zmanjšamo na 140 N, kar bo znižalo stopnje izpostavljenosti tveganju (Slika 11).



Slika 11: Postopek določanja stopnje izpostavljenosti tveganju

6 ZAKLJUČEK

Postopek ocene tveganja je namenjen zaščiti delavcev, ki uporabljajo industrijske stroje. V primeru sodelovalne robotike se ocena tveganja izvaja za zagotovitev varnosti delavcev med izvajanjem sodelovalnih operacij v celotni robotski celici, v katero poleg robota sodijo tudi robotska prijemalka, predmeti manipulacije in ostale potrebne naprave in stroji. Ne glede na dejstvo, da proizvajalci sodelujočih robotov zagotavljajo varnostne zahteve za svoje naprave (PL=d), je še vedno potrebno opraviti postopek ocene tveganja z upoštevanjem specifičnih pogojev uporabe robota v delovnem okolju celice.

ZAHVALA

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Detection of Scratches on the Surface of Metallic Objects

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ABSTRACT

With today's manufacturing throughput in mind, a fast and accurate quality control stage is of extreme importance. This is why manufacturers are increasingly interested in using machines and artificial intelligence to streamline their quality control processes. In this paper, we explore the possibility of building a pipeline based on the use of line scanners, which produce 3D point clouds of objects with great detail, to detect scratches on their metallic surfaces. More specifically, we leverage a small sample base to establish the basic features of scratches and then use these principles to build a larger artificial set of examples. Finally, we train a classifier using the artificial examples and evaluate its performance on the few real-life objects which we were able to obtain.

KEYWORDS

quality control, scratch detection, point clouds

1 INTRODUCTION

Consumers rarely observe the manufacturing process of the items they use, but they are usually able to notice when there is a defect in the product. These defects can be limited to cosmetic damage, however, they can also result in very significant malfunctions. In contemporary manufacturing processes, unanticipated errors occur more frequently than most people realize, which can be a significant cost for the company if the error is not spotted early enough. This is the reason why quality control (real-time defect detection) is an important part of modern manufacturing. Currently, quality assessment is executed by human operators [3]. Even though people can generally perform these tasks better than machines, they are much slower. In addition, human operators require capabilities and skills that usually take a long time to acquire, which is why they are hard to find and maintain in the industry. In some applications, the quality assessment can be critical and dangerous. This is especially true in the automotive industry which is at the heart of this study and for which we develop a quality control pipeline. All of the reasons mentioned above are why automatic methods for quality control in the industry have received great interest in recent years [4][1]. Moreover, industrial adoption of artificial intelligence (AI) is becoming more and more feasible [5], mainly thanks to the significant progress in hardware computational resources. However, despite this, AI hasn't been fully adopted in the quality control processes in many industries. This paper aims to develop such a solution, which would utilize AI for quality control in the automotive industry, more specifically, the detection of scratches on the surface of metallic objects.

2 PROBLEM DEFINITION

One of the goals of the ROBKONCEL project is to produce quality control pipelines for specific components produced by the company Unior. These pipelines have the goal of detecting several different imperfections, either on the surface of objects or in their dimensions. The components in question are manufactured for the needs of several different automobile makers and as such are subject to extensive quality control measures. An example of one such object can be seen in Figure 1. The goal of the quality control pipeline which will be presented in this paper is to detect scratches on one of the highly polished parts of the objects. The system does not have to locate the detected scratches, but rather just sort the objects based on whether or not they possess a scratch. In the past, we have explored the implementation of such a quality control system based on computer vision and vibrations, but those pipelines have not been able to produce adequate results [2]. In this study, we explore the possibility of using a line scanner to create a point cloud of the objects and run our analysis on that data. This also plays nicely with the fact that point clouds can also be used to measure the dimensions of the objects with a high degree of accuracy.

3 DATA COLLECTION

To solve the problem of detecting very thin scratches on a polished surface with additional artefacts, we decided to explore the option of creating high definition 3D scans of the objects using a line scanner. The scanner in question is the LMI Gocator 2330 which has a resolution of 0.044mm in the X direction and 0.006mm in the Z direction. An image of the scanner and the axes can be seen in Figure 2. To create the point clouds, the scanner was attached to a rail above the object being scanned and was moved along an axis which is perpendicular to the X and Z-axis shown in Figure 2.

Because this type of error does not occur very often, at the time of development we had access to only four objects which contained a scratch on their polished cylindrical area and thus we were able to produce only four point clouds on which a scratch

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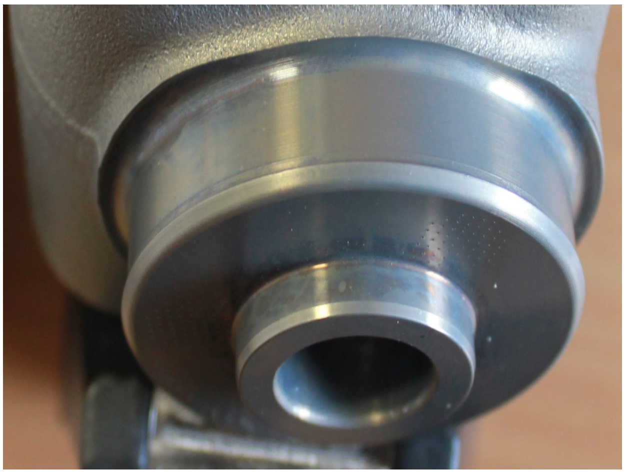

Figure 1: The object whose cylindrical polished surface we must examine for scratches

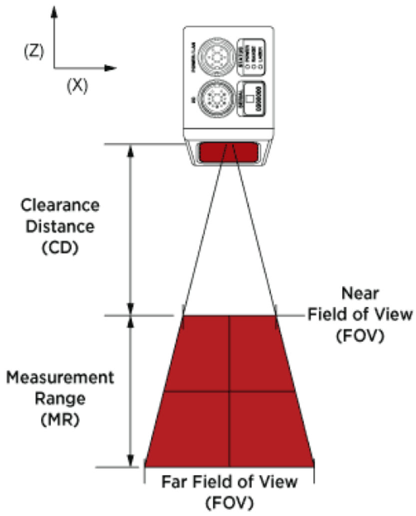

Figure 2: A diagram of the line scanner used to gather the point clouds.

was visible. In addition to this, we also scanned the surfaces of four other objects which did not contain a scratch. The point clouds for the four objects which contained a scratch can be seen in Figure 3. In the images, the color of each point represents the reflectance value that the sensor measured at that place and ranges from blue, which represents a low reflectance value, to red, which represents high reflectance values.

As we can see from the point clouds on Figure 3, the scratches are irregular and sometimes very complex in shape. Scratches, however, are always characterized by missing points as well as a change in the value of the reflectance. The number of missing points seems to increase as we approach the scratch centre line. Another important feature of a scratch that we noticed is that the width of the scratch is not constant along the entire length, that is, the scratch can be wider in one place compared to another. Finally, the reflectance values seem to be decreasing as we move from the area surrounding the scratch and towards the centre line. As was pointed out to us by Unior, in the real world, the width of the scratches ranges between 0.15mm and 2mm.

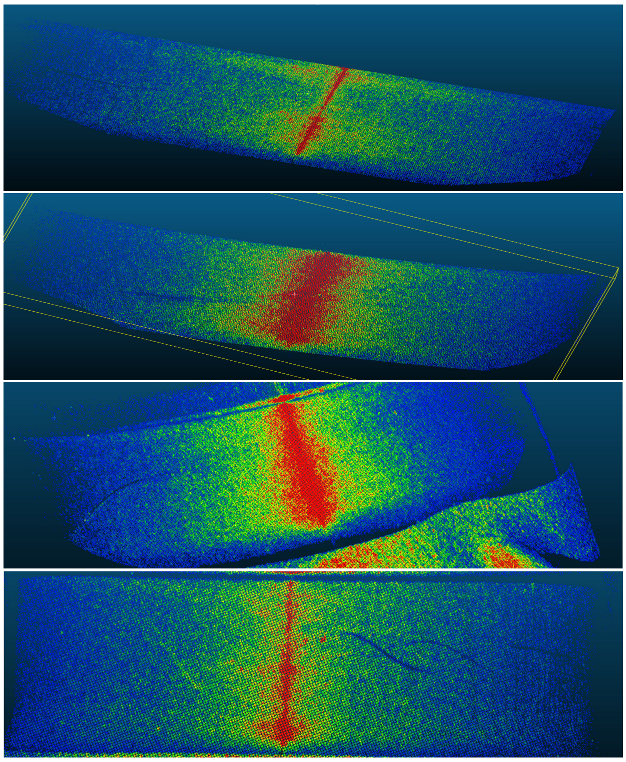

Figure 3: A visualization of several point clouds which show real-life objects with a visible scratch on their metallic surface.

3.1 Data generation

To perform any meaningful evaluation of our methods, we need to be able to have a set of point clouds on which we would tune the parameters of our algorithms and a separate set of point clouds on which we would test their accuracy. However, splitting the eight point clouds into two subsets would not yield satisfactory results. To this end, we opted to create tens of artificial examples that we would use to substantiate and evaluate our methods. The first step in generating each artificial point cloud is to select one of the previously mentioned point clouds without a scratch, to which we will later add a randomly generated imperfection. The next step is to add random noise to the point cloud. This is done by moving each of the points by a maximum of 0.001mm in any direction. Adding random noise allows us to always end up with a base that has not been previously used. At this stage, we have generated a surface that has not been previously seen and can be used as an artificially generated (part of an) object which does not contain a scratch. Finally, if we want to generate a surface with a scratch the following algorithm is used:

(1) Choose two points on the generated surface. The line between those points will be the one which passes through the center of the scratch.
(2) Choose a point on that line which will represent the place where the scratch will be widest.
(3) Mark all points inside the circle defined with the center line as its diameter as potentially affected points.
(4) Iterate through the potentially affected points and remove those points using some probability. The probability of removing a point is based on the distance between the point and the line from step (1) as well if the point is

part of a circle defined around the point chosen in step (2). Points which are closer to the center line and which belong in the circle have a higher probability of being removed, while that probability decreases as they move away from the center line and towards the edges of the circle. The radius of the circle is chosen randomly for each scratch and ranges between 0.15mm and 2mm.

(5) Iterate through all potentially affected points which were not removed in the previous step and lower their reflectance value using the same rule as the one for the probability of removal in step (4).

Figure 4 shows a few examples of artificially generated surfaces with scratches. In total, 226 examples without a scratch and 214 examples with a scratch were generated.

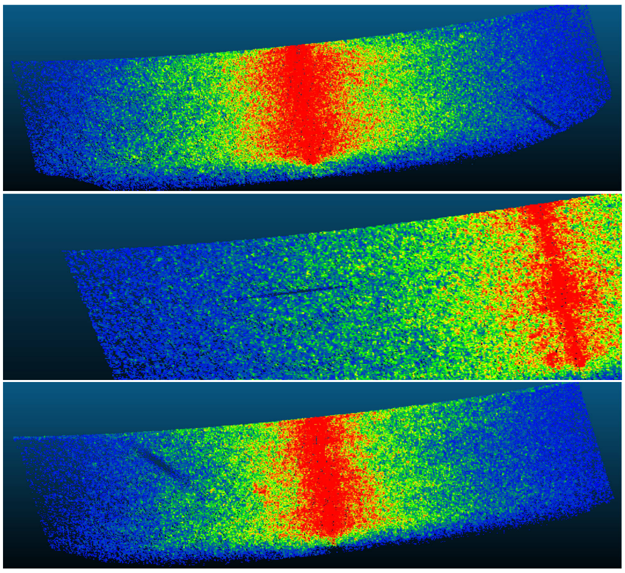

Figure 4: A visualization of several point clouds which show artificially generated surfaces with a visible scratch on their metallic surface.

4 METHOD

Our method rests upon one of the features of scratches mentioned in Section 3, specifically the fact that scratches are always represented by an area with missing points. The first step of our method, is to reduce the dimensionality of the problem by removing the Z-axis information of the point clouds. This creates a 2D representation that can be viewed and processed as an image. In fact, the Z-axis information is not completely lost and is used as the brightness of the pixels in the images. This allows us to work with previously used and extensively tested tools compared to the ones used for 3D data analysis.

The second step, after reducing the dimensionality, is to select the area in which we will perform our analysis. The 2D representation of a surface, along with the area which is selected for analysis, can be seen on Figure 5. We avoid the edges of each scan, because of the sparseness of points in those areas, which do not point to a scratch but rather to an intrinsic property of the scanning process.

The third step is to use a median filter on this image with a 3x3 kernel which smoothes the image and removes the parabolic lines visible on the surface, which are not scratches and are not actually on the object but are only the result of the scanning process. Next, we make a binary image using a threshold at a value of 60.

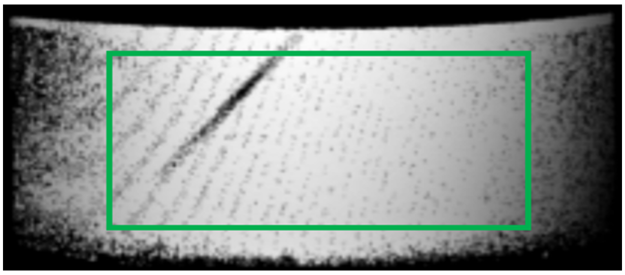

Figure 5: A 2D representation of a point cloud, with the Z-axis information coded as pixel brightness. The area of interest is the one in the green rectangle.

To decide on whether the selected area contains a scratch or not, we compare the image to an image of an error-free surface using a metric called the “structural similarity index”, which returns a value between 0 and 1.

Finally, using the structural similarity index as the only feature, we use a random forest classifier to differentiate between objects with and without a scratch. The training of this classifier is explained in the next section.

5 RESULTS

The training of the above-mentioned classifier, which uses the structural similarity index as the only feature is done primarily using artificially generated surfaces with and without an error.

In our first experiment, which deals with scratches whose width ranges between 0.5 and 2mm (higher end of the range), the classifier is trained and evaluated using 94 artificially generated surfaces without a scratch and 76 surfaces with a scratch. Half of the examples in each category are taken as a training set and the other half is used to evaluate the performance of the classifier. The confusion matrix for this experiment is shown in Table 1. As we can see, the classifier achieves a perfect score.

Table 1: A confusion matrix for the system when testing on artificial errors whose width ranges between 0.5 and 2mm.

True \ Predicted	No error	With error
No error	47	0
With error	0	38

In our second experiment we expand the range of scratch widths and they can now range between 0.15mm and 2mm. This experiment includes all of the artificial surfaces used in the previous experiment as well as 132 new surfaces without an error and 138 surfaces with an error. The scratch width of these new surfaces ranges between 0.15mm and 0.5mm. This new set of artificially generated surfaces brings the grand total to 440 (226 without a scratch and 214 with a scratch). As in the previous experiment, half of the examples from each category were used for training and half for evaluation. The confusion matrix of the classifier on the extended set can be seen in Table 2.

Table 2: A confusion matrix for the system when testing on artificial errors whose width ranges between 0.15 and 2mm

True \ Predicted	No error	With error
No error	113	0
With error	1	106

In our final evaluation, the classifier was trained using all artificial surfaces and its performance was tested on the eight point clouds which were created by scanning real-life objects. The classifier achieved a perfect score.

6 CONCLUSIONS

In this paper, we presented a methodology for detecting scratches on the surface of metallic objects by analysing their point clouds created using a line scanner. Based on our results, it seems that generating random artificial examples of the surfaces in question and using them to train a classifier is beneficial and produces adequate results. Based on the accuracy of the classifier alone it also seems that our pipeline is more than adequate for use as a tool in quality control processes. However, the method has one significant drawback in the time it takes to properly scan objects. It is our opinion that this time might be significant (especially if objects are large or need to be scanned from several angles) and cannot be overlooked, especially when the production throughput is high.

ACKNOWLEDGMENTS

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Infodemija: Etični vidik informiranja o COVID-19

Infodemia: Ethical Aspect of Informing About COVID-19

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POVZETEK

Infodemija je spremljajoč pojav pandemije COVID-19, ko se prvič v zgodovini pretežni del informacij pretaka po digitalnih omrežjih. Še bolj kot v dobi tiska se kažejo podobnosti med širjenjem infekcij in informacij, kar lahko pomaga pri njegovem razumevanju in upravljanju. Soočeni smo z neobvladljivim obsegom in hitrostjo širjenja lažnih novic, zmotnih, zavajajočih in zlonamernih informacij, ki zaznamujejo dobo post-resničnosti in post-žurnalizma. Pri iskanju poti do zaupanja vrednih informacij je treba upoštevati čustvene, epistemološke, pravne in etične kontekste in obnoviti sisteme ter orodja za evalvacijo kakovosti informacij. EU je za ta namen razvila izpopolnjene strategije upravljanja z zdravstvenimi informcijami ter izostrila etični kodeks boja z dezinformacijami.

KLJUČNE BESEDE

infodemija, infekcijski-informacijski processi, lažne novice, zmotne informacije, zavajajoče informacije, zlonamerne informacije, informacijski konteksti, EU kodeks ravnanja z dezinformacijami

ABSTRACT

The infodemic is an accompanying occurrence to the COVID-19 pandemic, as for the first time in history, the majority of information is travelling through digital networks. Even more so than in the times of print, there are similarities between spreading infection and information, which can help us understand and manage it. We are faced with an unmanageable amount and speed of spreading fake news, misinformation, misleading information and mal-information, which are shaping the era of post-reality and post-journalism. When searching for a way towards trustworthy information, emotional, epistemological, legal, and ethical contexts must be considered and the systems and tools for evaluating information quality must be renewed. For this purpose, the European Union developed improved strategies for managing medical information and tightened the code of ethics for the fight against misinformation.

KEYWORDS

infodemic, infection-information processes, fake news, misinformations, disinformation, mal-information, informational contexts, EU Code of Practice on Disinformation

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1 INFORMIRANJE KOT NALEZLJIVA BOLEZEN

COVID-19 je prva pandemija v zgodovini, pri kateri ima veliko vlogo informacijska tehnologija. Njene zmogljivosti naj bi prispevale k utrjevanju občutka varnosti, obveščenosti in povezanosti, toda soočili smo se z njenim nasprotnim delovanjem, ko spodkopava in ogroža ukrepanje za obvladovanje pandemije. Že 20. februarja 2020 je generalni director WHO Ghebreyesus na Minhenski varnostni konferenci opozoril: “Ne borimo se zgolj z epidemijo, borimo se z infodemijo!” [1]

Sledeč Williamu Goffmanu [2], smo že pred desetletjem pisali o pojavu, da se posebej v spletnem okolju informacije širijo kot nalezljive bolezni. [3] Posamezniki, izpostavljeni epidemiji, so bodisi imuni na nalezljivo bolezen bodisi se lahko okužijo ob stiku z gostiteljem bolezni ali vektorjem. Enako je s širjenjem religijskih idej ali znanstvenih konceptov itd... [4]

Odkritje podobnosti med infekcijskim in informacijskim procesom je pripomoglo k lažjemu razumevanju narave informacij, danes pa lahko informacijska znanost vrne uslugo in z informacijskimi modeli omogoči “jasnejšo predstavo o socialnih vidikih prenosa infekcijskih bolezni.” [5] Končno so infekcijske bolezni označene kot komunikabilne bolezni in prepoznan process inficiranja je identičen krožnemu prenosu informiranja: inficiran agent → dovzeten gostitelj → vstop → modus prenosa → izstop → zbiralnik. [6] Slabo je, če ljudje epidemijo dojemajo kot vreme in s strahom čakajo poročila, ali bo jutri dež ali sonce, namesto da bi zavzeli aktivno pozicijo kot je običajna v družbeni komunikaciji in jo danes IKT omogoča in podpira v neprimerljivo večji meri kot kdajkoli doslej. Problem pa nastane, če je družbeno informiranje moteno in je IKT zlorabljena kot v znanem škandalu Cambridge Analytica ob ameriških volitvah 2016.

Širjenje informacij kot nalezljive bolezni je splošni zakon, ki ga uporabljajo tudi v politični in ideološki sferi, in sicer za propagiranje svojih partikularnih interesov pod pretvezo skrbi za splošno dobro. Epidemijo bolezni je treba brezpogojno preprečiti, pri epidemiji političnih informacij pa se ravna drugače: krepi se zgolj imunost do alternativnih političnih idej, da bi se obdržala vladajoča struja in njena družbeno-gospodarska formacija. Nosilci alternativnih ideologij v sodobni globalni neoliberalni partitokratski družbi so prvenstveno marginalizirane družbene skupine ter kritična inteligenca in enako kot z virusom, je treba obračunati tudi z njimi. V času epidemije je najbolje to storiti kar obenem in v infodemijah se obe tendenci razvidno prepletata.

Informacijska obolelost se navzven prikazuje kot informacijsko onesnaženje t. j. hiperprodukcija in preobilica informacij. Informacij naj bi bilo preveč, kar je absurd, saj znanja nikoli ni dovolj. V resnici gre za etični vidik in za zlorabo informacijske tehnoloije. Informacijsko onesnaževanje ja lahko zavestno delovanje, podobno hekerstvu in širjenju računalniških virusov z namenom povzročanja škode. To je dejansko ozadje lažnih novic, napačnih informacij, zavajajočih informacij, zlonamernih informacij, sovražnega govora ipd.

2 ZNAČILNOSTI INFODEMIJE

Infodemologija kot veda o determinantah in distribuciji zdravstvenih informacij je znana že nekaj časa in je prisotna v študijskih programih nekaterih medicinskih fakultet, infodemija pa pomeni ekscesno količino nepresejanih informacij, ki zaradi neobvladljivega obsega in hitrosti njihovega širjenja ogroža družbo. Chris Zielinski [7] ugotavlja naslednje značilnosti infodemije: glede obsega informacij je nemogoče izslediti lokacijo izvora, ni jih mogoče v celoti zbrati in hraniti, težko je identificirati njihovo kakovost, njihov vpliv je nepregleden, težko je razkrinkati lažne novice; zaradi hitrosti objavljanja jih ni mogoče sproti analizirati, ni časa za njihovo izpodbijanje, nemogoče je vse korigirati, težko je slediti njihovemu toku in skratka ni mogoče zaustaviti snežne kepe. Tri milijarde uporabnikov spleta hlepi po informacijah in pripravljeni so klikniti prav vse, kar jim ponuja zaslon, za operaterje pa je to denar – infosfera je padla na najnižje veje etičnosti svojega poslanstva in je ključni generator infodemije. [8]

Upravljanje z informacijami o COVID-19 je praktično zatajilo in jih nikjer ne uspevajo sortirati, klasificirati, pregledati in pretehtati, niti prilagoditi različnim avditorijem in odločevalcem. Čeprav so se glede tega s skupnim pozivom oglasile vse poklicane multilateralne organizacije (WHO, ZN, UNICEF, UNDP, UNESCO, UNAIDS, ITU, IFRC itd.), to ni pomagalo. V mesecu maju 2021 so bile sprejete obširne Smernice Evropske komisije za podkrepitev Kodeksa ravnanja z dezinformacijami iz leta 2018, ki ga je bilo treba po izbruhu COVID-19 konkretizirati in spodbuditi podpisnike (med njmi so Facebook, Google, Twitter, Mozila in TikTok) k doslednejšemu ukrepanju. [9]

Formighieri Giordani s sodelavci [10] opredeljuje naslednje značilne pojave infodemije:

- *lažne novice (fake news),* ki so običajno neavtorizirane in imajo namen prevare, pojavljajo pa se kot satire, parodije, fabrikacije, manipulacije, propaganda, reklama, lahko tudi kot irelevantne vesti;
- *zmotne informacije (misinformation),* ki so nenamerne, napačno razumljene ali tolmačene informacije, v katere njihov razširjevalec bolj ali manj trdno verjame;
- *zavajajoče informacije (disinformation),* namerno napačne, da bi nekomu povzročile škodo in ga prizadele ali povzročile splošno zmedo, pogosto podložene še s teorijami zarote;
- *zlonamerne informacije (mal-information),* namerno potvorjene in neposredno kot orožje naperjene na posameznike ali manjšine, tipična pa sta sovražni govor in rasizem.

Vprašanje je, kako te goljufive vsebine pridobijo legitimnost pri masah, kako postanejo njeno prepričanje, zakaj se resnica ne veže več na objektivna dejstva? Očitno standardi in kriteriji v sodobnih kominkacijskih procesih, ki naj bi odločali o kredibilnosti, niso več isti kot prej. Reference tradicionalnih medijev so v času post-resničnosti izhlapele in javnost brez razmišljanja sprejema post-žurnalizem in post-faktičnost. Porazdelila se je v algoritemsko tvorjene mnenjske mehurčke, od katerih ima vsak svojo resničnost, podprto s filtriranimi dejstvi. Kar je za enega resnica, je za drugega laž. Mehanizem te transformacije je začel razkrivati Jűrgen Habermas že v šestdesetih, ko je pojasnil razmerje med javnim mnenjem in družbenim prostorom, v katerem je možna kritika, obramba lastnih idej, reflektiranje lastnega položaja v svetu ter avtonomno odločanje. Nenadomestljivo vlogo pri oblikovanju javnega mnenja imajo mediji. [11] Če jim je sprva ustrezala ohlapnejša uredniška odgovornost in so se radi prelevili v "rumeni tisk", ob tem pa še izkoristili mnogo lagodnejše digitalne informacijske tehnologije, so kmalu ugotovili, da so jih te "izboljšave" požrle. Namesto, da bi formirali javno mnenje, so se začeli ozirati po dominantnih mnenjskih mehurčkih, pripravljeni vstopiti v njihovo službo. S to naravnanostjo, ne morejo odigrati pametne vloge v spoprijemu z infodemijo.

3 POT DO ZAUPANJA VREDNIH INFORMACIJ

Lavinia Marin ugotavlja, da pri infodemiji COVID-19 ne pomaga še tako skrbno (in takointako neizvedljivo) popravljanje podatkov, saj jih večina ne razume, pač pa iščejo pojasnila o smiselnosti ukrepov proti pandemiji, ki jih potem iščejo pri povsem nekompetentnih virih. In še: "Eden od najbolj problematičnih vidikov infodemije je, da ustvarja preobilje informacij, ki povzroča informacijsko zasičenost in utrujenost uporabnikov: njihova kapaciteta pozornosti je omejena in se hitro izčrpa." [12]

Zavedati se moramo informacijskega konteksta, v katerem se spoprijemamo z infodemijo in zanj je značilno, da je emocionalno inteziven, da teži k normativizmu, da pa je epistemološko krhek. Ponudniki informacij to dobro vedo in večino sporočil rekontekstualizirajo na način, prilagojen omenjenim značilnostim, zato informacije razvlečejo, skrivijo ali predelajo, neredko povsem na novo sfabricirajo.

Manipuliranje čustev ima že ustaljeno strokovno ime "empatična optimizacija", razpolaga s celim spektrom preizkušenih orodij in Facebook je v primeru COVID-19 dodal le še nekaj emotikonov. Normativistična preokupacija je povezana z dokazovanjem, da je "naša" država naredila več kot "druge" in potem se opisi razglašajo za predpise in raziskovalne hipoteze o aerosolih za osnovo kaznovanja tekačev po parkih, jasno pa je tudi, da je nacionalni pravni okvir nezadosten in so potrebni mednarodni dogovori. Epistemološke težave izhajajo že iz tega, da družbena omrežja niso narejena za razširjanje znanja, ampak za klepet in zabavo, pri COVID-19 pa so postala za večino glavni vir zdravstvenih informacij, ki jih večinoma ne razumejo, jih pa na veliko delijo z drugimi. Vsak si najde svojega "eksperta" ali pa kar pri samem sebi nenadoma odkrije tako zmožnost.

S kakovostjo informiranja o COVID-19 nima problemov le laično, ampak tudi strokovno obveščanje. Recenzijski postopki in drugi načini evalviranja kakovosti zdravstvenih informacij beležijo resne zdrse. *HONcode* (Health on the Net Foundation

Code of Conduct), certificira spletne strani na podlagi 8 točk etičnega kodeksa: ugleda, celovitosti, zaupanja, pravičnosti, prispevanja, transparentnosti, finančne neodvisnosti in politike reklamiranja. Od vzorca 110 spletnih strani, ki so 2/2 2020. obravnavale "koronavirus", bi le dve dobili etični certifikat. *JAMA Benchmarks* vrednoti avtorstvo, vsebinski prispevek, finančno neodvisnost in pravočasnost. Le 10 % istih spletnih strani o koronavirusu je ustrezalo vsem štirim kriterijem, 40 % pa ni izpolnjevalo niti enega. *Google rank*, ki algoritemsko izračunava hierarhično pozicijo spletne strani, je le dvema priznal mesto med prvimi desetimi. *Webside Categorization* je med 110 spletnimi stranmi, ki so obravnavale koronavirus le 2 prepoznal kot "medicinski". [13]

Pri HONcode se je po poročanju Zielinskega (isti vir) zgodilo še nekaj hujšega, da se je vanj vtihotapilo ok. 200 proticepilskih spletni strani, kar je ogrozilo celotno shemo in razvrednotilo njen etični kodeks – temu se reče onesnaženje lastnega gnezda. Kontaminiranih je 8.000 spletnih strani, ki so po letu 1995 prejele certifikat HONcode. WHO je znova pred problemom, kako zagotoviti domeno najvišje ravni (TLD – top level domain), ki bi zagotavljala verodostojne zdravstvene informacije in bi bila vredna zaupanja. Zdravstveni in farmacevtski kapital bo naredil vse, da do take nepodkupljive domene ne pride.

V informacijski zmedi glede COVID-19 sta se izoblikovala dva pola: znanstveni in oporečniški. Znanstvena stran se trudi vzpostaviti konsenz znotraj znanstvene skupnosti in zagotoviti neoporečnost informacijskih virov na podlagi načel transparentnosti, reproduktibilnosti in kontrolibilnosti dognanj. Opredeljen je klinični sprekter bolezni, vključno s prevencijo. Oporečniška stran pa se navezuje na neresnične informacije in na teorije zarote. Zanika vse, kar odkriva znanost, COVID-19 je zanjo običajna gripa, kar ne opravičuje ukrepov kot so maske, omejitev gibanja, zapiranje fitnesov, prazne nogometne stadione itd.. Zagovarja pa vse mogoče pripravke za "zgodnjo zaščito", tudi gospodinjska čistilna sredstva in kot povzema Zielinski, je bilo zabeleženih 5.800 hospitalizacij na tej osnovi ter najmanj 800 smrti. Oporečniška fronta je široka, saj vključuje številna retrogradna gibanja, ki zagovarjajo ploščatost zemlje, splošni antiintelektualizem, so aktivni anti-semiti in zanikajo holokavst, se identificirajo za neofašiste, svarijo pred večkulturnostjo in so zagrizeni proticepilci. Kriza legitimnosti oblasti, poglabljanje nezaupanja, zavračanje meritokracije, razkroj javnih sistemov in institucij že dlje časa odpirajo prostore za takšne retrogradne procese, zato ni mogoče govoriti o kakšnem presenečenju.

Za predinternetne medije je samoumevno, da morajo prevzeti pravno in moralno odgovornost za vsebine, ki jih objavljajo. Pri internetu take odgovornosti ni več, ker pravo raje gleda stran ali pa odgovornost opredeljuje zelo približno. Ameriški Communication Decency Act (1966) izrecno navaja (razdelek 230), da niti ponudnik niti uporabnik internetne storitve nista ne izdajatelj, ne prednašalec informacije, tudi ko gre za zlonamerno laganje. V Nemčiji kličejo na odgovornost posredovalce sovražnega govora, ki ga je treba v 24 urah odstraniti, toda le v primerih digitalnih platform z več kot 2 milijona uprabnikov. Leta 2018 je EU sprejela Kodeks ravnanja z dezinformacijami, ki obvezuje naslovnike, da nadzirajo pojavljanje lažnih novic online. Med drugim je prepovedano financiranje spletnih strani, ki zavestno delijo lažne, senzacionalistične ali zarotniške informacije na način, da nadzorujejo lažne račune, jamčijo uporabnikom transparetnost, označujejo politična propagandna sporočila, omogočajo uporabnikom dostop do kvalitetnih virov itd.. Kodeks EU ne priporoča arbitrarnega umikanja potencialno zavajajočih informacij, če ne vsebujejo sovražnega govora, ne kršijo zakonskih predpisov in nimajo značaja prevare. Vendar tudi EU nudi "popuste" za ponudnike e-storitev, ki imajo manj kot milijon dostopov mesečno v zadnjih dveh letih, ali manj kot 25 milijonov evrov letnih prihodkov – noben problem za prilagoditev konfiguracije firm s slabimi nameni.

Infodemija kot sinonim poplave zmotnih informacij in lažnih vsebin postane veliko tveganje, ko zajame nazore o zdravju, o preventivnem ravnanju in o javnem zdravstvu. Posledice so smrtne in družbo nepreklicno potiskajo v vseobsegajočo krizo. Protislovno čvekanje po družbenih mrežah ruši vsakršno zdravstveno doktrino in z razvrednotenjem znanja in znanosti napoveduje distopijo tragičnih razsežnosti.

Ob nedorečenosti slovenske strategije spopada z infodemijo, preostane trdnejša naslonitev na EU in njeno strategijo boja z dezinformacijami. [14] "Kriza zaradi COVID-19 je pokazala ključno vlogo svobodnih in neodvisnih medijev kot bistvene storitve, saj državljanom zagotavljajo zanesljive in preverjene informacije, ki prispevajo k reševanju življenj" (str.11). Vzpostavljena je EDMO – Evropska opazovalnica digitalnih medijev (https://edmo.eu/), ki naj bi dobila tudi slovensko izpostavo, a ima že sedaj o razmerah pri nas bistveno natančnejšo sliko kot si kdo predstavlja, zanimajo pa jo pobude za spodbujanje verodostojnosti vsebin in za izboljšanje ozaveščenosti uporabnikov, aktivno razkrivanje manipulativnega vedenja družbenih medijev in podatki o tokovih oglaševanja s pomočjo dezinformacij o COVID-19. Sprotno spremlja tudi raziskave o dezinformacijah v povezavi s COVID-19 v članicah EU, pri čemer 2 raziskavi (od 76) zajemata tudi Slovenijo, vendar med 115 raziskovalci ni nikogar iz naše države. [15]

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PREDGOVOR

Soočamo se z velikimi spremembami v procesih vzgoje in izobraževanja, ki jih je povzročila epidemija COVID-19 ob širokem razmahu uporabe informacijsko-komunikacijske tehnologije. Upamo, da bo v prihodnjih letih prevladovala šola v živo, kar pa ne pomeni, da se bomo povsem vrnili na stare tirnice. Rešitve pouka na daljavo so pokazale tudi pozitivne plati. Upravičeno govorimo o smiselnosti hibridnih modelov poučevanja in spremembah v vsebini in metodiki dela.

Podobno kot lanska bo tudi letošnja konferenca Vzgoja in izobraževanje v informacijski družbi 2021 potekala na daljavo. Pogovarjali se bomo o različnih rešitvah in spoznanjih, kako si lahko v bodoče pomagamo s sodobno tehnologijo pri prenosu znanja. Izkušnje minulih let nas ne bodo vodile v stanje pred epidemijo ampak nas bogatijo in vodijo v renesanso vzgoje in izobraževanja v novi realnosti.

Vabimo vas, da se aktivno udeležite konference Vzgoja in izobraževanje v informacijski družbi 2021, da predstavite svoje poglede in izkušnje ter da skupaj snujemo našo prihodnost.

Uredniški odbor

FOREWORD

We are facing grand changes in the educational processes caused by the COVID-19 epidemic and the widespread use of information and communication technology. We hope that direct face-to-face education will prevail in the coming years, but that does not mean that things will be completely as they were. Distance learning solutions have also shown positive sides. It is reasonable to talk about the significance of hybrid teaching models and changes in the content and methodology of work.

Similar to last year, this year's conference Education in Information Society 2021 will be held online. We will discuss various solutions and insights into how we can help ourselves in the future with contemporary technology in the processes of knowledge transfer. The experiences of the past years will not lead us to the state before the epidemic, but enrich us and lead us to a renaissance of education in a new reality.

We invite you to actively participate in the conference Education in Information Society 2021, to present your views and experiences, and to plan our future together.

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Poučevanje elektronike z uporabo spletnega programskega okolja Tinkercad

Teaching electronics using online software Tinkercad

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POVZETEK

Učitelji smo se med epidemijo morali prilagoditi na poučevanje na daljavo. Poseben izziv nam je predstavljalo poučevanje praktičnega pouka strokovnih modulov. Pri praktičnem delu modula Digitalna tehnika poučevanje poteka v laboratoriju, kjer imajo dijaki dostop do elektronskih elementov in vse potrebne opreme. Ker so bile šole zaprte in pouk, ki smo ga običajno izvajali, ni bil mogoč, je bilo potrebno poiskati alternativo, ki bi bila primerna za poučevanje na daljavo. Odločili smo se za spletno okolje Tinkercad, ki nam omogoča izdelovanje in simuliranje elektronskih vezij. V prispevku je prikazana izvedba praktičnih vaj v okolju Tinkercad in njihova primerjava z realno izvedbo v laboratoriju. Podane so prednosti in pomanjkljivosti okolja Tinkercad ter naše izkušnje z le-tem. Zanimala nas je tudi povratna informacija dijakov oz. njihovo mnenje o takšnem načinu dela na daljavo. S tem namenom smo izvedli anketo. Rezultati kažejo, da se večini dijakov zdi spletno okolje Tinkercad zelo uporabno, vendar ima kljub temu velika večina še vedno raje delo v laboratoriju oz. delavnici. Naše ugotovitve kažejo, da je Tinkercad odlično orodje, ki je uspešno omogočalo poučevanje praktičnega pouka elektronike. Kljub temu pa ne more v polnosti nadomestiti praktičnega dela v šoli in lahko služi zgolj kot dobrodošla dopolnitev.

KLJUČNE BESEDE

Elektronika, poučevanje na daljavo, praktični pouk, Tinkercad

ABSTRACT

We teachers had to adapt to distance learning during the epidemic. A special challenge for us was teaching practical lessons of professional modules. In the practical part of the Digital Electronics module, teaching takes place in a laboratory, where students have access to electronic elements and all the necessary equipment. Since the schools were closed and the lessons we normally conducted were not possible, it was necessary to find an alternative that would be suitable for distance teaching. We opted for the online environment Tinkercad, which allows us to create and simulate electronic circuits. The paper presents the implementation of practical exercises in the Tinkercad environment and their comparison with the actual implementation in the laboratory. The advantages and disadvantages of the Tinkercad environment and our experience with it are also given. We were also interested in the feedback of students or their opinion on such a way of working remotely. To this end, we conducted a survey. The results show that most students find the Tinkercad online environment very useful, but the vast majority still prefer to work in a laboratory or workshop. Our findings show that Tinkercad is an excellent tool that has successfully enabled the teaching of practical electronics lessons. Nevertheless, it cannot fully replace practical work in school and can only serve as a welcome addition.

KEYWORDS

Electronics, distance learning, practical lessons, Tinkercad

1 UVOD

Zaradi pojava epidemije in posledično dela na daljavo je bilo potrebno spremeniti način poučevanja. Poseben izziv je predstavljalo poučevanje praktičnega pouka elektronike. Pri praktičnem delu strokovnega modula Digitalna tehnika dijaki spoznavajo integrirana vezja. Na testni plošči povezujejo elektronske elemente in testirajo delovanje vezij. Delo običajno poteka v namenskih učilnicah oz. laboratorijih, kjer je na voljo vsa potrebna oprema kot so npr. merilni instrumenti, testne plošče, elektronski elementi in računalniki z ustrezno programsko opremo.

Zaradi nezmožnosti dela v šoli je bilo potrebno poiskati primerno aplikacijo, ki bi nam omogočala učinkovito poučevanje na daljavo. Obstajajo različna programska okolja s katerimi lahko simuliramo elektronska vezja kot so npr. SimulIDE, Simulator.io, Circuito.io, Fritzing, EveryCircuit, Wokwi, Tinkercad. Vsako okolje ima svoje prednosti in slabosti. Iskali smo aplikacijo, ki vsebuje vse elemente, ki jih potrebujemo za izvedbo vaj. Aplikacija mora biti enostavna za uporabo in mora čim bolj realistično prikazovati uporabljane elemente. Pomembno nam je bilo tudi to, da se simulacija izvaja kar na spletu in aplikacija ni plačljiva.

Pri nekaterih okoljih kot npr. Wokwi [1] lahko zgolj spreminjamo obstoječe primere, tako da popravljamo programsko kodo. Pomanjkljivost je tudi to, da ni mogoča uporaba »drag and drop« elementov, ampak je potrebno

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spreminjati kodo v Java Script. Veliko naštetih okolij se osredotoča predvsem na uporabo mikrokrmilniških razvojnih plošč, ne pa tudi na simulacijo različnih integriranih vezij, ki jih pri pouku uporabljamo. Po hitrem pregledu in primerjavi vseh možnosti nas je najbolj prepričalo okolje Tinkercad.

V nadaljevanju je opisan potek poučevanja z uporabo spletnega okolja Tinkercad in izkušnje, ki smo jih pri tem pridobili.

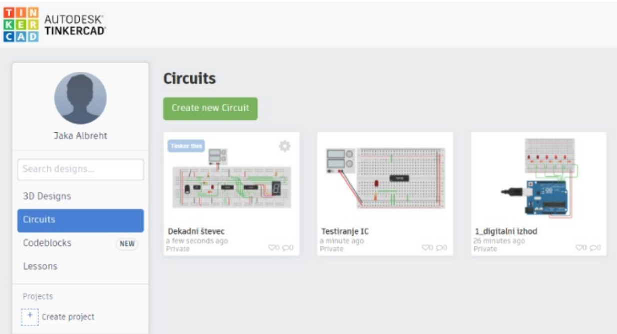
2 POUČEVANJE V OKOLJU TINKERCAD

Tinkercad je spletno okolje, ki nam omogoča izdelavo 3D modelov, testiranje programske kode in simuliranje elektronskih vezij. Istoimensko podjetje Tinkercad (Slika 1) je bilo ustanovljeno leta 2010 z namenom izdelave preprostega programa, ki bi omogočal 3D modeliranje, dostopno širši populaciji. Leta 2011 je bila postavljena tudi spletna stran Tinkercad [2]. Le-ta omogoča, da v spletnem okolju izdelujemo 3D modele, testiramo programsko kodo ali sestavljamo in simuliramo elektronska vezja. Za naše potrebe smo se omejili na izdelovanje in simuliranje elektronskih vezij.

Slika 1: Tinkercad logotip

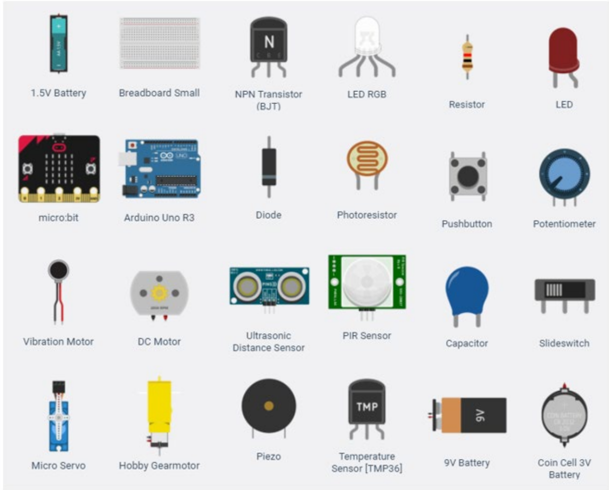
2.1 Kako začeti?

Na spletni strani se prijavimo z elektronskim naslovom ali Google računom. Izberemo novo delovno površino kjer bomo sestavljali vezje (Slika 2). Vsi elektronski elementi (Slika 3) in oprema je na voljo na desni strani delovne površine.



Slika 2: Začetna stran okolja Tinkercad

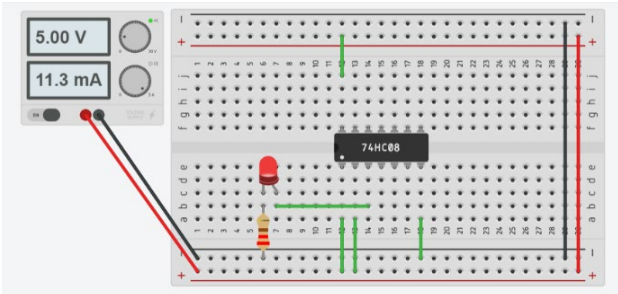
Element s klikom in potegom preprosto prenesemo na delovno površino. Elemente povežemo med seboj in poženemo simulacijo. Če želimo spreminjati vezje, je potrebno ustaviti simulacijo. Povezavam, ki predstavljajo žice je mogoče spreminjati tudi barvo, zaradi česar je vezje bolj pregledno.



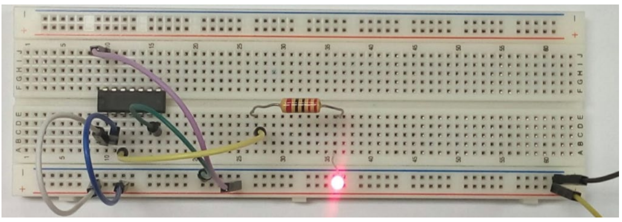
Slika 3: Prikaz nekaterih elektronskih elementov

2.2 Izvedba praktičnega dela strokovnega modula Digitalna tehnika

Praktični del modula Digitalna tehnika je razdeljen na tri sklope. V prvem sklopu dijaki spoznajo integrirana vezja, ki vsebujejo logična vrata. Na testni plošči (breadboard) testirajo delovanje. Slika 4 prikazuje izvedbo vaje v spletnem okolju Tinkercad, Slika 5 pa izvedbo v realnosti. Pri tej vaji smo testirali delovanje integriranega vezja 7408, ki vsebuje logična vrata IN (AND).

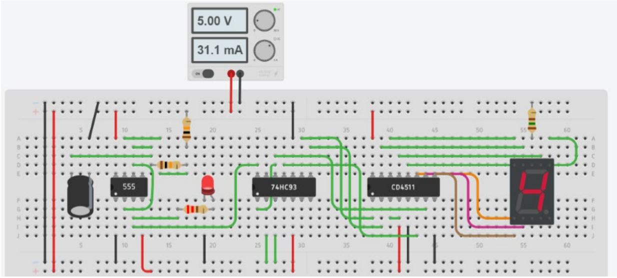


Slika 4: Testiranje integriranega vezja v okolju Tinkercad

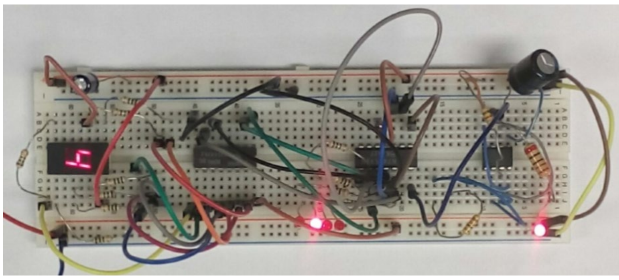


Slika 5: Testiranje integriranega vezja v realnosti

V drugem delu dijaki sestavijo kompleksnejše vezje in sicer dekadni števec s prikazovalnikom. V tem primeru je potrebno povezati več elementov. Na Sliki 6 vidimo simulacijo v okolju Tinkercad, na Sliki 7 pa prikaz izvedbe vaje v šoli.

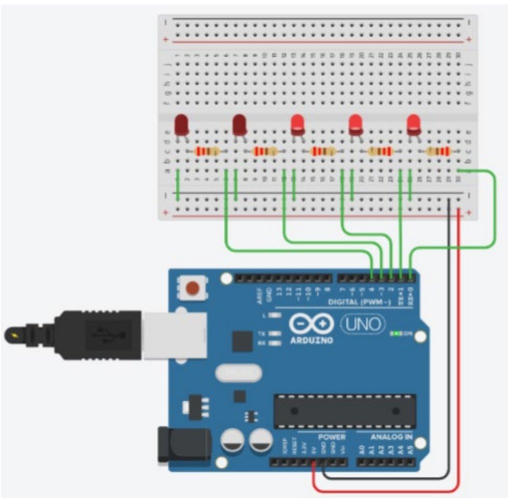


Slika 6: Simulacija dekadnega števca s prikazovalnikom v okolju Tinkercad



Slika 7: Prikaz dekadnega števca s prikazovalnikom v realnosti

Tretji sklop vaj je namenjen spoznavanju programirljivih vezij. Dijaki uporabljajo razvojno ploščo Arduino UNO [3] na kateri je mikrokrmilnik Atmega328. Poleg povezovanja vhodno-izhodnih elementov je potrebno napisati tudi programsko kodo. Spletno okolje Tinkercad nam omogoča tudi pisanje programske kode, ki se nato v okviru simulacije izvaja na razvojni plošči Arduino UNO. Možno je tudi izbrati grafični način programiranja, ki vključuje različne funkcijske bloke, ki jih povezujemo med seboj.



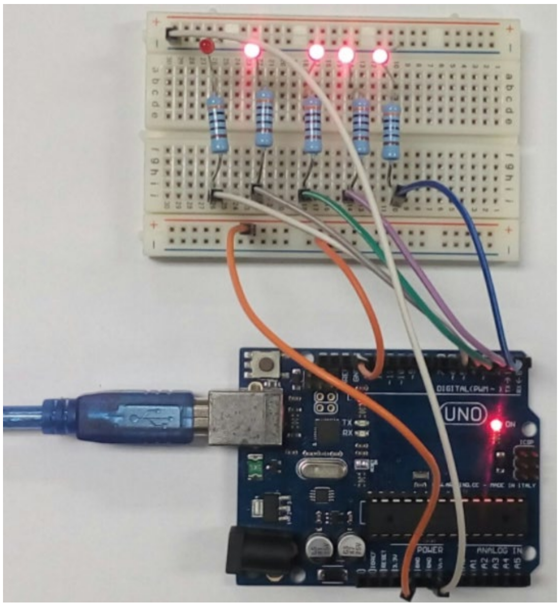
Slika 8: Arduino UNO v okolju Tinkercad

Na Sliki 8 je prikazana simulacija delovanja razvojne plošče Arduino UNO. Na njo so priključene svetleče diode (LED) s predupori. Programska koda na Sliki 9 povzroči postopno prižiganje in ugašanje svetlečih diod.

```
int led0=0;
int led1=1;
int led2=2;
int led3=3;
int led4=4;

void setup()
{
     for(int x=0;x<=4;x++)
          {
               pinMode(x,OUTPUT);
          }

}

void loop()
{
     for(int x=0;x<=4;x++)
     {
          digitalWrite(x,HIGH);
          delay(200);
     }
     for(int x=4;x>=0;x--)
     {
          digitalWrite(x,LOW);
          delay(200);
     }
}
```

Slika 9: Programska koda v okolju Tinkercad

Oglejmo si še izvedbo vaje v šoli (Slika 10). V tem primeru je bila programska koda napisana v programskem okolju Arduino, ki je bilo predhodno nameščeno na računalniku. Program s Slike 11 smo, po uspešnem prevajanju, preko povezave USB naložili na mikrokrmilnik in opazovali delovanje.



Slika 10: Arduino UNO v realnem okolju

```
int led0=0;
int led1=1;
int led2=2;
int led3=3;
int led4=4;

void setup()
{
  for(int x=0;x<=4;x++)
    {
      pinMode(x,OUTPUT);
        }

}

void loop()
{
  for(int x=0;x<=4;x++)
  {
      digitalWrite(x,HIGH);
      delay(200);
    }
    for(int x=4;x>=0;x--)
    {
      digitalWrite(x,LOW);
      delay(200);
    }
}
```

Slika 11: Programska koda v okolju Arduino

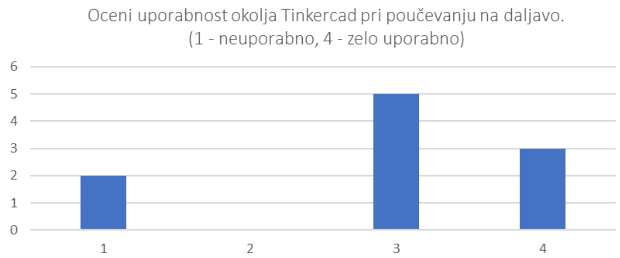
2.3 Delo na daljavo

V času epidemije smo se na šoli odločili, da poenotimo orodje za poučevanje in komuniciranje z dijaki. Izbrali smo aplikacijo Microsoft Teams [4], ki nam je omogočala uspešno delo na daljavo. Pouk smo v največji meri izvajali preko videokonferenc. Dijaki so pri praktičnem pouku modula Digitalna tehnika med videokonferenco ob učiteljevi razlagi sestavljali in preizkušali elektronska vezja v spletnem okolju Tinkercad. V primeru nejasnosti oz. težav so lahko delili svoj zaslon, kar se je izkazalo za zelo uporabno. Učitelj je nato opozoril na morebitne napake v vezju. Na ta način so se tudi ostali dijaki naučili, na kaj je treba biti pozoren in kje se lahko pojavijo napake. Nekateri dijaki so tudi sami sodelovali pri odkrivanju napak v vezjih svojih sošolcev.

3 REFLEKSIJA

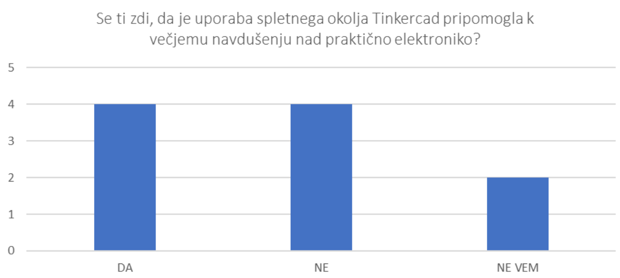
Zanimalo nas je kakšne so bile izkušnje dijakov s spletnim okoljem Tinkercad, zato smo jih prosili, da izpolnijo kratko anketo. Glede na to, da so anketo reševali med počitnicami lahko razpolagamo le z manjšim vzorcem (N=10).

Najprej smo jih prosili naj ocenijo uporabnost okolja Tinkercad pri delu na daljavo (Slika 12). Večini se zdi okolje uporabno, kar se je videlo tudi med samim poučevanjem saj je ta način dela večina lepo sprejela.



Slika 12: Rezultati ankete (uporabnost okolja Tinkercad)

Zanimalo nas je tudi ali je uporaba spletnega okolja Tinkercad pripomogla k večjemu navdušenju nad elektroniko (Slika 13). Mnenja glede tega so deljena. Zanimanje za elektroniko je težko v večji meri pripisati le vplivu ene aplikacije.



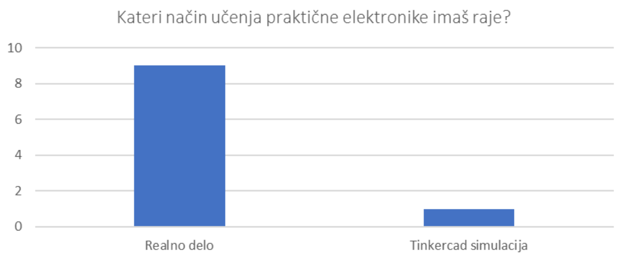
Slika 13: Rezultati ankete (vpliv okolja Tinkercad na zanimanje za elektroniko)

Podali so nam tudi svoje videnje prednosti in slabosti omenjenega okolja, kar prikazuje Tabela 1. Dijaki so prepoznali veliko prednosti spletnega okolja, prav tako pa se zavedajo tudi nekaterih pomanjkljivosti.

Tabela 1: Prednosti in slabosti okolja Tinkercad po mnenju dijakov

Prednosti	Slabosti
Možno je delo od doma Lažje se odpravi težave Ne moremo ničesar uničiti Lažje razumevanje vezij Brezplačna aplikacija Dostopno povsod kjer je internet Vse komponente delujejo	Ni dela na realnih komponentah Ni na voljo vseh elementov Potreben je zmogljiv računalnik

Na koncu pa so podali svoje mnenje glede tega, kateri način učenja jim je bliže (Slika 14). Velika večina ima kljub vsem prednostim, ki jih ponuja okolje Tinkercad, še vedno raje praktični pouk v šoli.



Slika 14: Rezultati ankete (primerjava realnega dela in simulacije Tinkercad)

4 ZAKLJUČEK

Spletno okolje Tinkercad se je med poučevanjem na daljavo izkazalo za odlično izbiro. Predvsem dobro se je obneslo v kombinaciji z videokonferencami znotraj aplikacije Microsoft Teams.

Kljub temu, da so že dijaki podali svoje videnje prednosti in slabosti spletnega okolja pa si vseeno oglejmo še naše izkušnje. Med prednosti lahko uvrstimo naslednje. V primerjavi s profesionalnimi programi za simulacijo in 3D modeliranje je Tinkercad relativno enostaven za uporabo. Uporabljamo ga lahko zastonj in ne potrebujemo nobenih licenc. Do aplikacije dostopamo kar preko spleta, prav tako nam ni potrebno nameščati namizne aplikacije. Vse naše delo se shrani v računu s katerim smo se prijavili. Z elektronskimi komponentami lahko poljubno eksperimentiramo, brez skrbi, da bi kaj uničili ali se sami poškodovali. Zaradi izkušenj z delom v virtualnem okolju lažje preidemo na realno izdelovanje vezij na testni plošči.

Kot pomanjkljivost bi izpostavili to, da je potrebno imeti internetno povezavo, saj zgolj namizna aplikacija še ni na voljo. Poleg tega nimamo fizičnega stika z elektronskimi elementi, kar posledično pomeni, da ni realnih problemov kot npr. slab stik, nedelujoče komponente, motnje ipd. Pri virtualnem delu se ne razvija fine motorike, ne uri se ročnih spretnosti pri sestavljanju elektronskih vezij. Prav tako ne rešujemo realnih problemov, saj je simulacija vedno zgolj približek realnosti.

Menimo, da najboljše rezultate pri poučevanju dosežemo s kombinacijo spletnega okolja in praktičnega dela, zato lahko okolje Tinkercad služi kot dobrodošla dopolnitev pri poučevanju praktičnega pouka elektronike. Nikakor pa ne more v polnosti nadomestiti dela v laboratoriju oz. delavnici.

VIRI

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Izzivi izvedbe praktičnega izobraževanja na višjih strokovnih šolah v pogojih COVID-19

Challenges of the implementation of practical education at higher vocational schools in the conditions of COVID-19

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POVZETEK

Pandemične razmere COVID-19 so ustvarile povsem nova izhodišča pri delovanju družbe in v vseh njenih spremljajočih vitalnih mehanizmih. Poleg osnovnih življenjskih vrednot je v takih pogojih potrebno poskrbeti tudi za delovanje vseh ostalih sistemov, med katere spada tudi izobraževanje s celovitim in korektnim funkcioniranjem vseh predpisanih in ustaljenih protokolov. Pri tem lahko izpostavimo tudi konkretne težave pri vzpostavitvi in tekoči izvedbi obveznega praktičnega izobraževanja (PRI) na višjih strokovnih šolah (VSŠ). VSŠ programi se v Slovenskem ogrodju kvalifikacij (SOK) nahajajo na ravni 6/1. Programi so ovrednoteni s 120 kreditnimi točkami (KT) in trajajo 2 leti. Za doseganje ustreznih strokovno-teoretičnih kompetenc je zelo pomemben del študijskega procesa, ki vključuje PRI v podjetju in zajema 800 ur oziroma traja 20 tednov.

V tem delu so v izobraževalni proces vključeni tudi mentorji iz posameznih podjetij, s katerimi je potrebno vzpostaviti interaktiven in delujoč komunikacijski kanal, ki smo ga v preteklosti realizirali s pomočjo obiska organizatorja PRI v podjetju. V pogojih pandemije zaradi COVID-19 je prav na področju tekočega spremljanja dejavnosti v okviru PRI prihajalo do občasnih motenj v utečenem sistemu sodelovanja. Tako, kot večina komunikacije v tem obdobju je tudi tu potekala preko IKT in telefonskih pogovorov.

Razvili smo nov model komunikacije z vključevanjem virtualnih obiskov organizacij, z izvedbo pogovorov z mentorji v podjetjih in s študenti na dejanskih delovnih mestih. Povratne informacije povsem ekvivalentno sledijo rezultatom raziskav iz preteklih let.

KLJUČNE BESEDE

Praktično izobraževanje, COVID-19, mentor, študent, višja strokovna šola

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ABSTRACT

The COVID-19 pandemic situation has created completely new starting points in the functioning of the society and in all its accompanying vital mechanisms.

In addition to the basic values of life, in such conditions it is necessary to take care of the operation of all other systems, including education with the comprehensive and correct functioning of all prescribed and established protocols. We can also point out the concrete problems in the establishment and ongoing implementation of compulsory practical education / on the job training (PE/OJT - PRI) at higher vocational schools (HVS - VSŠ). VSŠ programs in the Slovenian Qualifications Framework (SQF - SOK) are located at level 6/1. The programs are evaluated with 120 credit points (ECTS - KT) and last for 2 years. To achieve the appropriate professional-theoretical competencies, it is a very important part of the study process, which includes PRI in the company and covers 800 hours or lasts 20 weeks.

In this part, mentors from individual companies are also included in the educational process, with whom it is necessary to establish an interactive and functioning communication channel, which we realized in the past with the help of the PRI organizer's visit to the company. In the conditions of the pandemic due to COVID-19, it was in the field of ongoing monitoring of activities within the PRI that there were occasional disturbances in the established system of cooperation. Like most communication in this period, it also took place here through ICT and telephone conversations.

We have developed a new model of communication by including virtual visits to organizations, by conducting interviews with mentors in companies and with students in actual jobs. The feedback follows the results of previous years' research in exactly the equivalent way.

KEYWORDS

Practical education, COVID-19, mentor, student, higher vocational school

1. UVOD

Višje strokovno izobraževanje je osredotočeno na usposabljanje visoko usposobljenih, aplikativno usmerjenih strokovnjakov, ki se zaposlujejo na vodilnih mestih proizvodnih ali storitvenih oddelkov v podjetjih. Osnovno vodilo v VSŠ je stalno izboljševanje kakovostnega izobraževanja s praktičnim usposabljanjem in inovativnimi izobraževalnimi metodami. Sinteza vsega naštetega spodbuja razvoj individualnih praktičnih sposobnosti in zagotavlja njihov individualni razvoj.

V našem primeru skrbimo za razvoj teoretičnega znanja na področju informatike, skupaj s praktičnimi veščinami na tem področju. Smisel PRI je v poglabljanju študentovega razumevanja njihovega osnovnega strokovnega znanja, hkrati pa jim daje dodatne možnosti spoznavanja realnega delovnega okolja v katerem bodo morda našli ali iskali svojo zaposlitev. Vključevanje v sistem PRI običajno razkriva tudi posebnosti posameznih osebnostnih značilnosti študentov in pokaže možnosti integracije v realna delovna okolja. Proučevanje naštetih relacij je koristno tako za študenta, kot delodajalca, mentorja v podjetju, VSŠ in seveda za razvijalca kurikuluma.

Študenti se seznanijo s kompleksnimi nalogami, ki se izvajajo v podjetjih in pri tem spoznajo praktične modele reševanja realnih izzivov. Temeljni namen višješolskega izobraževanja je torej prizadevanje za ustrezne odločitve in doseganje večje uspešnosti bodočih zaposlenih v realnih delovnih okoljih [1].

V EU se v okviru mreže višjih strokovnih šol izobražuje več kot 1,7 milijona ljudi. Ti programi so nastali na osnovi poklicnih standardov, ki so jih narekovale potrebe gospodarstva. Podoben sistem najdemo tudi v Sloveniji. Izobraževanje za pridobitev in izpopolnjevanje javnoveljavne višje strokovne izobrazbe in organizacijo višjih strokovnih šol (VSŠ) v Sloveniji ureja Zakon o višjem strokovnem izobraževanju (ZVSI) [2].

Višješolski programi (VSŠ) se v Slovenskem ogrodju kvalifikacij (SOK) nahajajo na ravni 6/1 [3, 4]. Programi trajajo 2 leti in so ovrednoteni s 120 kreditnimi točkami (KT). Za doseganje teh ciljev je zelo pomemben tisti del študijskega procesa, ki vključuje praktično izobraževanje (PRI) v podjetju in zajema 800 ur oziroma traja 20 tednov.

Normativne podlage za izvajanje PRI študentov v podjetjih opredeljuje Zakon o višjem strokovnem izobraževanju v 50. členu [2]. Zakon določa, da morajo šole sodelovati z delodajalci in da pogodbo o izvajanju PRI lahko sklenejo s tistimi delodajalci, ki imajo ustrezne prostore in opremo, katerih poslovanje obsega dejavnost poklica, za katerega se študent izobražuje, in imajo zaposlenega, ki je lahko mentor študentu. Podrobne pogoje, povezane s prostorom, opremo in mentorji, je določila Gospodarska zbornica Slovenije, ki tudi vodi register delodajalcev.

Izvajanje PRI spremlja in vodi mentor v podjetju v skladu z okvirnim programom za izvedbo PRI. Ob zaključku PRI mentor izdela ustrezno poročilo o opravljenem PRI študenta, v katerem poda oceno o PRI ter izpolni anketni vprašalnik o PRI, kar študent skupaj s svojim poročilom odda organizatorju PRI.

VSŠ imajo izkušnje z načrtnim organiziranjem mreže podjetij, pri tem pa imajo posebej pomembno vlogo zaposleni v podjetju, ki so mentorji študentom. Tak način partnerskega sodelovanja med šolo in podjetji je primerljiv z evropsko uspešno prakso in posebej primeren za področje strokovnega izobraževanja, ki naj usposablja za potrebe konkretnih delovnih okolij [5]

V sistemu izvajanja PRI gre za tripartitni odnos, v katerem sodelujejo študenti s specifičnimi znanji, izkušnjami in osebnostnimi lastnostmi, podjetja oz. različne organizacije z realnimi delovnimi okolji in ustrezno usposobljenimi mentorji ter šola (org. PRI, predavatelji, vodstvo šole). [6].

V okviru PRI imajo študenti priložnost razvijati in utrjevati številne kompetence, kot so sposobnost organiziranja delovnega časa, reševanje realnih problemov, uporaba znanja v praksi … Pridobijo si sposobnosti ustne in pisne komunikacije (kjer je to pomembno, tudi v tujem jeziku). PRI mora biti usmerjeno tudi v razvijanje kompetence, kot so kritičnost, samokritičnost, delo v skupini, etičnost, samoiniciativnost, kreativnost, avtonomnosti pri delu, podjetništvo, sposobnost prilagajanja novostim, skrb za kakovost, sposobnost priprave in vodenja ali koordiniranja projektov [1].

V izobraževalni proces so vključeni tudi mentorji iz posameznih podjetij, s katerimi je potrebno vzpostaviti interaktiven in delujoč komunikacijski kanal, ki smo ga v preteklosti realizirali s pomočjo obiska organizatorja PRI v podjetju. V pogojih pandemije zaradi COVID-19 je prav na področju tekočega spremljanja dejavnosti v okviru PRI prihajalo do občasnih motenj v utečenem sistemu sodelovanja. Tako, kot večina komunikacije v tem obdobju je tudi tu potekala preko IKT in telefonskih pogovorov.

2. METODE

Zaradi znanih pogojev dela v okviru pandemičnih omejitev, je bilo potrebno slediti novim idejam komuniciranja tudi na omenjenem področju. Del študijskega leta 2019/20 in pretežni del študijskega leta 2020/21 sta potekali v posebnih okoliščinah, kjer je bil neposredni stik sodelujočih deležnikov praktično onemogočen. Tako, kot v večini primerov je bila vsa možna dejavnost prenešena v virtualno okolje. V določenem začetnem obdobju pandemije so bile smernice še zelo nejasne, vendar so se z razvojem dogodkov in spoznavanjem nevarnosti COVID-19, počasi spreminjale. Celotni šolski sistem je sproti dobival navodilo za delo is strani NIJZ [7], Ministrstva za izobraževanje, znanost in šport MIZŠ [8], glede integracije PRI pa smo delo koordinirali tudi v skladu s priporočili Ministrstva za gospodarski razvoj in tehnologijo [9]. V navodilih za delo so bili opredeljeni grobi okviri, natančne smernice pa smo oblikovali v skladu z našimi idejami in širšimi priporočili.

PRI je kljub zaostrenim delovnim pogojem potrebno izvesti na najvišjem možnem nivoju. Če želimo zagotoviti kakovost tega dela izobraževanja, je potrebno sprotno samoevalviranje vseh izvedbenih elementov. Ključni členi pri samoevalvaciji PRI so študenti, organizacije in mentorji v šolah in organizacijah.

Pridobljene informacije v okviru PRI so zelo pomembne, saj plemenitijo celotni formalni del izbranega programa, v katerem sodeluje posamezni študent.

Regulacijska sposobnost informacijskega sistema na področju PRI za spodbujanje sinergije med pedagoškim in poslovnim okoljem, je kompleksna. V letu 2020 je bil razvit model sporočilnih poti v sistemu sooblikovanja t.i. reflektivne prakse v okviru PRI [1]. Zaradi jasno postavljenega sistema PRI je bilo v danih pogojih moč dokaj nemoteno pristopiti k oblikovanju virtualnih obiskov organizacij, z izvedbo pogovorov z mentorji v podjetjih in s študenti na dejanskih delovnih mestih.

Virtualni obisk podjetja je pomembna točka v razvoju medsebojnih tripartitnih odnosov v sistemu višješolskega izobraževanja, saj s tem vzpostavimo temelje nadaljnjemu sodelovanju, vzpostavimo sistem regulacijskega kroga med višjo šolo in podjetjem ter spodbujamo aktivno interaktivno sodelovanje med vsemi sodelujočimi. S pomočjo proučevanja kazalnikov smo želeli opredeliti dejansko stanje na področju izvedbe PRI in odkriti morebitne usmeritve za delo v prihodnjem obdobju.

Ideja virtualnega obiska zahteva temeljite priprave pred izvedbo, zato smo ob vseh obiskih želeli pridobiti temeljne informacije v zvezi z izvedbo, ki bi jih lahko koristno uporabili ob morebitnem nadaljevanju ogroženosti s COVID-19 v naslednjem študijskem letu. Osredotočili smo se na vlogo mentorja v podjetjih in v ta namen pripravili anketni vprašalnik s temeljnimi demografskimi vprašanji, s sklopom vprašanj v zvezi z opredelitvijo podjetja, z vprašanji o vlogi mentorja v podjetju in vprašanja v zvezi s povratno informacijo pri izvedbi PRI s poudarkom na virtualnem obisku organizatorja PRI iz VSŠ.

Študenti v tej raziskavi niso bili posebej vključeni.

3. REZULTATI

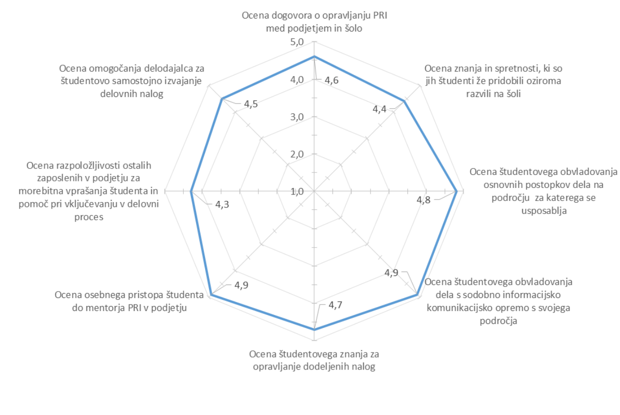
Prispevek se ukvarja z evalvacijo virtualnega obiska organizatorja PRI v podjetju v okviru programa Informatika na VSŠ ŠC Kranj. V študijskem letu 2020/2021 je bilo na opravljanje PRI v 2. letniku napotenih 38 študentov, ki so opravljali PRI v 32 različnih podjetjih. V raziskavo smo uspeli vključiti 17 mentorjev iz nabora vseh sodelujočih podjetij.

V okolju Microsoft Teams smo oblikovali skupino v kateri so bili istočasno prisotni študent, mentor iz podjetja in organizator PRI. V okviru omenjene skupine smo izvedli klasični 15 – 20 min. pogovor, ki ga sicer opravimo tudi v normalnih nepandemijskih časih. Pogovor poteka po običajnem dnevnem redu, ki vključuje naslednje elemente:

- izmenjava informacij o poteku PRI z usvajanjem kompetenc,
- spremljanje in vrednotenje PRI študenta,
- problematika v zvezi z dokumentacijo PRI (študent, mentor),
- informiranje v zvezi z razpisom za sofinanciranje spodbud delodajalcev, ki izvajajo PRI študentov,
- pogovor o morebitni izbiri teme diplomske naloge,
- verifikacija učnih mest za študente na GZS,
- pedagoško-andragoško usposabljanje mentorjev,
- drugo (posebnosti, pripombe, pohvale ...),

V raziskavi so sodelovali mentorji, ki prihajajo iz podjetij z do 10 zaposlenimi (55%), iz podjetij z 11-50 zaposlenimi (18%) in iz podjetij z 51-150 zaposlenimi (18%).

Mentorji v podjetju svojo vlogo razumejo različno. Raziskava ugotavlja, da 64% mentorjev svojo vlogo razume kot sodelavca v študijskem procesu za praktični del pri ustvarjanju bodočega kadra, 27% mentorjev svojo vlogo vidi v organizatorju dela za novo delovno moč v delovnih procesih, 9% mentorjev pa svojo vlogo vidi v "podaljšani roki" kadrovske službe pri iskanju potencialnega sodelavca.

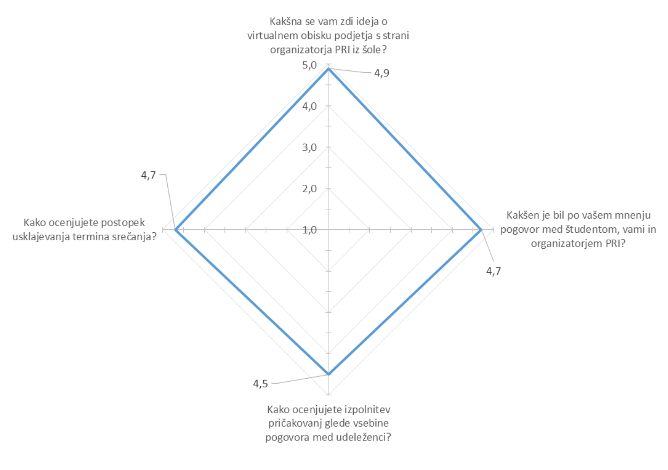


Slika 1: Mnenje mentorja o pripravi in izvedbi PRI

Priprava in izvedba PRI je ključnega pomena za vse sodelujoče (slika 1) Praktično vsi kazalniki dosegajo zelo visoko povprečno oceno (4,64). Najnižjo oceno (4,3) beležimo pri oceni razpoložljivosti ostalih zaposlenih v podjetju za morebitna vprašanja študenta in pomoči pri vključevanju v delovni proces, kar je razumljivo, saj študenti iz vidika vodenja podjetja in količnika cost/benefit predstavljajo določen izziv.

V danih pogojih je bil virtualni obisk podjetja zanimiv izziv, ki se je po naših optimističnih napovedih pokazal tudi kot izjemno dobro sprejet pri mentorjih v podjetjih.

Ocena virtualnega obiska organizatorja PRI v podjetju (slika 2) praktično soglasno podpira idejo o virtualnem obisku podjetja s strani organizatorja PRI iz šole (4,9). Mentorji v podjetjih tudi zelo visoko ocenjujejo pogovor med študentom, mentorjem in organizatorjem PRI (4,7) in so prav tako zelo zadovoljni z usklajevanjem termina srečanja (4,7). Organizator PRI je tudi povsem izpolnil pričakovanja glede vsebine pogovora med udeleženci (4,5).



Slika 2: Ocena virtualnega obiska organizatorja PRI v podjetju

Mentorji so tudi zelo zadovoljni s časovnim obsegom obiska (15 do 20 minut). 91% mentorjev je bilo mnenja, da bi podoben način izvedbe obiska organizatorja PRI v podjetjih v prihodnje še nadaljevali.

4. RAZPRAVA

Pandemija COVID-19 je vplivala na vse pore našega življenja, posredno pa tudi na vse sisteme vezane v naš vsakdan. Naša tematika se je lotevala racionalnih rešitev, ki so bile potrebne za rešitev problematike celovite izvedbe PRI v okviru VSŠ izobraževanja. Razumljivo je, da so nastale razmere zahtevale kompromisno delovanje v določenih okvirih, npr. zamiki datumov odhoda študentov na prakso v posamezna podjetja. Povsem nekaj drugega pa je premik / zamik / odlog 400 urnega bloka obveznih dejavnosti (PRI) v okviru izobraževanja na VSŠ za posamezni letnik. Izobraževalni program Informatika ima že po svoji strukturi velik potencial organiziranja dela na daljavo, kar so delodajalci in mentorji iz podjetij s pridom izkoristili. Kljub dejstvu, da je veliko študentov delo v okviru PRI opravilo tudi na daljavo, pa je za funkcionalno in delujočo strukturo PRI nujno potrebno aktivno in soodvisno sodelovanje med študenti, mentorji v podjetjih in organizatorjem PRI v VSŠ.

Na način, ki ga ponuja opisan model nismo izgubljali na kakovosti izvedbe, še več – v danih razmerah smo s pomočjo virtualnega obiska v podjetjih preizkusili drugačen model, ki ga morda v običajnih razmerah ne bi uspeli realizirati v realnih pogojih.

Model virtualnega obiska smo izvedli preko orodja MST in na ta način na daljavo obiskali mentorja in se istočasno povezali s študentom na svojem delovnem mestu. V realnem svetu je organizatorju PRI marsikdaj onemogočen dostop do dejanskega delovnega okolja, kjer določeni študent opravlja PRI. Vzroki za prepoved vstopa v zaščiteno področje so različni (varnost in zdravje pri delu, vnos nečistoč, segrevanje prostorov, občutljivost delujočih sistemov, poslovne skrivnosti...). Virtualni obisk organizatorja PRI v podjetjih pa marsikdaj omogoči video in audio vstop v zaščitena področja, video vpogled v študentovo delo na njegovem dejanskem delovnem mestu itd.

Raziskava potrjuje naše domneve o pozitivni afiniteti mentorjev v podjetjih do obiska organizatorja PRI. Na virtualni način je organizacija obiska bolj natančno določena in načrtovana. Delodajalci so zadovoljni, saj njihovi predstavniki – mentorji v podjetjih za to dejavnost lahko namenijo manj njihovega dragocenega časa.

Vsekakor ne smemo zanemariti velike prednosti klasične izvedbe obiska organizatorja PRI v podjetju, saj je osebna izmenjava mnenj in iskanje idej ter rešitev vsekakor boljša in zelo dobrodošla, toda tudi virtualni obisk je svojevrsten izziv, posebno če je izveden v okoljih, ki jih vključeni deležniki že dobro poznajo.

Pri razpravi o nadgradnji modela, bi morali razmisliti še o celovitem in zanesljivem sistemu izmenjave dokumentacije z uporabo verificiranih potrdil. Pričakujemo, da bo ta del logična nadgradnja vseh zastavljenih sistemov v Digitalni Sloveniji [10].

5. ZAKLJUČEK

Pandemične razmere ob pojavu COVID-19 so nas prisilile, da smo praktično povsod začeli razmišljati "izven škatle" in bili prisiljeni uporabiti vse mogoče pripomočke za izhod iz nastale družbene slepe poti. Tudi v okviru izobraževanja so se pojavili nešteti izzivi, ki smo jih bili prisiljeni reševati. Razvili smo model virtualnega obiska podjetij med izvedbo PRI na VSŠ in na ta način uspeli vzpostaviti povsem ekvivalentno strukturo dela, ki je bila običajna v nepandemijskem obdobju. Določene izkušnje bi veljalo obdržati in jih skladno z razvojem digitalizacije tudi nadgrajevati.

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Skupinske oblike svetovanja na daljavo v času epidemije covid-19 – ugotovitve raziskav in praktične izkušnje

Group telecounseling during the covid-19 epidemic – research findings and practical experience

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POVZETEK

Izbruh epidemije covid-19 je v šolski prostor prinesel številne nenadne spremembe, ki so zahtevale spremembe vzgojno izobraževalnega procesa in prilagoditve vseh udeležencev le tega. Svetovalna služba kot pomemben povezovalni in svetovalni člen in podporne zunanje strokovne institucije, med katerimi imajo pomembno vlogo svetovalni centri, so morali v kratkem času spremeniti način delovanja in se iz svetovanja v živo preseliti na splet. Pri tem so se zaradi povečanih stisk pri uporabnikih storitev pokazale povečane potrebe po tovrstnih obravnavah, strokovnjaki pa so se s spremembami soočali brez jasnih smernic in dokazov o učinkovitosti novih oblik dela. Namen prispevka je osvetliti teoretične ugotovitve raziskav glede skupinskih oblik svetovalnega in terapevtskega dela na daljavo ter predstaviti praktične izkušnje in mnenja uporabnikov tovrstnih oblik dela na Svetovalnem centru Maribor. Vsi predstavljeni rezultati vodijo do ugotovite, da je skupinsko svetovalno in terapevtsko delo preko videokonferenc kljub nekaterim omejitvam in ob pomanjkanju teoretičnih dokazov o učinkovitosti, v praksi učinkovit in pri uporabnikih dobro sprejet način dela, za katerega bi bilo smiselno, da se v prihodnosti večji meri uvaja v svetovalne službe na šolah in v podpornih zunanjih institucijah.

KLJUČNE BESEDE

Šolski svetovalni delavci, skupinsko svetovanje, epidemija covid-19, svetovanje na daljavo

ABSTRACT

The outbreak of the covid 19 epidemic brought about many sudden changes in the school environment, requiring changes in the educational process and adjustments by all involved. The school counselors, as a key link and counseling member, and the supporting external professional institutions, among which counseling centers play an important role, had to change their mode of operation in a short period of time, moving from live counseling to the Internet. Increased service user distress created an increased need for such treatment and professionals faced the change without clear guidelines and evidence of the effectiveness of the new ways of working. The purpose of this article is to highlight the theoretical findings of research into group forms of counseling and therapeutic work at a distance and to present practical experiences and opinions of users of such forms of work at Counseling Center Maribor. All the findings presented lead to the conclusion that despite some limitations and the lack of theoretical evidence of effectiveness, group counseling and therapeutic work by videoconferencing is effective in practice and well received by users, which would make further introduction into counseling services in schools and in supportive external settings useful.

KEYWORDS

School counselors, group counseling, epidemic covid-19, telecounseling

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1 UVOD

Epidemija covid-19 je v šolski prostor prinesla veliko negotovosti in sprememb. Na spremembe se ni bilo mogoče pripraviti vnaprej, zaradi česar je bilo prilagajanje še zahtevnejše. Pouk na daljavo, okrnjenost in spremenjenost vzgojno-izobraževalnega procesa so zahtevali hitre prilagoditve tako učiteljev, kot učencev in staršev. V teh okoliščinah je bila vloga svetovalne službe izjemnega pomena. Njena temeljna naloga je namreč, "da se na podlagi svojega posebnega strokovnega znanja preko svetovalnega odnosa in na strokovno avtonomni način vključuje v kompleksno reševanje pedagoških, psiholoških in socialnih vprašanj vzgojno-izobraževalnega dela v vrtcu oziroma šoli s tem, da pomaga in sodeluje z vsemi udeleženci v vrtcu oziroma šoli in po potrebi tudi z ustreznimi zunanjimi ustanovami." [10]

Svetovalni center Maribor z namenom celostne in strokovne podpore uporabnikom intenzivno sodeluje tudi s svetovalnimi službami na šolah. Na Svetovalnem centru smo v času epidemije covid-19 zaznali povečane potrebe po psihološki, specialno-pedagoški in podobni podpori. Z namenom nudenja podpore čim večjemu številu uporabnikov, smo želeli v kar največji meri ohraniti skupinske oblike dela. Zaradi ukrepov za omejevanje gibanja in združevanja pa smo morali tako v svetovalnih službah kot v Svetovalnih centrih začeti iskati nove in izvirne pristope pri svojem delu.

2 SKUPINSKE OBLIKE DELA – IZZIVI IN MOŽNOSTI V ČASU EPIDEMIJE COVID-19

Skupinsko svetovanje preko spleta je relativno nova modaliteta za vodenje skupin. Raziskave, ki bi evalvirale učinkovitost skupinskih oblik dela preko spleta (kot so svetovanje, terapija, vodenje in podobno) ali postavljale jasne smernice za izvajanje tovrstnih oblik pomoči, so redke. Med številnimi strokovnjaki [6] je v preteklosti veljalo prepričanje, da je zaradi vseh omejitev, ki jih tovrstna oblika dela prinaša, učinkovitost skupinskih oblik dela na daljavo okrnjena do te mere, da je pod vprašanjem upravičenost izvajanja tovrstnih oblik svetovanja in terapije. Z izbruhom epidemije covid-19 pa je delo na daljavo postalo nuja in številne skupine so bile primorane svoja srečanja nadaljevati na način videokonferenc, hkrati pa so se povečale potrebe po strokovni pomoči [7], zaradi česar so se oblikovale številne nove skupine. Tako je postalo nujno, da se strokovnjakom, strokovnim delavcem v šoli in v zunanjih strokovnih institucijah čim prej ponudi pregled raziskav in jasne smernice za delo skupin preko spleta. Randomiziranih raziskav na tem področju je sicer še vedno malo, dostopne ugotovitve pa so sledeče[14]:

- Udeleženci, ki so bili del spletnih skupin za samopomoč, so poročali o večji opolnomočenosti.
- Video-konferenčne skupine so izvedljive, učinki pa so primerljivi kot v skupinah, ki se srečujejo v živo.
- Skupine, ki temeljijo na vedenjsko – kognitivnih principih dosegajo podobne učinke, kot intervencije, ki potekajo v živo, a je doseganje primerljivih rezultatov običajno dolgotrajnejše.
- Učinkovitost spletnih skupin se poveča z uvedbo gradiva za samopomoč.
- Tako videokonferenčne skupine kot skupine, ki temeljijo na izmenjavi pisnih mnenj (*chat group*) kažejo pomembna izboljšanja v primerjavi s kontrolno skupino, vendar kažejo videokonferenčne skupine primerjalno pomembnejše izboljšanje mentalnega zdravja.
- Učinkovitost spletnih oblik skupinskega dela se razlikuje glede na modaliteto vodenja, vključene posameznike in glede na naravo težav in teme, ki se na skupini odpirajo. Pri mlajših, bolj izobraženih, je možnost uporabe IKT v svetovalni dejavnosti večja, hkrati so večji tudi učinki tovrstnega svetovanja. Večje učinke kažejo skupine, ki delajo po vedenjsko-kognitivnih principih, a upoštevati je potrebno, da je tudi raziskav na teh skupinah več (verjetno zaradi lažjega merjenja učinkov).
- Omejitve dela na daljavo se najbolj intenzivno kažejo na področju oblikovanja skupinske klime in zaupnosti.

Tudi nekatere slovenske raziskave potrjujejo ugotovitve, da kakovost komunikacije in dela na daljavo ni enaka kot prej, saj manjka predvsem osebni stik s sogovorniki, ta stik pa lahko interakcija ob pomoči sodobnih tehnologij samo delno nadomesti [4], kar velja tako za individualne kot za skupinske oblike dela.

Raziskave na področju spletnih skupin so maloštevilne in potrebnih je več raziskav, da bi se raziskalo učinkovitost tovrstnega načina dela za različne posameznike in vsebine. Odprta ostajajo številna vprašanja kot so etična vprašanja, vprašanja zaupnosti informacij in nevarnosti spleta, možnosti za izgradnjo dobrega odnosa, vpliv odsotnosti očesnega stika in fizične bližine in podobno. Vse to so vprašanja, ki doprinašajo k učinkovitosti skupinskih oblik dela in jih je potrebno ob delu na daljavo še posebej nasloviti.

3 DELO SVETOVALNIH SLUŽB IN ZUNANJIH STROKOVNIH INSTITUCIJ V ČASU EPIDEMIJE COVID-19

Mrvar, Jeznik, Šarić in Šteh [4] navajajo: »Ob izbruhu epidemije covida-19 se je življenje in delo v vzgojno-izobraževalnih ustanovah v trenutku izjemno spremenilo. Skupnost otrok, učencev oz. dijakov in strokovnih delavcev se je preselila v virtualni prostor.« Z namenom podpore so bila izdana priporočila za delo z uporabniki, izvedene pa so bile tudi raziskave o tem, kako se je način dela v času epidemije spremenil.

3.1 Predlogi in priporočila za delo šolske svetovalne službe v času izolacije zaradi epidemije

Kmalu po izbruhu epidemije covid-19 in selitvi vzgojno izobraževalnega in svetovalnega dela na daljavo, sta se Zavod RS za šolstvo in Oddelek za pedagogiko in andragogiko Filozofske fakultete UL odzvala na novo nastale razmere in podal nekaj predlogov za delo šolske svetovalne službe v času izolacije zaradi epidemije [12]. Predlogi so se nanašali na:

- ohranjanje stika z udeleženci vzgojno-izobraževalnega procesa,
- dejavnosti v oddelčni skupnosti,
- pripravo napotkov za samostojno učenje doma,
- vprašanja motivacije učencev za šolsko delo,
- seznanjenost o bolezni covid-19 in ukrepih v zvezi z epidemijo in
- na skrb zase.

Posebej so bili izpostavljeni predlogi za individualni pogovor z učenci/dijaki na daljavo. Predlogov in navodil za skupinsko izvajanje podpore in pomoči je bilo manj. Svetovalke ZRSŠ [9] so svetovale, da se svetovalna služba vključi v izvajanje videokonferenčnih razrednih ur, kamor se lahko vključi delavnice iz socialnega in čustvenega učenja. Omenile so tudi možnost organiziranja posebne skupine učencev ali dijakov, ki potrebujejo še dodatno spremljanje, razbremenilne pogovore, konkretnejšo spodbudo in pomoč.

V aprilu 2020 je bila na Oddelku za pedagogiko in andragogiko Filozofske fakultete Univerze v Ljubljani izvedena raziskava, namen katere je bil proučiti, kako se je svetovalna služba soočala z vprašanji, izzivi in težavami, ki so se pojavili med izvajanjem izobraževalnega in svetovalnega dela na daljavo [4]. Dve vprašanji v raziskavi sta se nanašali na sodelovanje svetovalnih delavcev v času dela od doma z drugimi udeleženci, to je s sodelavci, učenci oziroma dijaki, kolegi svetovalnimi delavci in na oceno tega sodelovanja. Iz rezultatov je razvidno, da so bili v stalnem stiku z učitelji oz. vzgojitelji, da so si nudili medsebojno podporo, se posvetovali in reševali aktualne težave. Glede sodelovanja z učenci oz. dijaki raziskava ugotavlja precejšnje razlike glede odzivnosti in sodelovanja, globalna ugotovitev pa je, da »tisti učenci in dijaki, ki že v času rednega pouka niso dobro sodelovali, se tudi sedaj slabo ali pa sploh ne odzivajo«. Tudi glede sodelovanja s starši so rezultati raziskave podobni – pomemben delež staršev ostaja neodziven. Tudi tisti svetovalni delavci, ki so sodelovanje ocenili kot dobro, pa opozarjajo, da manjka osebni stik.

Hkrati so navajali, da je (bilo) v času izobraževanja na daljavo več dela, da je to bolj naporno (za vse udeležene), mnogim se je delavnik raztegnil čez ves dan. Večina dela je potekala individualno, z učenci in dijaki ter učitelji preko e-pošte in videokonferenc, s starši pa je prevladovala komunikacija po spletni pošti. Ugotovitev o prevladujočih načinih komunikacije in o povečanem obsegu dela na področju svetovalne službe, mora nujno voditi v razmišljanje o možnih rešitvah za nastalo situacijo. Ena od možnih rešitev je lahko v skupinskih oblikah dela.

3.2 Primernost skupinskih oblik dela za delo šolske svetovalne službe

Skupinske oblike dela, kot so svetovanje in terapija, so v vzgojno-izobraževalnem prostoru (ob ustrezni usposobljenosti strokovnega delavca) primerne za vse skupine uporabnikov – tako učence, kot starše in učitelje. V skladu s standardi ameriške psihološke agencije APA [11] skupinsko svetovanje praviloma poteka v skupini od 5 do 15 udeležencev z dvema voditeljema, ki sta za tovrstno delo ustrezno usposobljena. Običajno se skupine srečujejo enkrat tedensko in posamezno srečanje traja eno ali dve uri. Številne skupine so oblikovane z namenom psihoterapevtske podpore na točno določenem področju (na primer depresija, anksioznost, motnje hranjenja in podobno), druge pa se usmerjajo na bolj splošna vprašanja izboljšanja socialnih spretnosti, pomoč pri spoprijemanju z jezo, izgubo, sramežljivostjo, osamljenostjo ali nizko samopodobo ali na aktualne izzive vsakdanjika. V šolskem okolju so skupinske oblike dela učinkovite tudi pri spodbujanju izvršilnih funkcij, pridobivanju učnih in organizacijskih veščin, obravnavi tem s področja poklicne orientacije, izgradnji rezilientnosti, podpori staršem pri vprašanjih glede šolanja njihovega otroka ali kot oblika intervizije učiteljev ali drugih strokovnih delavcev in podobno.

Čeprav je vključitev v skupino tujcev lahko sprva zastrašujoča misel, ima skupinsko delo številne prednosti, ki jih individualno svetovanje in pomoč ne moreta nuditi. Prednost skupinskega svetovanja in drugih oblik skupinskega dela z uporabniki je, da omogoča deljenje izkušenj, takojšnje povratne informacije s strani udeležencev skupine in medsebojno učenje. Pomembna prednost skupine je tudi podpora, ki jo skupina nudi posamezniku in normalizacija težav, ki jo lahko posameznik doživi v skupini. Pogosto je namreč prepričanje, da je posameznik v stiski sam, da določeno težavo doživljamo le on, v skupini pa lahko člani spoznajo, da gredo tudi drugi člani skupine skozi podobne težave in da niso sami. Hkrati pridobijo dobrodošle ideje, kako se lahko z neko težavo in stisko soočijo.

Medsebojna podpora je pomembna prednost skupinskega svetovanja, vendar to ni edina prednost skupine. Vsako skupino vodita en ali dva usposobljena voditelja, ki člane skupine učita z dokazi podprtih strategij za reševanje problemov. Zanemariti ne gre niti časovne in finančne ekonomičnosti takih oblik dela, saj lahko en ali dva strokovna delavca v določenem časovnem terminu nudita podporo večjemu številu uporabnikov, kar je še posebej dobrodošlo v časih povečanih stisk in negotovosti, kot je tudi obdobje epidemije covid-19. Zaradi vsega navedenega je lahko intenzivnejše uvajanje skupinskih oblik dela v času dela v živo ali na daljavo, pomembna dopolnitev za svetovalne delavce, s katero lahko delujejo na vseh osnovnih vrstah dejavnosti, predvsem pa na področju razvojnih in preventivnih dejavnosti [10].

4 PRAKTIČNE IZKUŠNJE PRI IZVAJANJU SKUPINSKIH OBLIK DELA NA DALJAVO V SVETOVALNEM CENTRU MARIBOR

Ob intenzivnem sodelovanju s svetovalnimi službami smo v Svetovalnem centru Maribor zaznali povečane potrebe po strokovni pomoči tako staršem, otrokom in mladostnikom, kot strokovnim delavcem šol. Kljub zavedanju omejitev spletnega skupinskega dela smo se zaradi možnosti podpore večjemu številu uporabnikov in ob prednostih, ki jih skupinske oblike dela prinašajo, odločili za izvedbo več skupinskih programov, ki so vsi potekali preko videokonference ZOOM:

- Neverjetna leta – trening starševstva, namenjen staršem vzgojno zahtevnejših predšolskih otrok.
- Učimo se učiti – delavnice namenjene učencem druge in tretje triade z namenom spoznavanja sebe kot učenca, učenje organiziranja časa, preizkušanje različnih strategij učenja in razvijanje veselja do učenja.
- HOPS – delavnice namenjene učencem tretje triade za spodbujanje izvršilnih funkcij, kot so organizacija, pozornost, spomin, začenjanje z aktivnostjo in podobno.
- Trening branja – za učence 4. in 5. razredov, ki se spopadajo s šibkostmi na področju branja ali jim za branje primanjkuje motivacije.
- Supervizija za učitelje – namenjena učiteljem in svetovalnim delavcem kot strokovna in medsebojna podpora v času sprememb, povečanega obsega dela in negotovosti.

Po zaključku posameznih skupinskih programov, je bila izvedena tudi evalvacija s strani udeležencev in izvajalcev. Evalvacija je praviloma potekala v obliki nestrukturiranega intervjuja ali krajše ankete. Povzamemo lahko, da so bile vse oblike skupinskega dela na daljavo kljub določenim omejitvam izvedbe dobro sprejete. Iz odgovorov udeležencev in izvajalcev lahko povzamemo nekatere prednosti in ovire ter izpeljemo priporočila za nadaljnje izvajanje skupinskih oblik dela na daljavo.

Med prednostmi takega načina dela so udeleženci navajali:

- možnost delitve mnenj, izkušenj,
- pridobivanje praktičnih napotkov za reševanje težav,
- učinkovitost naučenih strategij,
- časovno ekonomičnost,
- večjo sproščenost, kot pri srečanjih v živo in
- zmanjšanje občutka osamljenosti.

Omejitve skupinskega dela na daljavo, ki so jih udeleženci zaznavali so bile podobne tistim, o katerih beremo v raziskavah. Poleg pomislekov glede zasebnosti in pasti, ki jih prinaša deljenje zasebnosti preko spleta, so čutili manjšo povezanost skupine zaradi pomanjkanja osebnega stika in neverbalne komunikacije. Nekateri učenci so izrazili pomisleke zaradi manjše zasebnosti – v kolikor do spleta dostopajo iz skupnega prostora v stanovanju, kamor imajo kadarkoli dostop tudi drugi družinski člani. Pomembna ovira so lahko tudi tehnične težave, vendar udeleženci na Svetovalnem centru tega niso posebej izpostavljali.

Skupinsko delo je glede na izkušnje uporabnikov Svetovalnega centra Maribor dobrodošla dopolnitev k podpori, pomoči in svetovanju v času izrednih razmer zaradi epidemije [1, 2, 3]. Vsekakor je pri načrtovanju tovrstnih aktivnosti potrebno upoštevati omejitve in posebnosti, ki jih prinaša videokonferenčni način srečevanja. Med možnimi rešitvami in prilagoditvami so delo v manjših skupinah, ki omogoča bolj poglobljeno diskusijo, dodatne spodbude voditeljev, dodatna gradiva za samopomoč, digitalne oblike nagrajevanja in spodbujanja, spodbujanje k prosti diskusiji med odmori z namenom večjega povezovanja članov skupine in podobno [1, 2, 3, 5 in 13].

5 ZAKLJUČKI

Na področju skupinskega dela na daljavo so potrebne dodatne raziskave. Posebej ostajajo odprta vprašanja vzpostavljanja skupinske povezanosti in dinamike, vpliv pomanjkanja neposredne interakcije, predvsem očesnega stika in vprašljiva kvaliteta vzpostavljenih odnosov. Prehod na spletne oblike skupinskega svetovanja zahteva znanje in trening. Kljub odprtim vprašanjem, pomanjkanju teoretičnih izhodišč in smernic, pa so se skupinske oblike svetovanja v času epidemije izkazale kot učinkovita in dobrodošla oblika dela za vse vključene skupine uporabnikov. Uporabniki so kot posebej dobrodošlo izpostavljali možnost deljenja izkušenj, medsebojnega učenja in medsebojno podporo. Ob strogem omejevanju gibanja in združevanja, so jim tedenska srečanja omogočala stik z drugimi ljudmi in lajšala občutek osamljenosti.

Skupinsko svetovanje tako ostaja pomembna oblika dela z uporabniki v času omejitev in sprememb in je lahko dobrodošlo strokovno in ekonomično dopolnilo k delu svetovalne službe in strokovnih delavcev v zunanjih strokovnih institucijah.

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Karierna orientacija na daljavo

Career orientation online

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POVZETEK

Šolsko leto 2020/21 se je pričelo s »cmokom v grlu«, saj smo se na podlagi pomladne izkušnje zaprtja šol zaradi spopadanja s koronavirusom (COVID-19) spraševali, kako bo potekalo neposredno delo z učenci v novem šolskem letu. Pripravljali smo se na delo »v živo«, a se vzporedno ves čas izobraževali za delo na daljavo.

Ena od pomembnih nalog svetovalne službe je področje kariernega svetovanja – to je dejavnost, ki se načrtno izvaja v zadnji triadi osnovnošolskega izobraževanja in kjer se učenci ob pomoči in vodenju svetovalnega delavca učijo postavljati karierne cilje in sprejemati karierne odločitve. Da bodo učenci sprejeli prave, morajo dobro poznati svoje interese, možnosti in zmožnosti. Šolska podpora in pomoč pri samospoznavanju sta usmerjeni tako v skupinsko delo z učenci kot individualno informiranje.

V prispevku je predstavljen proces karierne orientacije v 8. in 9. razredu osnovne šole v šolskem letu 2020/21, ki je, z izjemo izpolnjevanja prijavnic za vpis v srednjo šolo, potekal na daljavo. Največji izziv je bila soorganizacija tehniškega dne za učence treh osnovnih šol občine Škofja Loka z naslovom »Karierni dan« prek spletnega orodja ZOOM. Tudi individualna svetovanja učencem so do marca potekala prek orodja ZOOM in Arnesovih spletnih učilnic, za starše pa je bila pripravljena posneta Powerpoint predstavitev o dejavnikih kariernega odločanja ter v februarju izveden tudi ZOOM roditeljski sestanek.

S pripravljenostjo na novo učenje, prilagajanje, sodelovanje in iskanje novih rešitev, se je izkazalo, da »ZOOM karierna orientacija iz domačega naslonjača« prinaša tudi nekatere prednosti pred klasičnim načinom dela, ki jih velja razvijati tudi v prihodnje.

KLJUČNE BESEDE

Karierna orientacija, vpis v srednjo šolo, karierni dan, spletno orodje ZOOM, spletna učilnica

ABSTRACT

The 2020/21 school year began with a "lump in the throat", as we wondered how direct work with pupils would take place in the new school year, based on the experience from spring of closing schools due to the Coronavirus (COVID-19). We were preparing for "live" work, but at the same time, we were constantly training for online “distance” education.

One of the important functions of the school counselling service is the field of career counselling - this is an activity that is systematically carried out in the last triad of primary education and where pupils learn to set career goals and make career decisions with the help and guidance of a counsellor. In order for the pupils to determine the right ones, they need to know their interests, opportunities, and abilities well. School support and the help with self-knowledge are focused on both; group work with pupils as well as individual advising.

The article presents the process of career orientation in the 8th and 9th grade of primary school in the school year 2020/21, which, with the exception of filling out application forms for enrolment to secondary school, took place online. The greatest challenge was the co-organization of a technical day for pupils of three primary schools in the municipality of Škofja Loka entitled "Career Day" through the online application ZOOM. Until March, individual counselling for pupils had been conducted using the ZOOM application and Arnes online classrooms, and a recorded PowerPoint presentation on career decision-making factors was prepared for parents, including a ZOOM parents meeting in February.

The readiness for new learning, adaptation, cooperation and finding new solutions have proved that "ZOOM career orientation from the comfort of your home" has indeed some advantages over the traditional way of working, which should be further developed in the future.

KEYWORDS

Career orientation, high school enrolment, career day, online application ZOOM, online classroom

1 UVOD

Svet in ljudje smo v četrti industrijski revoluciji, ki je s seboj prinesla digitalizacijo, avtomatizacijo in robotizacijo, ki posledično močno vplivajo na delovna mesta, dinamiko trga dela in narekujejo prilagajanje vseh vpletenih v ta ekosistem, med

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drugim tudi izobraževalnih inštitucij, kjer se posameznik prvič sreča s karierno orientacijo [1].

Karierna orientacije je orodje, s katerim posameznikom pomagamo pri načrtovanju in vodenju kariere. Zajema tako delo s posamezniki v procesu izobraževanja (tu gre za začetek), kot tudi s tistimi, ki se odločajo za zaposlovanje, so že zaposleni in iščejo novo delo. Ukvarja se tudi z razvojem kadrov in načrtovanjem aktivnosti po upokojevanju.

Prav zaradi sprememb v okviru četrte industrijske revolucije, kot so npr. razvoj na področju genetike, umetne inteligence, nanotehnologije, 3-D tiskanja, biotehnoliogije, … potreba po učinkoviti karierni orientaciji postaja vse večja, saj morajo državljani obvladovati vedno pogostejše prehode znotraj izobraževanja, dodatnega usposabljanja in trga delovne sile [2].

Zaradi bliskovitih tehnoloških sprememb je zelo težko napovedati spremembe v spretnostih, znanjih in veščinah, ki jih bodo posamezniki potrebovali pri opravljanju svojih poklicev. Do leta 2030 naj bi se povečevalo povpraševanje po tehnoloških, socialno-čustvenih in višjih kognitivnih sposobnostih (npr. kritično mišljenje, odločanje, kompleksna obdelava informacij, …). Za mlade, ki prihajajo na trg dela, je tako najbolj pomembno, da spremljajo prihajajoče trende, razvijajo kompetence ter osebno prožnost in fleksibilnost pri odločitvah o poklicni poti [1].

Mladi potrebujejo pomoč pri učenju postavljanja kariernih ciljev in sprejemanju kariernih odločitev. Šolska podpora in pomoč pri samospoznavanju sta usmerjeni tako v skupinsko delo z razredom kot tudi v individualno informiranje in spremljanje posameznega učenca.

Vloga pedagoških delavcev na področju karierne orientacije se je spremenila skladno s spremembami na trgu dela. Ključen premik je v smeri od »tistega, ki ve« v smer vodnika in mentorja, ki učencu »stoji ob strani«. Poleg dobrega poznavanja področja karierne orientacije mora svetovalni delavec biti opremljen tudi z veščinami empatičnega poslušanja, postavljanja vprašanj, vodenja procesa, usmerjanja in svetovanja [1].

Karierna orientacija je pomembno področje, ki se v okviru razrednih ur in dodatnih dejavnosti vključuje v zadnjo triado izobraževanja v osnovni šoli. Kljub spremenjenim pogojem dela zaradi koronavirusa v šolskem letu 2020/21 je svetovalna delavka zavzela stališče, da učenci ne smejo biti prikrajšani za suport in vodenje pri sprejemanju pomembnih življenjskih odločitev, kot je izbira srednješolskega programa oziroma začetek načrtovanja poklicne poti.

2 KARIERNA ORIENTACIJA V OSNOVNI ŠOLI

Karierna orientacija (sprva se je področje dela imenovalo poklicno usmerjanje) je bila tista naloga, zaradi katerih so se pred dobrimi 50-imi leti svetovalni delavci prvič pojavili v slovenskih šolah [3].

Še vedno aktualne programske smernice svetovalne službe v osnovni šoli iz leta 1999 [4] opredeljujejo poklicno orientacijo kot delo z učenci, učitelji, starši in vodstvom šole z namenom pomagati učencem pri izbiri in uresničevanju izobraževalne in poklicne poti.

Ta med drugim zajema:

- sodelovanje pri poklicni vzgoji v okviru rednega pouka učiteljev, skladno s cilji, zajetimi v učnem načrtu, in v okviru ur oddelčne skupnosti;
- svetovalno delo z učenci: zajema vse od informiranja do organizacije obiskov učencev v podjetjih in pri delodajalcih, organizacijo predavanj in pogovorov z zunanjimi strokovnjaki, izvedbo predavanj in delavnic za učence, zbiranje podatkov o učencih za potrebe poklicnega svetovanja ter individualno in skupinsko svetovanje;
- svetovalno in posvetovalno delo z učitelji in drugimi sodelavci na šoli, skrb za bazo informativnih poklicnih gradiv na šoli;
- svetovalno in posvetovalno delo s starši: organizacija predavanj in delavnic o vlogi staršev pri poklicnem razvoju in odločanju;
- sodelovanje z vodstvom in
- sodelovanje in koordinacijo dela z zunanjimi ustanovami (npr. Zavod za zaposlovanje, srednje šole, podjetja, …).

Karierna orientacija zajema štiri ključne elemente [5]:

1. učenje odločitev: učenci razvijajo veščine odločanja;
2. zavedanje o priložnostih: učenci ob strokovni podpori izkusijo in spoznajo svet dela, potencialne priložnosti, zahteve in odgovornosti, ki jih bodo morali izpolniti;
3. učenje prehoda: razvijajo samozavedanje in spretnosti, upravljajo prehode v odraslost, razvijajo mehke veščine, ki jim bodo pomagale pri vstopu na trg dela;
4. samozavedanje: razvijajo zavedanje podobnosti in razlik v primerjavi z drugimi, spoznavajo svoje kompetence in omejitve, raziskujejo interese in vrednote.

Vloga kariernega svetovalca v osnovni šoli je podpora učencem pri spodbujanju spoznavanja samega sebe, raziskovanja področij, interesov, močnih kompetenc, in omogočanje učenja o tem, kako in kje še lahko iščejo informacije, oblikujejo podporno mrežo in tudi načrtujejo cilje in aktivnosti.

Izbira poklica ni več statična, ampak dinamična in spremenljiva, kot je okolje, v katerem odraščajo nove generacije [1].

3 KARIERNA ORIENTACIJA V OSNOVNI ŠOLI CVETKA GOLARJA

3. 1 OSMI RAZRED

Proces karierne orientacije v OŠ Cvetka Golarja poteka na dveh ravneh: na prvi ravni se učenci s poklici seznanjajo na različne načine v okviru pouka vse od 1. razreda dalje, svetovalna služba pa se intenzivneje neposredno v to področje vključi v 8. razredu, ko psihologinja pripravi po dve razredni uri za vse učence. S tema razrednima urama želi učence informirati s srednješolskimi možnostmi v slovenskem izobraževalnem sistemu, hkrati pa preveri predznanje učencev s tega področja. Namen prvih razrednih ur je učence tudi spodbuditi, da začno aktivno raziskovati svoje interese, želje, možnosti in zmožnosti. V drugi polovici šolskega leta se učenci udeležijo tudi tehniškega dne na temo karierne orientacije: pred koronavirusom so obiskovali Vrtiljak poklicev – poklicni sejem gorenjskih srednjih strokovnih in poklicnih šol; v šolskem letu 2020/21 pa so na šoli v sodelovanju s Karierním placom za mlade organizirali tehniški dan, v okviru katerega so učenci spoznali pojem kompetence ter se udeležili različnih delavnic s področja projektnega vodenja, kreativnih poklicev in izdelave Lego animacije. V okviru razrednih ur se učenci učijo tudi postavljanja ciljev, iščejo področja, na katerih so do sedaj že pridobili formalna in neformalna znanja ter raziskujejo lastne interese in izkušnje.

Izkušnje iz prakse kažejo, da večina učencev v 8. razredu intenzivneje še ne razmišlja o prehodu na naslednjo izobraževalno raven. Menijo, da imajo za to odločitev še dovolj časa. Zato svetovalna delavka več aktivnosti s področja karierne orientacije izvede, ko učenci vstopijo v deveti razred in so že bolj notranje motivirani za proces samospoznavanja in postavljanja osebno pomembnih ciljev.

3. 2 DEVETI RAZRED

Delo v 9. razredu se najprej začne z roditeljskim sestankom za starše. Tu so v šoli v letošnjem šolskem letu naleteli že na prvo težavo, saj skupnega dela roditeljskega sestanka za vse starše devetošolcev (trije oddelki učencev) zaradi ukrepov pred širjenjem koronavirusa v živo ni bilo mogoče izvesti. Ker so razredniki srečanje s starši izpeljali v »mehurčkih« v svojih učilnicah, se svetovalna delavka ni odločila za dodatno ZOOM srečanje za starše, saj ni želela podvajati dogodkov. Za starše je pripravila Powerpoint predstavitev o dejavnikih kariernega odločanja in o poteku dela z učenci v 9. razredu ter informacije, ki jih je želela predstaviti staršem, posnela na PPT predstavitev. Predstavitev je v obliki videoposnetka objavila na Youtube kanalu šole. Dobila je kar nekaj povratnih informacij staršev, da je bila predstavitev koristna za pridobivanje informacij s področja karierne orientacije. Osebno pa ni bila čisto zadovoljna z izvedbo prvega predavanja, saj ji je manjkal neposredni stik s starši, zato se je odločila, da bo drugi roditeljski sestanek, če bo le mogoče, izveden v živo ali prek videokonference.

Z devetošolci so konec oktobra začeli z izpolnjevanjem Elektronskega vprašalnika o poklicni poti, ki so ga pripravili na Zavodu za zaposlovanje in že pred leti prevedli v e-obliko, zato ga vsako leto učenci rešujejo v računalniški učilnici. Pred zaprtjem šol je bila dejavnost izpeljana le v enem oddelku, zato je svetovalna delavka vsem ostalim učencem razdelila uporabniška imena in gesla ter pripravila pisna navodila za samostojno delo doma. Večina učencev je elektronski vprašalnik uspešno izpolnila, nekateri učenci pa so imeli težave z izgubljenimi gesli, nedokončanjem vprašalnika, manjšina učencev pa k reševanju sploh ni pristopila. Delo »v živo« ima tu prednost, saj strokovni delavec lahko neposredno pomaga učencu pri izpolnjevanju vprašalnika, kadar pride do težav in tudi motivira učence za reševanje. Učenci pri izpolnjevanju vprašalnika pogosto potrebujejo vodenje odrasle osebe, saj ob podpori odrasle osebe lahko ocenijo svoja močna področja, razmišljajo o svojih interesih, zaznanih ovirah ter motivacijskih elementih in svojih prihodnjih izobraževalnih namerah. Ker o sebi na ta način šele začenjajo razmišljati, potrebujejo mentorstvo in pomoč. Psihologinji ta vprašalnik služi kot priprava na individualne razgovore z učenci v svetovalni službi.

V novembru je šola ponovno sodelovala v soorganizaciji Kariernega dneva – tehniškega dneva za devetošolce. S kolegicama iz sosednjih osnovnih šol so se že konec avgusta dogovorile, da v vsakem primeru karierni dan izvedejo na daljavo – prek spletnega orodja ZOOM, saj je bilo udeleženih okoli 300 devetošolcev in več kot 20 srednjih šol ter njihovih predstavnikov, ki bi se srečevali in se menjavali v skupinah.

Srednjim šolam so svetovalne delavke poslale dopis s povabilom k sodelovanju. Ker tudi same niso bile enotne v uporabi spletnih orodij za videokonference (na eni šoli so uporabljali le MS Teamse, na eni šoli pa tako Teamse kot ZOOM), so se odločile, da bodo zaradi bolj enostavne uporabe srednje šole prosile, da pripravijo predstavitve svojih programov v živo prek spletnega orodja ZOOM ali jim posredujejo vnaprej pripravljeno e-gradivo v obliki promocijskih filmov, povezav do spletnih strani in koristnih informacij glede vpisa. Večina srednjih šol ni imela težav s prilagajanjem na nov način dela, zato so OŠ Cvetka Golarja, OŠ Škofja Loka-Mesto in OŠ Ivana Groharja 11. 11. 2020 v popoldanskem času izvedle dogodek v živo prek spleta, na katerem se je predstavilo več kot 20 srednješolskih programov v posameznih ZOOM predstavitvah. K sodelovanju so povabile srednješolske programe, za katere so učenci izrazili največ interesa v predhodno izvedeni anketi. Vsak učenec si je v posameznem terminu izbral po eno ZOOM predstavitev izmed ponujenih, v prvem delu tehniškega dne pa so vsi učenci prisluhnili kratki predstavitvi Kompetenc, ki so jo pripravili v Kariernem placu za mlade v Kranju. Vse povezave so bile dan pred dogodkom objavljene v spletni učilnici šolske svetovalne delavke. Vsaka svetovalna delavka je koordinirala delo svojih učencev, v prvem delu predstavitve pa so sodelovali tudi razredniki, ki so preverili prisotnost učencev na tehniškem dnevu.

Prednosti e-tehniškega dneva:

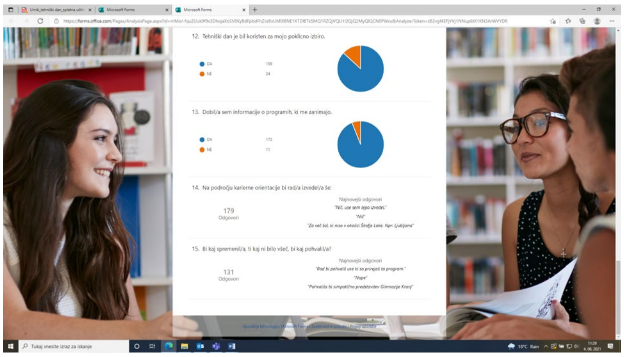
- vse tri šole so ga lahko izvedle istočasno (v preteklosti je bilo treba tehniški dan zaradi velikega števila učencev izvesti na dveh lokacijah);
- če učenec v terminu ZOOM predstavitev ni našel predstavitve, ki bi ga zanimale, si je v tem času ogledal pripravljena promocijska gradiva v obliki filma ali je pregledoval spletne strani;
- tudi po zaključku tehniškega dneva so bile učencem na voljo vse zbrane povezave do koristnih informacij posameznih srednješolskih programov;
- ni bilo prehajanja med učilnicami in dela s pripravo prostorov v šoli; posledično je sodelovalo tudi manj strokovnih delavcev šole.

Pomanjkljivosti oziroma predlogi za naslednje šolsko leto:

Vsaka šola, ki je pripravila ZOOM dogodek, bi morala imeti poleg predavatelja v skupini tudi »co-hosta«, ki skrbi za nemoten potek komunikacije – poskrbi za komunikacijo v »chatu« in bdi nad tem, da učenci z vmesnimi komentarji ne motijo predstavitve.

Ob zaključku tehniškega dneva so učenci v spletnem orodju Forms izpolnili evalvacijo dneva dejavnosti, iz katere je bilo razvidno, da se je večini učencev tehniški dan zdel koristen in zanimiv in so na njem dobili koristne informacije v zvezi z nadaljnjim izobraževanjem.

V Formsih je bila narejena statistična analiza zadovoljstva s tehniškim dnevom vseh udeleženih (slika 1), v Excellovi tabeli pa so bili zbrani posamezni odgovori učencev, tako da so svetovalne delavke dobile povratne informacije o vsakem posameznem učencu šole, ki je izpolnil evalvacijo. Izpolnjena evalvacija je bila pogoj za uspešno opravljen tehniški dan učencev.



Slika 1: Prikaz zadovoljstva učencev s Kariernim dnevom (evalvacija v Formsih)

Od novembra 2020 so potekali individualni pogovori z devetošolci, za katere so starši podpisali soglasje za pomoč na področju karierne orientacije (71 od 73 učencev). Svetovalna delavka je na ZOOM razredni uri učencem objavila razpored prostih terminov, na katere so se učenci vpisali. Seznam s povezavo do srečanj je bil nato objavljen v spletni učilnici. Za razliko od dela v šoli, ko so učenci prihajali na razgovore v času pouka, so bili tokrat razgovori zaradi majhnega števila ur ZOOM pouka, izvedeni izven pouka. Vsak učenec je imel na voljo 20 minut za prvi pogovor. V razgovoru je svetovalna delavka izhajala iz odgovorov, podanih v elektronskem vprašalniku o poklicni poti in z vtisov tehniškega dne. Pregledali so tudi rokovnik za vpis. Večina devetošolcev je že imela oblikovane karierne cilje, neodločeni pa so se večkrat udeležili individualnega pogovora prek ZOOMA, izpolnili pa so tudi interesni vprašalnik Kam in kako. Psihologinja jih je spodbudila tudi k raziskovanju možnosti prek spletnih strani, na primer ogledu spletnih strani srednjih šol in predmetnikov, uporabi aplikacij spletne strani mojaizbira.si, filmov To bo moj poklic na Youtubu. Nezanemarljiv je tudi pogovor s starši, sorojenci in prijatelji.

Namesto šolske oglasne deske je psihologinja oblikovala svojo spletno učilnico. V njej so učenci našli vse aktualne informacije v zvezi z vpisom v srednje šole, objavila je tudi rokovnik o vpisu z vsemi pomembnimi datumi za vpis. Oblikovala je tudi forum za morebitna vprašanja učencev. Učencem je bila na voljo tudi za klepet v klepetalnici spletne učilnice ali prek elektronske pošte. Svetovalno delo tako ni imelo več osemurnega delovnika od ponedeljka do petka, ampak je bilo razporejeno čez ves dan in tudi ob koncih tedna, saj je bilo potrebno uskladiti delovne in domače oz. družinske obveznosti. V februarju se je psihologinja s starši devetošolcev srečala še na ZOOM roditeljskem sestanku, kjer so starši dobili informacije o rokovniku za vpis v srednje šole, dosedanjem delu na področju karierne orientacije z njihovimi otroki ter informacije o štipendijah. Tokrat so zaradi dogodka v živo lažje tudi vzpostavili dvosmerno komunikacijo in tako so starši takoj dobili odgovore na vsa vprašanja. Največ vprašanj je bilo glede spremenjenih pogojev za pridobitev Zoisove štipendije zaradi posledic koronavirusa.

Tudi informativni dnevi so potekali na daljavo in učenci so ponujene termine v večini dobro izkoristili. Srednje šole so se potrudile, da bi učencem čim bolj približale izobraževalne programe, za katere izobražujejo, in okolje, v katerem poteka izobraževanje.

V mesecu marcu je ostalo le še izpolnjevanje prijavnic za vpis v srednjo šolo, ki pa je, kljub naprednemu razvoju in pridobljenemu znanju na področju e-tehnologij, zaradi zastarelosti in preobremenjenosti portala ministrstva potekal po starem – s pisno prijavnico po navadni pošti. Svetovalna delavka je v okviru razrednih ur učencem pomagala pri izpolnjevanju prijavnic in jih nato tudi poslala na naslove srednjih šol. Na ta način pridobi podatke o vpisu učencev v posamezne izobraževalne programe in poskrbi, da prav vsi učenci do izteka roka oddajo prijavnico za vpis.

Po končanem postopku vpisa je bila svetovalna delavka učencem na voljo še za vprašanja o prenosu prijavnic, informacije o vpisnem postopku ter načinih in rokih za oddajanje vlog za pridobivanje različnih štipendij. Karierna orientacija se za večino devetošolcev konča z zaključkom šolskega leta in uspešnim vpisom, nekateri učenci pa se po pomoč v šolo vračajo tudi v času drugega in tretjega vpisnega roka.

4 ZAKLJUČEK

Dolgotrajno šolanje na daljavo je prineslo številne izzive, saj je pouk od doma od učencev zahteval veliko samostojnosti in samoiniciativnosti. Na področju karierne orientacije so učenci 8. in 9. razreda OŠ Cvetka Golarja v šolskem letu 2020/21 pokazali veliko mero odgovornosti, samostojnosti in pripravljenosti za delo v spremenjenih pogojih. To dokazuje, da je karierna orientacija področje dela, ki je za učence zelo pomembno, zato so se tudi udeležili vseh ponujenih aktivnosti. Redno so pregledovali spletno učilnico svetovalne delavke, se odzivali na elektronsko pošto, ob dogovorjenem času so se udeleževali ZOOM razrednih ur, individualnih srečanj in opravili vse zadolžitve v okviru kariernega dne.

Čeprav nam je vsem bolj blizu klasičen način dela v učilnicah, je na področju karierne orientacije smiselno obdržati nekatere oblike dela. Karierni dan je tako tudi v šolskem letu 2021/22 načrtovan prek spletnega orodja ZOOM, prav tako bo svetovalna delavka ohranila oglasno desko v spletni učilnici, ki učencem omogoča, da le s klikom na miško pridejo do želenih informacij na svetovnem spletu.

Nenazadnje pa so tudi strokovni delavci okrepili svoje digitalne kompetence in pridobili ogromno novega znanja, ki omogoča inovativen pristop k poučevanju sodobnih generacij.

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Z orodjem Nearpod do interaktivne obravnave domačega branja

With the online tool Nearpod to interactive home reading discussion

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POVZETEK

Domače branje je obvezna dejavnost v okviru pouka slovenščine, s katero učenci razvijajo sposobnost branja, razumevanja in vrednotenja književnih besedil. Izbrano književno besedilo učenci doma preberejo in zapišejo bralni dnevnik, pri pouku pa sledijo pestre dejavnosti, ki preverjajo in nadgrajujejo učenčevo razumevanje prebranega ter razvijajo kritično mišljenje in ustvarjalnost. Izpeljava omenjenih dejavnosti po samostojnem branju se je izkazala kot poseben izziv v času pouka na daljavo, saj je bil učitelj dolžan poiskati in osvojiti orodje, ki je nezahtevno za uporabo, oz. interaktivne dejavnosti, ob katerih bi učenci najlažje usvojili vse predvidene učne cilje.

V prispevku je predstavljena procesna obravnava književnega besedila na daljavo, izdelana v plačljivem spletnem orodju Nearpod, ki omogoča vključevanje učiteljevih lastnih gradiv, povezav na videe in številnih interaktivnih aktivnosti, ki od učencev zahtevajo aktivno udeležbo. Rešitve nalog so predstavljene v obliki poročil, ki učitelju služijo kot dokaz o aktivnosti in napredku posameznega učenca in vplivajo na metode in oblike dela v prihodnjih učnih urah. Za izbiro tega orodja smo se odločili tudi zato, ker uporaba ni zapletena, učenci za sodelovanje ne potrebujejo gesel in uporabniških imen. Nekatere naloge so učenci reševali samostojno, ko jim je časovno ustrezalo, medtem ko so kviz reševali istočasno, v živo, ko smo se srečali na videokonferenci. Za reševanje interaktivnih izzivov v orodju Nearpod so bili učenci visoko motivirani, naloge so bile rešene v z visokim deležem. Nekateri so se reševanja lotili tudi večkrat in izkazali željo po znanju. Še posebej so bili pripravljeni sodelovati v kvizih, ki so bili izvedeni istočasno, saj so bili tako povezani s sošolci, pa tudi element tekmovalnosti je pripomogel k strmenju po napredku.

KLJUČNE BESEDE

Nearpod, domače branje, pouk na daljavo, interaktivne naloge

ABSTRACT

Home reading is a compulsory activity within the Slovene language lessons, with which pupils develop the ability to read, understand and evaluate literary texts. Pupils read the selected literary text at home and write a reading diary, followed by a variety of activities that check and upgrade the pupil's understanding of what is read and develop critical thinking and creativity. Carrying out the mentioned activities after independent reading proves to be a special challenge during distance learning, as the teacher is obliged to find and master a tool that is not demanding to use or interactive activities in which pupils would find it easiest to master all the intended learning objectives.

The article presents the process discussion about a literary text during distance learning, made in the paid online tool Nearpod, which includes the inclusion of the teacher's latest constructions, links to videos in various interactive activities that require pupils to actively participate. Solutions of the tasks are presented in the form of a report that serves as a proof to the teacher of the activities in the progress of an individual pupil and influences the methods and forms of work in future lessons. We chose this tool also because the use is not complicated, pupils do not need passwords and usernames to participate. Some tasks were solved by the students independently when the time suited them (Student-Paced), while they solved the quiz at the same time, live, when we met at the videoconference (Live Participation). To solve the interactive challenges in the Nearpod tool, the pupils were highly motivated, the tasks were solved in a high proportion. Some of them also solved the tasks several times and showed a desire for knowledge. In particular, they were willing to participate in quizzes that were conducted at the same time, as they were thus connected to classmates, and the element of competition also helped to strive for progress.

KEYWORDS

Nearpod, home reading, distance learning, interactive assignments

1 UVOD

Posodobljeni učni načrt za slovenščino iz leta 2018 na ravni vključevanja medpredmetnih vsebin posebno pozornost namenja razvijanju digitalne pismenosti učencev. Ti naj bi uporabljali digitalno tehnologijo pri razvijanju sporazumevalne zmožnosti in pri komunikaciji (dejavnem stiku) z besedili, in sicer:

- pri sprejemanju, razčlenjevanju in tvorjenju neumetnostnih in umetnostnih besedil;
- kot podporo kritičnemu mišljenju, ustvarjalnosti in inovativnosti;
- za iskanje, zbiranje, izmenjavo in obdelavo podatkov ter njihovo sistematično rabo pri tvorjenju informacij, pri čemer naj bi se posluževali primerne strojne in programske opreme in samostojno uporabljali primerne

didaktične računalniške programe in splet kot vir podatkov in komunikacijsko orodje [1].

Učitelji slovenščine, ki nam je IKT blizu, smo pri neposrednem delu v učilnici že pred prenovo učnega načrta nemalokrat uporabljali spletna orodja in e-vsebine (e-gradiva, e-učbenike, spletne slovarje in druge jezikovne priročnike) ali izpeljali učno uro v računalniški učilnici, kjer so učenci oblikovali besedila in se seznanili tudi s kritično uporabo urejevalnikov, pregledovalnikov in črkovalnikov besedil. Pri pouku z vključevanjem IKT je učitelj mentor, ki glede na učenčevo zmožnost uporabe strojne in programske opreme diferencira metode in oblike dela. Nekateri učenci niso suvereni pri uporabi računalnika in programske opreme – te učitelj vodi, da se seznanijo s programom oz. spletnim orodjem, v nadaljevanju pa so usmerjeni k doseganju učnih ciljev predmeta. Domačih zadolžitev ali projektnih nalog, ki bi vključevale uporabo IKT, večinoma nismo vključevali, saj vsem učencem ne bi mogli zagotoviti enakih možnosti (neenakovredna preskrbljenost gospodinjstev s strojno opremo).

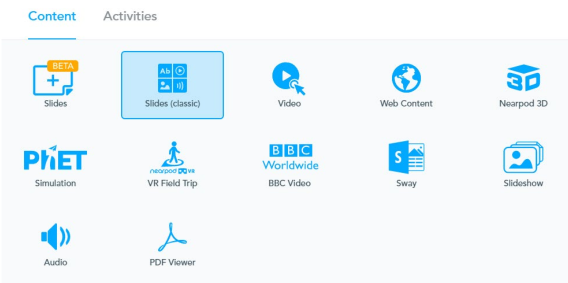
V času pouka na daljavo so bile tako za učitelje kot učence edina mogoča izbira učne ure v spletnem okolju. Poleg uporabe spletne učilnice in videokonferenčnega orodja Zoom, na uporabo katerih smo učence sistematično pripravljali od prvega tedna v šolskem letu 2020/21 dalje, smo učitelji želeli učencem ponuditi privlačnejše interaktivne vsebine, zato smo poiskali in raziskali številna spletna orodja. Z vidika učitelja nas je zanimalo, ali e-gradivo sledi učnim ciljem, ali bo učencem zanimivo, ali vsebuje kakovostne multimedijske elemente, kakšne vrste nalog vsebuje … Z vidika uporabnika učenca pa smo morali upoštevati učenčevo znanje o uporabi informacijskih tehnologij, preglednost e-gradiva, preprostost uporabe, vsebnost multimedijskih elementov, presoditi koliko naše pomoči učenec potrebuje oz. v kolikšni meri je ob naših navodilih lahko samostojen (razumljivost razlage, nalog …), koliko je učenec lahko dejaven (interaktivnost e-gradiva), na kakšen način bomo lahko mi in učenci dobili povratno informacijo o njihovem znanju, ali je e-gradivo res vsem dostopno ipd. [2]. Poleg omenjenega je bilo bistvenega pomena, da učitelj zna izdelati, oblikovati ali posodobiti e-gradiva in dejavnosti, s katerimi je sodelujočim v procesu izobraževanja pri pouku omogočeno sodelovalno delo, reševanje problemov, raziskovanje ali ustvarjanje [3].

V nadaljevanju prispevka bo natančneje predstavljeno plačljivo orodje Nearpod, ki smo ga izbrali za obravnavo književnega besedila, ki so ga učenci prebrali kot domače branje v 6. razredu. Orodje omogoča vključevanje učiteljevih elektronskih prosojnic, povezav na videe in številnih interaktivnih aktivnosti, ki predvidevajo učenčevo aktivno udeležbo.

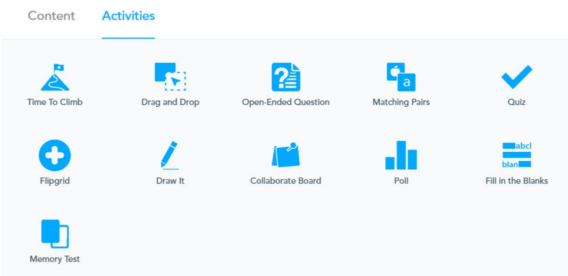
2 PRIMER UPORABE SPLETNEGA ORODJA NEARPOD

2.1 Kaj je Nearpod?

S spletnim orodjem Nearpod lahko pripravimo vsako učno uro interaktivno. Oblikovano je v obliki nadzorne plošče, kamor lahko naložimo PPT-projekcije, Google prosojnice (Google Slides), PDF-je ipd. in vključimo svoje videe ali dodamo video direktno z YouTuba (Slika 1). Da lahko učenci pokažejo, kaj znajo, nam orodje ponuja številne interaktivne didaktične igre npr. kviz, kratka vprašanja, likovni izziv, iskanje parov, dopolnjevanje besedila …) (Slika 2). Rezultati reševanja nalog so prikazani v obliki natančnih statistično oblikovanih poročil. Kdaj in kako bodo učenci naloge reševali je mogoče nastaviti – ali ko bodo imeli čas (način Student-Paced) ali v živo, istočasno, v našem primeru na videokonferenčni uri (način Live Participation).



Slika 1: Nabor gradiv, ki jih lahko naložimo na nadzorno ploščo

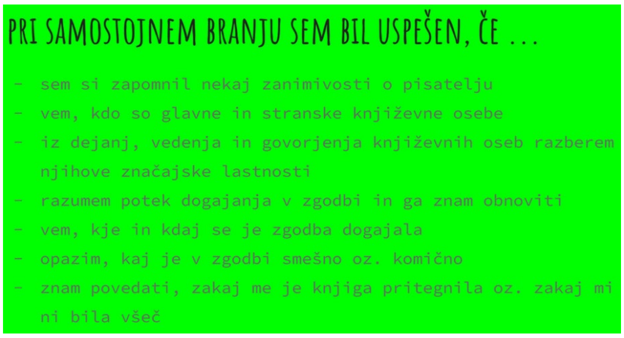


Slika 2: Nabor interaktivnih aktivnosti

2.2 Uvodna motivacija

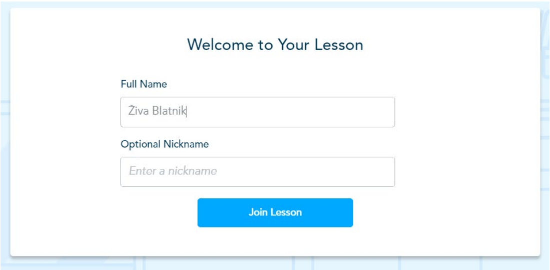
Med ali po branju so učenci samostojno zapisali bralni dnevnik (podatki o avtorju in književnem besedilu, kratka obnova, razločevanje glavnih in stranskih književnih oseb, izražanje mnenja o ravnanju književnih oseb in utemeljitev o všečnosti prebranega besedila) in fotografijo dela zapisa posredovali v spletno učilnico. Bralni dnevniki so bili prvi dokazi o tem, kako natančno je bilo branje in kako so besedilo razumeli. V skladu s temi dokazi smo pripravili nadaljnje aktivnosti v orodju Nearpod.

Prvo uro so učenci razmišljali, ali so bili pri samostojnem branju uspešni. Učni sklop smo tako začeli s prosojnico o kriterijih uspešnosti (Slika 3) in se o njih pogovorili na videokonferenčni učni uri.



Slika 3: Vstavljena Google prosojnica

Učni sklop so dopolnjevale interaktivne naloge, ki naj bi jih učenci približno dve šolski uri reševali samostojno v t. i. Student-Paced načinu, zato je v nadaljevanju učne ure sledila predstavitev spletnega orodja in konkretna ponazoritev njegove uporabe. Učencem smo pokazali, da bodo v spletno učilnico dobili povezavo do učnega sklopa. Ko bodo kliknili na povezavo, se bo odprlo okno, kamor bodo zapisali svoje ime in priimek in kliknili gumb »Join Lesson« (Slika 4). Pokazali smo jim, katere aktivnosti jih čakajo v tem spletnem okolju, kako se jih rešuje in na kakšen način oddajo svoje rešitve (s klikom na »Post« ali »Submit«). Preden smo se poslovili, so vsi poskusili, ali na njihovi napravi povezava deluje.

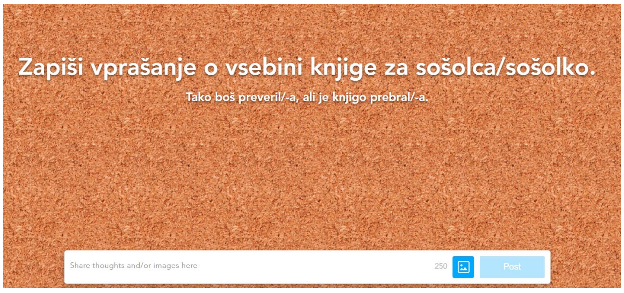


Slika 4: Vstop v interaktivno učno uro

2.3 Interaktivne aktivnosti (Student-Paced)

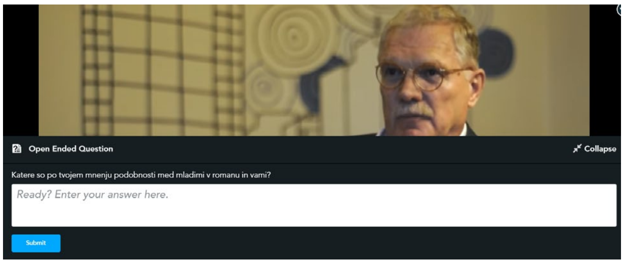
Interaktivne dejavnosti so bile izbrane premišljeno in so učence postopoma vodile od osvajanja minimalnih do temeljnih standardov znanja.

Prva naloga je narekovala, da zapišejo vprašanje o vsebini prebranega, ki bi ga zastavili sošolcem (Slika 5). S postavljenem vprašanja sošolcu je učenec dokazal, da je tudi sam prebral besedilo. Na vprašanja, ki so se pojavila na tabli, so učenci odgovarjali na eni od naslednjih videokonferenčnih ur.



Slika 5: Tabla, na katero so učenci dodajali vprašanja

Druga aktivnost je bila sestavljena iz posnetka, v katerem pisatelj Slavko Pregl pojasnjuje okoliščine nastanka mladinskega romana in značajske posebnosti književnih oseb. V posnetek smo vstavili odprta vprašanja, ki so preverjala tako razumevanje književnega dogajanja kot vrednotenje besedila oz. posameznih prvin besedila (Slika 6).



Slika 6: Primer odprtega vprašanja, vključenega v posnetek

Sledila je aktivnost, ki je preverjala razumevanje zaznamovanih besed oz. besednih zvez in besed v prenesenem pomenu ter zaznavanje humorne perspektive v besedilu. Gre za igro spomina – na eni kartici je v beseda oz. besedna zveza, na drugi pa njena razlaga. Učenci so morali ustrezno povezati pare (Slika 7).

Slika 7: Igra spomin

Zadnja aktivnost je bila pripravljena v obliki kviza (Slika 8) in je preverjala, ali učenec sledi književnemu dogajanju in ga razume ter prepozna glavne motive za ravnanje književnih oseb.

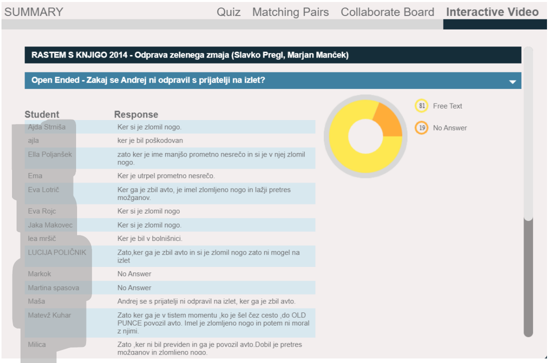
Slika 8: Primer vprašanja v kvizu

2.4 Poročila

Interaktivna učna vsebina je bila časovno omejena za reševanje na 48 ur, po tem času sodelovanje bi bilo več mogoče. Nato smo pregledali poročila, ki jih orodje statistično natančno izdela (Slika 9).

Iz poročil smo izvedeli:
- kateri deli besedila so bili učencem težje razumljivi;
- kako dobro so uspeli razvozlati besedne igre, besede v prenesenem pomenu ipd.;
- ali so v besedilu zaznali humorno perspektivo in kje;
- ali razumejo časovno in vzročno-posledično zaporedje dogodkov, vzvode za ravnanje književnih oseb itd.

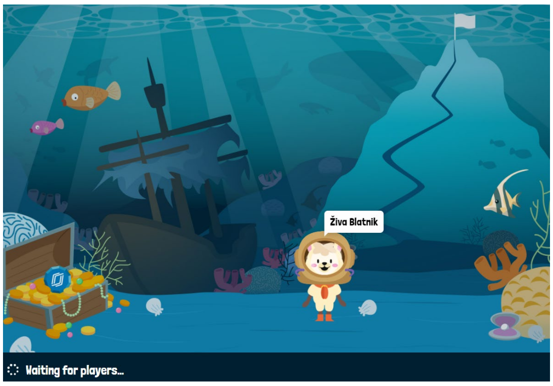
V skladu z ugotovitvami smo pripravili še 2 učni uri, pri katerih so učenci sodelovali v razgovoru in v zvezek zapisali nekaj bistvenih ugotovitev.



Slika 9: Primer poročila

2. 5 Istočasna interaktivna dejavnost (Live Participation)

Zadnjo uro obravnave domačega branja smo preverili, kako dobro so učenci usvojili predvidene učne cilje. Pripravili smo kviz »Time to climb«, ki je preverjal tako doživljanje, razumevanje in vrednotenje književnega besedila kot tudi literarnovedno znanje. Učitelju je omogočena izbira med različnimi izgledi kviza, ki prispevajo k privlačnejši podobi in posledično bolj doživeti uporabniški izkušnji. Na videokonferenci so se učenci s kodo pridružili kvizu v živo, izbrali so si svoj vzdevek in karakter (Slika 10). Ko so bili v kviz vpisani vsi učenci, smo delili zaslon, kjer so lahko opazovali, kako napredujejo v primerjavi s sošolci. Vsako rešitev smo sproti pokomentirali, da so tudi učenci z napačnimi rešitvami lahko zapolnili vrzeli v svojem znanju. Motivacija za tak način dela je bila v času pouka na daljavo še posebej visoka, saj je sodelovanje s sošolci vzbujalo občutek pripadnosti in povezanosti. Učenci so želeli kviz reševati kar dvakrat in tako so vsi še dodatno utrdili svoje znanje.



Slika 10: Kviz omogoča izbiro karakterja

3. REZULTATI

Kljub temu da so bile vse ure pouka, v okviru katerih smo obravnavali domače branje, izpeljane na daljavo – ali v obliki videokonferenčnega pouka ali samostojnega dela učencev v spletnem orodju Nearpod – so vsi učenci dosegli večino zastavljenih učnih ciljev. O doseganju standardov znanja pričajo poročilo zaključnega kviza in preverjanje ter ocenjevanje znanja ob vrnitvi v šolske klopi. Lahko trdimo, da so bili nekateri učenci v spletnem okolju celo aktivnejši, kot so pri običajnem pouku. Kot narekujejo Smernice za uporabo IKT pri predmetu slovenščina, se je izkazalo, da lahko raba informacijskih tehnologij bistveno pripomore h kvalitetnejšemu pouku, ko je tesno povezana z novimi načini in oblikami dela, predvsem pa s cilji in z vsebinami pouka slovenščine, tj. z razvijanjem sporazumevalne zmožnosti [4].

4. ZAKLJUČEK

V obdobju, ki je za učence predmetne stopnje trajalo skoraj štiri mesece, je bilo smiselno in zaželeno, da smo učitelji posegali po spletnih orodjih, ki učne vsebine popestrijo, učence spodbudijo k aktivnemu učenju in pripomorejo k razvijanju učenčeve odgovornosti za lastno učenje.

Uporaba spletnega orodja Nearpod pri obravnavi domačega branja v času pouka na daljavo se je izkazala kot uspešen primer prakse, saj je omogočila hitrejše in kakovostnejše doseganje ciljev pouka književnosti. Učenci so bili namreč nasičeni s frontalnim delom v obliki videokonferenc in jim je bilo reševanje oz. igranje interaktivnih nalog in iger v veselje. Izkazalo se je tudi, da so bile omenjene naloge rešene z visokim deležem (21 učencev od 22), nekatere celo večkrat. Vsekakor pa so bili najbolj motivirani za igranje kvizov istočasno, v živo, ki so omogočili tekmovanje s sošolci in izražanje pripadnosti oddelku. Nestabilna internetna povezava v domovih nekaterih učencev se je pokazala kot edina pomanjkljivost pri istočasnem sodelovanju v kvizu, saj jim je kviz prekinjal ali pa jim je bilo sodelovanje celo onemogočeno.

Na katero izmed vrsto aktivnosti, ki jo omogoča orodje Nearpod, bi se bilo smiselno opreti tudi med poukom v učilnici (tako pri slovenščini kot drugih predmetih) kot element uvodne motivacije ali hitrega preverjanja znanja na inovativen in igriv način.

5. LITERATURA IN VIRI

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Liveworksheets - ko učni listi oživijo

Liveworksheets - when worksheets come alive

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POVZETEK

Namen prispevka je predstaviti spletno orodje za izdelavo interaktivnih učnih listov Liveworksheets ter nekaj primerov nalog. S tem orodjem lahko različne dokumente (pdf, jpg, png) spremenimo v spletne vaje, ki omogočajo samodejno popravljanje nalog. Učitelju orodje nudi tudi vpogled v to, kako so učenci reševali naloge. Na podlagi tega lahko učitelj nato učencem poda povratno informacijo o njihovem delu in napredku.

KLJUČNE BESEDE

Liveworksheets, spletno učno orodje, učni listi, interaktivne naloge, formativno spremljanje

ABSTRACT

The aim of the article is to present an online learning tool called Liveworksheets and a few examples of exercises designed with it. This learning tool allows us to transform different documents (pdf, jpg, png) into interactive online exercises with self-correction. By using Liveworksheets, teachers get a chance to check the students' answers and give them feedback on their work and progress.

KEYWORDS

Liveworksheets, online learning tool, worksheets, interactive exercises, formative assessment

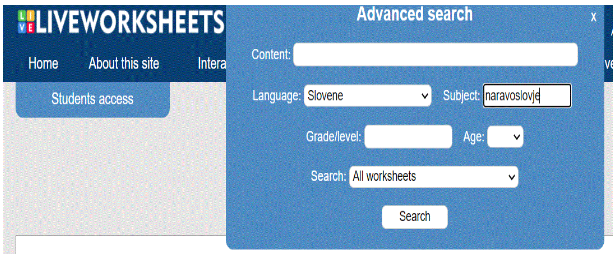
1. UVOD

Zadnji dve šolski leti sta bili popolnoma drugačni od prejšnjih let. Šole so se za nekaj mesecev zaprle, učitelji pa smo izgubili neposreden stik z učenci. Spoprijeti smo se morali s poučevanjem učencev na daljavo. Učencem smo pošiljali navodila za delo preko različnih kanalov, pošiljali smo jim učne liste in posnetke z razlago učne snovi, obenem pa iskali nova spletna orodja, ki bi nam vsem delo olajšala. Eno izmed spletnih orodij, ki sem ga preizkusila pri pouku angleščine, je spletna stran za izdelavo interaktivnih učnih listov Liveworksheets. Meni osebno se je izkazala za zelo uporabno sredstvo poučevanja in učenja pri angleščini.

2. UČNO ORODJE LIVEWORKSHEETS

Liveworksheets je spletno orodje, ki običajne učne liste spremeni v interaktivne spletne naloge, ki omogočajo samodejno popravljanje nalog. Učenci dobijo takojšnjo povratno informacijo, pregled nad njihovimi odgovori pa ima tudi učitelj. [1]

Orodje nam uporabnikom ponuja dve možnosti. Prva možnost je, da na spletni strani https://www.liveworksheets.com/ z brskalnikom 'Search interactive worksheets' pregledamo bazo že obstoječih nalog in uporabimo le-te. Zbirka že pripravljenih nalog zajema veliko različnih jezikov in predmetov. Za lažje iskanje imamo možnost uporabe naprednega iskanja ('advanced search'), kjer poleg ključnih besed lahko vnesemo še nekaj ostalih filtrov: jezik, predmet, razred oz. stopnjo ter starost (slika 1).

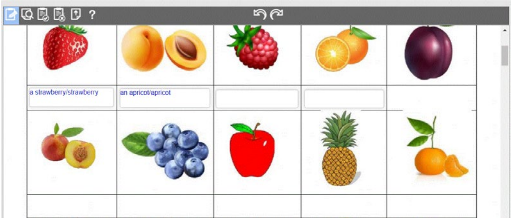


Slika 1. Določanje kriterijev za napredno iskanje (VIR: lasten, zajem zaslonske slike)

Za iskanje ustreznih nalog lahko namesto zgornjega brskalnika ali naprednega iskanja uporabimo tudi zavihek 'Interactive worksheets'. Na seznamu na levi strani izberemo področje, ki nas zanima, in pregledamo ponujene naloge.

Če med že obstoječimi nalogami ne najdemo ustrezne, lahko ustvarimo tudi lastne naloge (za to je potrebna registracija). Z izbiro zavihka 'Make interactive worksheets' se nam prikažejo tri možnosti. Ko se prvič spopademo z ustvarjanjem lastnih nalog, nam prvi dve možnosti ('tutorial' in 'video tutorial') ponujata navodila za delo v pisni in video obliki. Z možnostjo 'Get started' nato pričnemo z delom. V orodje naložimo datoteko, ki jo želimo pretvoriti v interaktivno nalogo. Sistem datoteko pretvori v sliko. Na tistih mestih, kjer od otrok želimo odgovore, narišemo okvirčke in vanje vnesemo pravilne odgovore (slika 2), da lahko računalnik potem nalogo pregleda. [2]

Zaželeno je, da ustvarjene interaktivne naloge delimo z drugimi uporabniki, določeno število nalog pa lahko nastavimo kot zasebne in jih obdržimo zase oz. delimo le s svojimi učenci.



Slika 2. Vnašanje okvirčkov in pravilnih odgovorov (VIR: lasten, zajem zaslonske slike)

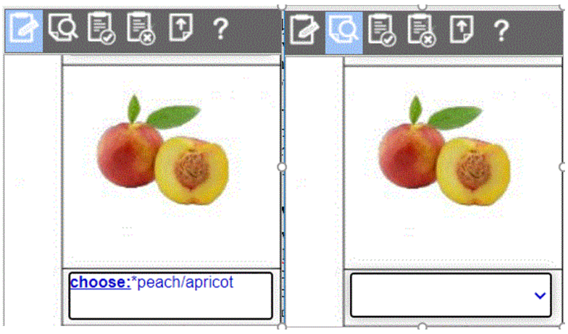
3. TIPI NALOG

3.1 Dopiši ustrezen odgovor ('gap fill')

Orodje omogoča oblikovanje različnih tipov nalog. Najbolj osnoven tip naloge (in za oblikovanje tudi najenostavnejši) je, da na mestih, kjer želimo odgovore, narišemo okvirčke in vnesemo odgovore, za katere želimo, da se štejejo kot pravilni. Priporočljivo je, da vnesemo vse odgovore, ki so sprejemljivi (npr. an apricot, apricot). [3]

3.2 Izbirni tip s spustnim menijem ('drop down select box')

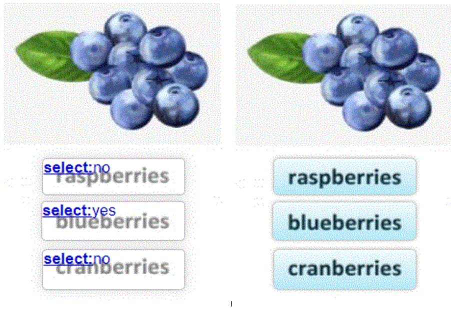
Pripravimo lahko tudi nalogo izbirnega tipa, pri kateri učenci med vsaj dvema odgovoroma v spustnem meniju izberejo pravilnega. To storimo tako, da v okvirček najprej napišemo besedo 'choose', dodamo dvopičje, nato pa vnesemo možne odgovore. Pravilni odgovor označimo z zvezdico (slika 3).



Slika 3. Priprava naloge 'izbirnega tipa s spustnim menijem in končana naloga (VIR: lasten, zajem zaslonske slike)

3.3 Izbirni tip ('multiple choice exercise')

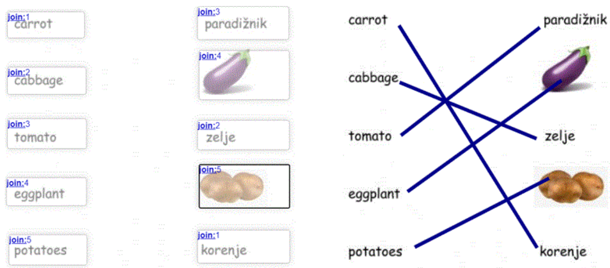
Ustvariti je možno tudi drugačno nalogo izbirnega tipa. Učencem lahko ponudimo več odgovorov, med katerimi enega izberejo. Možni odgovori se v tem primeru ne nahajajo v spustnem meniju, ampak morajo biti napisani že na učnem listu, ki smo ga naložili na internet. Čez vsak možen odgovor narišemo okvirček, vanj pa natipkamo besedo 'seleči', dodamo dvopičje, nato pa pri pravilnem odgovoru napišemo 'yes', pri napačnem pa 'no' (slika 4).



Slika 4. Priprava naloge 'izbirnega tipa' in končana naloga (VIR: lasten, zajem zaslonske slike)

3.4 Povezovanje parov ('join with arrows')

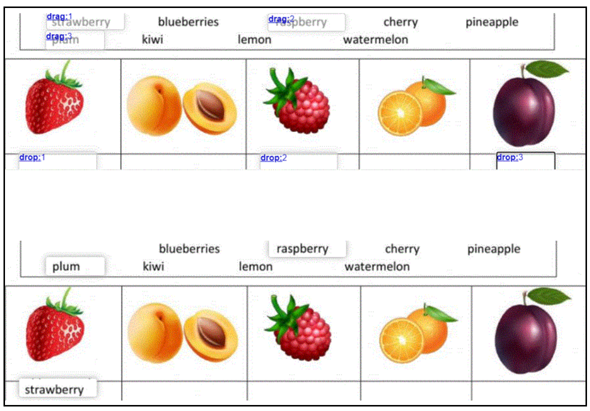
Zelo priljubljen tip naloge, ki jo je možno narediti, je povezovanje parov. Čez odgovore na učnem listu narišemo okvirčke, vanje vnesemo besedo 'join', dodamo dvopičje, nato pa odgovora, ki ju je potrebno povezati, označimo z isto številko (slika 5).



Slika 5. Priprava naloge 'povezovanja parov' in rešena naloga (VIR: lasten, zajem zaslonske slike)

3.5 Povleci na ustrezno mesto ('drag and drop')

Oblikujemo lahko tudi nalogo, kjer je potrebno odgovore prenesti na ustrezna mesta. Okvirčke narišemo tja, kamor želimo, da učenci premaknejo posamezne odgovore. Vanje napišemo 'drop', dodamo dvopičje, nato pa številke. Odgovori, za katere želimo, da jih učenci potegnejo na ustrezna mesta, morajo biti napisani že na učnem listu. Čez njih narišemo okvirčke ter vanje natipkamo 'drag', dvopičje in številko mesta, na katerega je potrebno polje prenesti (slika 6).



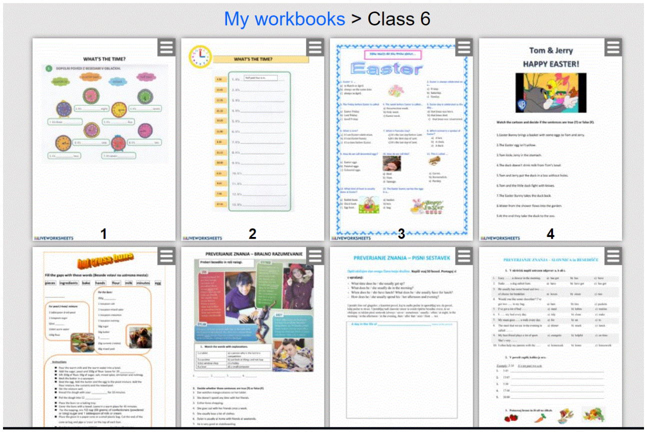
Slika 6. Priprava naloge tipa 'povleci na ustrezno mesto' in končana naloga (VIR: lasten, zajem zaslonske slike)

3.6 Ostale možnosti

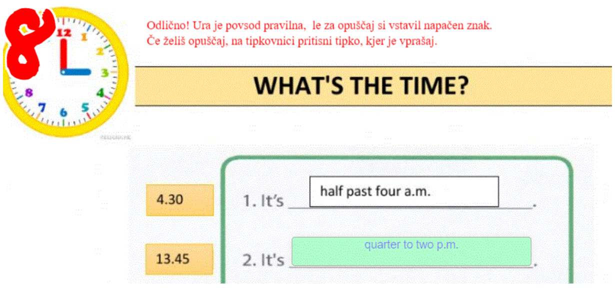
V učne liste lahko dodamo še zvočne posnetke, video posnetke, datoteke Powerpoint, pripravimo lahko govorne naloge (te učenci rešijo s pomočjo mikrofona). Naredimo lahko tudi naloge odprtega tipa. Pri teh vnesemo le okvirček za odgovor in pustimo praznega. Teh nalog učenci seveda ne morejo sami pregledati. [3]

4. REŠEVANJE NALOG IN POVRATNA INFORMACIJA

Učenci do nalog dostopajo na dva načina. Prva možnost je, da od učitelja prejmejo povezavo do naloge in jo rešijo. Na koncu naloge pritisnejo gumb 'Finish' in 'Check my answers', da pregledajo odgovore. Pravilni odgovori so obarvani z zeleno, napačni pa z rdečo. V zgornjem levem kotu se jim prikaže tudi skupna ocena. Če želijo svoje odgovore pregledati in jih hkrati poslati učitelju, izberejo gumb 'Send my answers to the teacher'. V tem primeru morajo vnesti elektronski naslov svojega učitelja. Učitelj obvestilo o rešeni nalogi dobi v elektronski nabiralnik, učenčeve odgovore pa ima shranjene tudi v svojem računu na Liveworksheets v zavihku 'Notifications'.



Slika 7. Primer interaktivnega delovnega zvezka (VIR: lasten, zajem zaslonske slike)



Slika 8. Primer komentarja ob nalogi (VIR: lasten, zajem zaslonske slike)

Če učitelj želi boljši pregled nad delom učencev, pa se lahko odloči za drugo, nekoliko bolj zapleteno varianto. Za učence ustvari interaktivne delovne zvezke (slika 7), v katere doda lastne naloge oz. naloge drugih uporabnikov. Učenci si morajo za dostop do delovnih zvezkov ustvariti svoj račun, lahko jim ga ustvari tudi učitelj. Z uporabniškim imenom in geslom se prijavijo v orodje (izberejo zavihek 'Student access') in dostopajo do delovnih zvezkov oz. nalog, ki jim jih učitelj dodeli. Učitelj ima v tem primeru vpogled v njihove delovne zvezke, kadarkoli lahko pregleda naloge, ki so jih rešili in zraven nalog oz. posameznih primerov doda svoje komentarje (slika 8).

Brezplačni paket učiteljem dovoljuje do 10 interaktivnih delovnih zvezkov in do 100 prijavljenih učencev. [3]

5. ZAKLJUČEK

Spletno učno orodje Liveworksheets je dokaj preprosto za uporabo. Klasične učne liste hitro spremeni v interaktivne naloge, ki so zaradi vseh možnosti, ki jih orodje ponuja, učencem bolj privlačne. Ker orodje učencem omogoča, da naloge sami pregledajo, učitelju prihrani veliko časa. Učenci lahko naloge rešijo večkrat, če seveda učitelj izbere to možnost med nastavitvami.

Orodje se lahko uporablja pri pouku različnih predmetov, saj lahko v interaktivno obliko pretvorimo katerikoli učni list. [4]

Kot učiteljica angleščine vidim dodano vrednost tega orodja tudi v tem, da lahko učencem z njim pripravim naloge, ki preverjajo slušno oz. bralno razumevanje, slovnične naloge, raznolike naloge za utrjevanje besedišča ter naloge, ki preverjajo pisno sporočanje. V gradivo lahko vstavim tudi zvočni posnetek z navodili za reševanje.

V času šolanja na daljavo sem svojim učencem najprej poslala povezave do posameznih nalog na tej spletni strani in jih prosila, da na koncu izberejo možnost pošiljanja odgovorov učitelju. Ker se je ta način dokaj dobro obnesel, smo kmalu prešli na interaktivne delovne zvezke, ki jih to orodje ponuja. Učenci so poročali, da jim to orodje odgovarja, saj ni bilo potrebno rešenih nalog fotografirati in naložiti v spletno učilnico, naloge pa so bile razgibane in zanimive. Odgovore sem jim sproti pregledovala in jim preko tega orodja dajala tudi povratno informacijo. Ker sem registrirala vse svoje učence in zanje pripravila interaktivne delovne zvezke, je zame največja prednost tega orodja, da imam vpogled v vse njihove naloge hkrati. Če vidim, da jim določena snov povzroča težave, jim ob nalogi lahko napišem komentar in poskusim snov ponovno razložiti. Predstavljeno orodje je meni in mojim učencem bistveno olajšalo obdobje šolanja na daljavo.

6. VIRI

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[2] M. Sukič Kuzma. *Spletna učna orodja za poučevanje in preverjanje znanja: Quizlet, Kahoot! In Liveworksheets.* Webinar Rokusove centrifuge https://s3-eu-west-1.amazonaws.com/rokus-video-transcode/player/index.html?video=rokus/dn200559_webinar_kuzma_mp4/stream (pridobljeno 10. 9. 2021)

[3] Spletno orodje Liveworksheets https://www.liveworksheets.com/aboutthis_en.asp (pridobljeno 16. 8. 2021)

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POVZETEK

Poučevanje na daljavo predstavlja izziv za veliko večino učiteljev, saj so bili čez noč prisiljeni spremeniti oz. prilagoditi klasičen način poučevanja. Učenci so sprva kazali navdušenje nad takšnim načinom dela, nato pa je motivacija hitro padla. Poučevanje na daljavo pri vsakem predmetu poteka drugače, kot sicer. Predmet fizike je še posebna specifika, saj proučevanje naravnih zakonov, s pomočjo različnih eksperimentov, zahteva precej prilagajanja pri sami izvedbi pouka. V prispevku je predstavljen IKT pristop k poučevanju loma, odboja svetlobe ter totalnega odboja v osnovni šoli. Pri delu je poleg klasičnih pripomočkov nujno potrebna optična zbirka in stojalo, kamor vpnemo kvalitetno spletno kamero. Razlago, podkrepljeno s poskusi, je smiselno povezati s spletnimi orodji (simulacijami, video posnetki, slikami življenjskih situacij). Poskusi in IKT poučevanje je eden izmed redkih pristopov, ki tudi v teh časih dvigujejo motivacijo med učenjem prek videokonferenc.

KLJUČNE BESEDE

Lom in odboj svetlobe, optična zbirka, simulacija, poučevanje na daljavo

ABSTRACT

Online teaching is initially a challenge for the vast majority of teachers, as they were forced to change classical way of teaching, overnight. Pupils were showing enthusiasm above such manner of work at first, then motivation fell quickly.

Distance learning for every single lesson requires different working modes, then usual.

For example, teaching Physics in Primary school, demands several considerable adaptation in the actual implementation of very individual clarifying of natural phenomena with its' experiments which should be associated with online learning.

Therefore, the paper presents the ICT approach to teaching refraction, reflection and total reflection in primary school.

For this kind of teaching an optical collection, stand and a well webcam are absolutely necessary.

Also, the explanation, supported by experiments, is reasonable to connect with online tools (simulations, videos, pictures of life situations).

Experiments and ICT teaching is one from among rare approaches that, even in these times, raises motivation while learning through video-conferencing.

KEYWORDS

Refraction and reflection of light, optical collection, simulation, online learning

1 UVOD

Epidemija je dodobra premešala karte v izobraževalnem sistemu na vseh stopnjah. Učitelji vseh predmetov so morali »čez noč« prilagoditi klasični pouk in se lotiti izvajanja pouka prek videokonferenc. Potek dela se je najbolj spremenil pri predmetih, pri katerih učenci pridobivajo ročne spretnosti in izvajajo, del ali večino ur, praktičnega pouka. Fizika je nekje vmes. Kakovostno razlaganje snovi ne vključuje zgolj teorije, ampak je treba teorijo in prakso, v ravno pravi mešanici, prepletati.

Poučevanje fizike na daljavo je za vsakega učitelja svojevrsten izziv, ker ustaljena praksa, ki predvideva demonstracije eksperimentov, pogosto pade v vodo oz. je potrebno kar nekaj truda in volje, če želimo isto snov učencem podati na podoben in zanimiv način kot v šoli. Nazornost prikazanega je ključna. Tu se mora učitelj potruditi, da zagotovi ustrezno opremo (prenosni računalnik, optično zbirko, močnejši laser, kakovostno spletno kamero na premičnem stojalu in druge pripomočke za demonstracijo eksperimentov) in prostorske pogoje (v tem primeru pri lomu svetlobe dovolj zatemnjeno učilnico), da so eksperimenti nazorni in dobro vidni. V prispevku bosta predstavljeni lom in odboj svetlobe ter totalni oz. popolni odboj z eksperimentalnega in IKT vidika pri delu na daljavo.

Tema bo predstavljena zaradi pohval s strani učečih. Po njihovem mnenju niso imeli večjih težav pri razumevanju obravnavane teme, ker so prek videokonferenc jasno videli laserje, oznake kotov in v celoti razumeli bistveno razlago, ki sodi k obravnavani snovi. Poleg poskusov so bile učencem pokazane simulacije, ki so v nadaljevanju predstavljene. Pomembno je, da so popoldne lahko v spletni učilnici odprli te iste programe, snov dodatno raziskali in nadgradili pridobljeno dopoldansko znanje, pravilno rešili kvize v spletni učilnici ter naredili nalogo v delovnem zvezku. Vsi učenci, ki so pokazali zanimanje za razumevanje snovi oz. željo po višjih ocenah, so snov razumeli. Na drugi strani pa je tako kot vedno (pre)visok odstotek tistih, ki jim je vseeno, s kakšnim znanjem bodo vstopili v srednjo šolo.

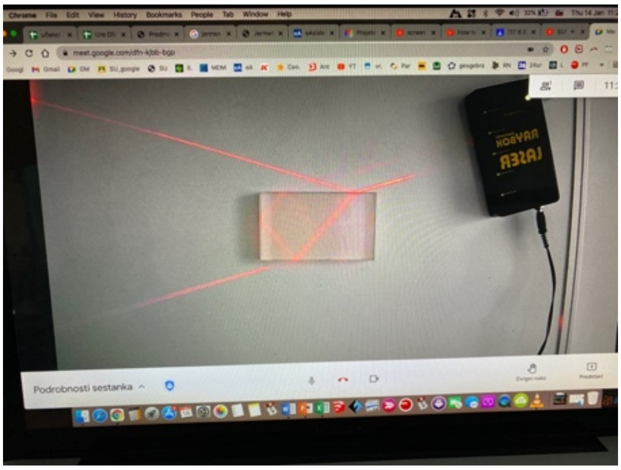
Pouk na daljavo je daleč od tega, kar si motiviran učitelj in učenec želita, se pa da na različne načine spodbuditi zanimanje za učenje fizike. Eden večjih minusov pouka na daljavo je stik v učilnici na relaciji učitelj – učenec. Povratna informacija je v razredu bistveno hitrejša in bolj nazorna. Konkretno pri lomu in odboju svetlobe, učitelj veliko hitreje opazi, ali so narisane vpadne pravokotnice, so označene puščice na žarkih ter ali so koti pravilno označeni itd.

2 JEDRO

Lom svetlobe je v življenju pogost pojav, zato je v knjigah, učbenikih in člankih mnogokrat opisan. Na to temo ni težko najti raznolikih zanimivih eksperimentov. Pri tej tem smo na daljavo, izvedli poskus s kovancem. Slednjega položimo v neprozorno posodo. Kamero nastavimo pod takšnim kotom, da nam rob posode zakriva kovanec. Ko v posodo nalijemo vodo, zaradi loma svetlobe kovanec zagledamo [1]. Če prst postavimo za steklen kvader, zagledamo navidezno razrezan prst [2]. Preprost poskus naredimo s slamico ali kakšnim drugim podolgovatim predmetom. Ko ga pod kotom postavimo v kozarec, je videti zlomljen, hkrati se pa navidezno spremeni tudi debelina potopljenega dela predmeta [3].

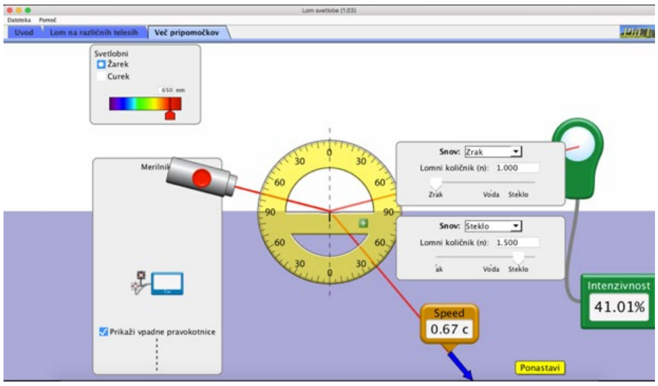
Odbojni zakon najlažje demonstriramo z optično zbirko, kjer preprosto prikažemo, da sta vpadni in odbojni kot skladna. Odboj svetlobe je pri ravnem zrcalu in zmečkani alufoliji popolnoma drugačen [4]. S tem prikažemo odboj na ravnih (okno) in hrapavih (malo razburkana gladina jezera/morja) površinah.

Za nazoren prikaz loma svetlobe potrebujemo optično zbirko, ki vključuje steklen kvader (planparalelno ploščo), laser, magnetno tablo in kamero. Priporočljivo je, da kamero fiksiramo na fleksibilno stojalo, zato da jo lahko hitro premikamo in pri tem ne izgubljamo časa pri menjavi poskusov. Ko zgornjo opremo ustrezno kalibriramo, je demonstracija loma svetlobe celo bolj nazorna kot v razredu pred učenci. Na slikah 1 je razvidno, da je vpadni kot (to je kot med vpadno pravokotnico in vpadnim žarkom) manjši od lomnega kota (to je kot med vpadno pravokotnico in lomnim žarkom) pri prehodu iz optično redkejše v optično gostejšo snov. Hkrati je viden tudi odbojni žarek pri prvem in drugem lomu. Žarek, ki izstopi iz stekla je vzporeden prvotnemu, preden je vstopil v steklo.



Slika 1: Demonstracija loma svetlobe na optični zbirki z uporabo planparalelne plošče (poskus prek videokonference)

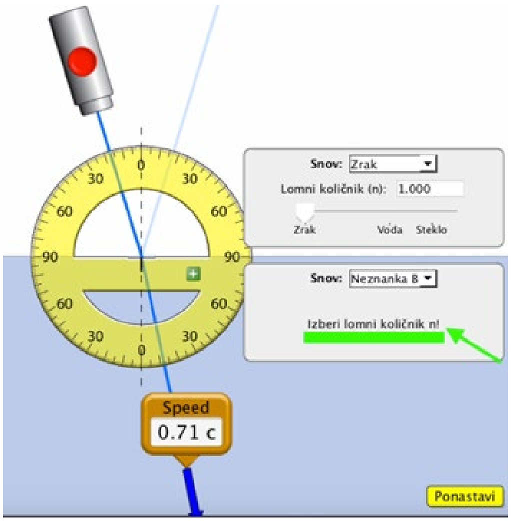
Z aplikacijo »bending-light« (slika 2) ali v prevodu »lom svetlobe« lahko učenci detajlno raziščejo odboj in lom svetlobe na prehodu sredstev različnih optičnih gostot oz. lomnih količnikov. Z merilnikom »speed« je mogoče izmeriti hitrost svetlobe v različnih medijih. Mala črka *c* je oznaka za hitrost svetlobe v vakuumu in znaša približno 300 000 km/s; 0,67 *c* pa v tem primeru predstavlja hitrost svetlobe v steklu, kar znaša približno 200 000 km/s. Z merilnikom »intenzivnost« je mogoče na preprost način analizirati, kako se gostota svetlobnega toka pri odbitem in lomnem žarku spreminja z vpadnim kotom (slika 2). Ena izmed možnih dodatnih nalog za učence je, da v tabelo vpišejo vpadni, lomni in odbojni kot, nato pa za vsako povečajo vpadni kot za 10 stopinj (od 0 do 90 stopinj) in z orodjem »intenzivnost« odčitajo odstotek svetlobe pri odbojnem in lomnem žarku.



Slika 2: Simulacija loma svetlobe z aplikacijo »bending-light« [5]

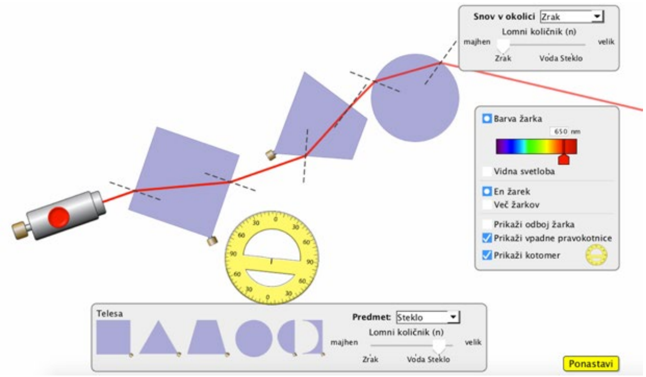
Z drsnikom lahko spreminjamo valovno dolžino in tako preverimo, katera barva se bolj lomi in razlago nadgradimo z življenjskim primerom, npr. rdeča barva sončnega zahoda.

V primeru na sliki 3, snov ni znana in je treba določiti lomni količnik te snovi in na podlagi njega sklepati, za katero snov gre. Nalogo lahko izvedemo na dodatnem pouku v osnovni šoli.



Slika 3: Simulacija loma svetlobe z aplikacijo »bending-light« [5]

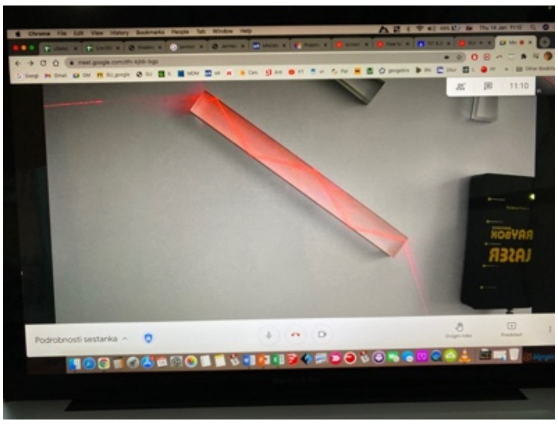
Na drugem zavihku »lom na različnih telesih«; na sliki 4, imamo na razpolago nekaj različnih teles, ki jim lahko nastavljamo lomni količnik, laser (ali več laserjev) s poljubno nastavljivo valovno dolžino. Vklopimo lahko tudi prikaze odboja žarkov, prikaz vpadnih pravokotnic in kotomer. Predvsem vpadne pravokotnice pridejo zelo prav (na sliki 4 so označene s črtkanimi črtami). Če zberemo vidno svetlobo namesto rdečega laserja, lahko na preprost način pokažemo razklon svetlobe (mavrico).



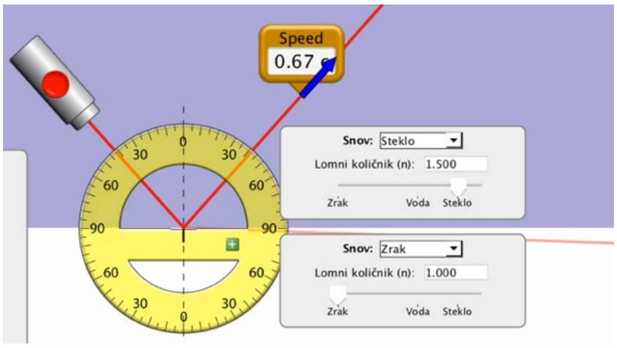
Slika 4: Prikaz različnih funkcij/parametrov (npr. lomni količnik teles in ozadja), ki jih omogoča simulacija »bending-light« [5]

Naslednja simulacija loma svetlobe nam omogoča spoznavanje lomnih količnikov na enostaven način [6].

Pri obravnavi loma svetlobe učenci spoznajo pojem popolni ali totalni odboj (na sliki 5 je predstavljen eksperiment na videokonferenci, na sliki 6 pa namenska aplikacija). To je pojav, pri katerem se vpadni žarek na meji med optično gostejšim in optično redkejšim sredstvom v celoti odbije, če je vpadni kot večji od mejnega kota. Demonstriramo ga lahko samo pri prehodu svetlobe iz optično gostejše snovi v optično redkejšo snov. Preprostih demonstracijskih poskusov je precej. Eden bolj zabavnih je ta, da v plastenko izvrtamo luknjo, vanjo natočimo vodo, nato pa z druge strani plastenke z laserjem posvetimo na luknjo. Laserski žarek se totalno odbija po curku vode in tako dobimo razsvetljen umivalnik. Poskus dobro uspe z močnejšim laserjem (moči npr. 250 mW). V šoli je treba paziti, da so učenci pravilno razporejeni, da ne bi pomotoma komu laser posvetil v oči. Pri tej moči je drugače zelo priporočljiva/nujna uporaba namenskih očal, pri poučevanju na daljavo pa tovrstni ukrepi za učence, niso potrebni.

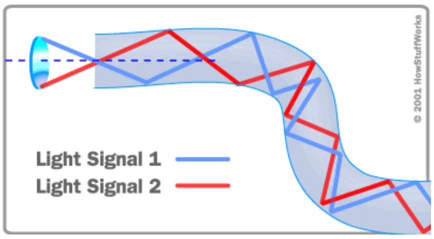


Slika 5: Totalni odboj na videokonferenci

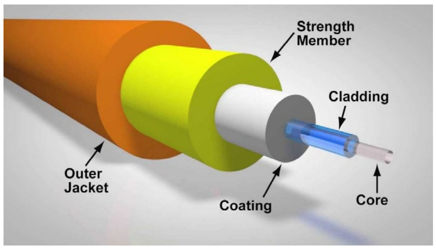


Slika 6: Totalni odboj v aplikaciji [5]

Poskuse pri fiziki je priporočljivo čim večkrat povezati z življenjem. Totalne odboje v optičnem vlaknu prikazuje slika 7, slika 8 predstavlja prerez optičnega vlakna, na sliki 9 pa je predstavljen eksperiment pri uri, katerega lahko brez težav povežemo z optičnim medmrežjem.



Slika 7: Totalni odboji v optičnem vlaknu



Slika 8: Prerez optičnega vlakna

Slika 9: Popolni odboji v optičnem vodniku (poskus pri uri)

Popolni odboj lahko pokažemo tudi z uporabo akvarija, vode in laserja [8].

S preprostim poskusom lahko pokažemo, da se svetloba lahko ukrivi [8]. Dan ali dva pred izvedbo poskusa v trilitrsko posodo z vodo (akvarij) stresemo 250 gramov sladkorja. Sladkorja ne mešamo, ker se sam raztopi v vodi. Pri tem se ustvari majhen gradient gostote, ki zadošča, da se laserski žarek v vodi ukrivi. Eksperiment je bistveno bolje viden, če je učilnica močno zatemnjena.

3 ZAKLJUČEK

V jedru članka so predstavljeni različni načini/ideje, kako učencem na daljavo ali v živo učitelji fizike predstavijo lomni in odbojni zakon ter popolni odboj. Skoraj 10-letna praksa kaže, da učenci snov razumejo, če je predstavljena na zgoraj opisan način, ki vključuje številne poskuse in simulacije. Podpora vsega naštetega v spletni učilnici je pika na i. Epidemija je temeljito spremenila poučevanje prek videokonferenc, ni pa izgovor, da se ne da kvalitetno predstaviti določene teme. Avtor članka bo navdušen, če bo kateri učitelj fizike ali naravoslovja v tem članku dobil kakšno praktično idejo in jo uporabil v praksi.

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Usvajanje črk v prvem razredu na daljavo

Teaching year 1 literacy online during the pandemic lockdown

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POVZETEK

V prispevku sem opisala delo v prvem razredu osnovne šole, ko so se šolska vrata za nekaj časa zaprla in je pouk potekal preko računalnikov. Čeprav na to nismo bili pripravljeni ali izobraženi, smo učni proces hitro izpeljali tako, da so učenci napredovali v svojem znanju in dosegali cilje, ki smo jih zastavili.

Pri izvajanju pouka preko računalnika so naši najmlajši šolarji potrebovali aktivno podporo staršev, s katerimi smo učitelji razvili še globje zaupanje in razvili povsem nov odnos.

Opisala sem enega izmed postopkov obravnave posamezne velike tiskane črke, ki se je izkazal kot odličnega. Pri tem sem upoštevala različne metode dela ter poskusila pouk preko ekrana vseeno izpeljati s čim več gibanja in različnimi dejavnostmi, kot to počnemo tudi v razredu.

Pri usvajanju velikih tiskanih črk v obdobju šolanja na daljavo sem upoštevala načelo raznolikosti z zavedanjem, da nimajo vsi otroci enakih možnosti, enake količine časa s starši in enake podpore s strani le teh.

KLJUČNE BESEDE

Opismenjevanje, faze opismenjevanja, delo na daljavo, prvi razred

ABSTRACT

The article details the process of teaching literacy in year one during the pandemic lockdown, while schools were closed and education continued online. Teachers found conducting literacy lessons specifically challenging, as many felt unprepared and untrained in the pedagogy of online teaching. Through the perseverance of teachers and peer support, lessons were redrafted and the learning process altered to advance knowledge more successfully and to better suit the needs of all students.

We found that our youngest students needed active parental support to participate in online lessons. We are delighted to report that during this interminable pandemic, parent-teacher relationships have further developed and deepened in terms of respect and trust.

This article describes a teaching procedure of a single capital letter. It proved itself as an excellent model for online learning, as it utilizes different teaching methods and employs a variety of teaching activities designed to promote physical activity in students. Diversity and inclusion principles were considered when planning lessons, as students do not share the same learning opportunities, like equity and accessibility to Technology and the same level or amount of parental support.

KEYWORDS

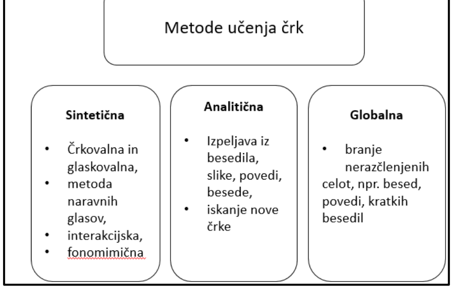
Literacy, stages of literacy, online learning, year 1

1 UVOD

Opismenjevanje je dolgotrajen in zahteven proces, s katerim človek razvije funkcionalno pismenost. Razvijati se začne že v predšolskem obdobju, poteka pa preko štirih komunikacijskih kanalov: poslušanja, govorjenja, branja in pisanja [1]. Dejavnosti, s katerimi razvijamo vse štiri veje opismenjevanja, se med seboj prepletajo, prav vse pa potrebujejo čas, veliko časa, da jih otroci usvojijo. Proces opismenjevanja se zaključi po koncu prve triade. Učni načrt za slovenščino (2018) predvideva, da proces opismenjevanja poteka postopno, sistematično in individualno [2]. Pomembno je zavedanje, da imajo otroci ob vstopu v šolo velike razlike v stopnji razvitosti pismenosti, zato nobena metoda ni primerna za vse učence. Naloga učitelja je ugotoviti, kako dobro predznanje ima posamezni otrok in na podlagi tega izdelati načrt opismenjevanja. Mlajši učenci so bili letos primorani precejšen del opismenjevanja opraviti doma. Njihovi učitelji so pripravili različne dejavnosti, a »glavni nadzorniki« so bili starši oziroma skrbniki.

V svojem prispevku se bom omejila na čas, ko smo s prvošolci glasovom dodajali črke in na daljavo spoznavali slovensko abecedo.

Ko učence učimo abecedo, lahko izberemo med tremi metodami poučevanja (slika 1).



Slika 1: Metode učenja črk

Najbolj praktična se mi zdi kombinacija analitične in sintetične metode, ker ima skoraj vsak glas v slovenski abecedi tudi svojo črko [3].

2 FAZE OBRAVNAVE TISKANE ČRKE

J. Chall zagovarja zgoden in sistematičen pouk glasovnega zavedanja, ki poteka preko več stopenj. Za nas sta pomembni predstopnja, ki poteka v predšolskem obdobju in v kateri otroci prepoznavajo rime, začetne in končne glasove, ter prva stopnja, poimenovana kot faza dekodiranja, pri kateri otrok vzpostavi povezavo med glasom in črko. Ob koncu te stopnje naj bi učenci razvili sposobnost vidnega in delno slušnega razločevanja [4].

Preden začnemo z obravnavo črk, veliko časa namenimo glaskovanju posameznih besed. Učenci tako že slišijo glasove in jih med seboj razlikujejo, sedaj pa je čas, da posameznemu glasu priredijo simbol, tj. črka.

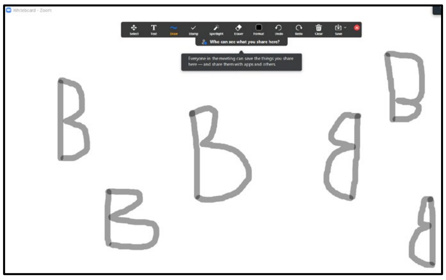
Učencem sem v digitalnih drsnicah pripravila različne fotografije. Njihova prva naloga je bila poimenovati predmet na fotografiji. Nato so izločili slike, ki ne vsebujejo določenega glasu. Med preostalimi slikami so izbrali najprej tiste, ki imajo obravnavan glas na začetku, nato na sredini in nazadnje še na koncu besede.

Sledila je naloga premikanja po domu. Učenci so poiskali čim več besed, ki vsebujejo v svojem poimenovanju obravnavan glas. Nastavila sem odštevalnik časa in po eni ali dveh minutah smo se spet srečali na videokonferenci. pred računalniškimi ekrani. Učenci so naštevali predmete, ki so jih našli. Ker smo imeli v naši skupini tudi učence s statusom tujca, smo določene predmete tudi opisali ali pa smo si pomagali s sliko na spletu. Tako smo poskrbeli, da so širili svoj besedni zaklad.

V naslednji fazi sem učencem pokazala poteznost obravnavane črke (slika 2). Pri tem smo uporabljali program za izdelavo digitalnih drsnic PowerPoint. Posnetek so si učenci večkrat ogledali. Skupaj smo opisali, kako je poteznost potekala. Pri vsaki črki smo vedno označili, kje se zapis začne, v katero smer poteka in katero črto (v kolikor jih je več) napišemo najprej in katero nazadnje.

Slika 2: Prikaz poteznosti obravnavane črke

Nato sem jim na »beli tabli« na videokonferenci pokazala še nekaj napačno napisanih črk, npr. narobe obrnjenih, neprimerne velikosti trebuščkov itd (slika 3). Učenci so potezo pravilno zapisane črke povadili s pisanjem po zraku, mizi, zvezku in po svoji dlani.



Slika 3: Prikaz napačnih črk

Sledil je trening poteznosti s konkretnimi materiali (slika 4). V veliko pomoč so bili starši oziroma skrbniki učencev, ki so pomagali pri pripravi materiala, nato pa še preverjali delo svojih otrok. Občasno smo se dogovorili, da so delo poslikali in mi poslali nekaj fotografij. Za vsako črko sem pripravila več dejavnosti, med katerimi so morali učenci opraviti vsaj dve, npr. oblikovanje črk s pokrovčki, vrvicami, kockami, slamicami, palčkami za ušesa, igračami, plastelinom …

Slika 4: Delo s konkretnim materialom

Ko so učenci usvojili poteznost črke s konkretnim materialom, smo prešli v fazo zapisa v zvezek. Pred začetkom smo bili pozorni na pravilno sedenje, pravilno držo telesa ter pravilen prijem svinčnika, ki je moral biti že pred poukom ošiljen. Sledili smo načelu od večje črke k manjši. Ob koncu ure so učenci zapisali tudi nekaj besed, ki vsebujejo obravnavano črko. Ker so nekateri izmed učencev že poznali zapis vseh črk, so namesto posameznih besed sestavljali smiselne povedi ali krajše zgodbe, ki so jih naslednjo uro z veseljem prebrali.

3 REZULTATI

Pri delu na daljavo sem uporabljala program PowerPoint, ki se je izkazal kot odličen pripomoček pri opismenjevanju. V njem sem lahko izdelala učno uro, ki je bila opremljena z zanimivimi animacijami in zvokom. Prav tako sem lahko izdelala kvize, ki so jih učenci hitro znali reševati tudi brez pomoči staršev.

Videokonferenčne ure smo izvajali s programom ZOOM, v katerem sem redno uporabljala belo tablo, deljenje zaslona in t.i. »breakout room«, kjer so učenci opravljali delo v manjših skupinah. Le tako sem lahko zagotovila ustrezno diferenciacijo pri poučevanju na daljavo v živo.

4 ZAKLJUČEK

Obdobje, v katerem smo se znašli, nam je prineslo obilico novih izkušenj, ki jih bomo lahko uporabili tudi v prihodnje. Med učitelji in starši se je razvilo zaupanje, ki je bilo nujno potrebno za dosego učnih rezultatov pri učencih. Starši so imeli vpogled v delo učitelja, učitelji pa smo bili v času šolanja na daljavo ob določenih trenutkih skoraj člani družine naših učencev.

Medsebojno spoštovanje vseh udeležencev šolanja na daljavo je učencem prineslo dobre temelje znanja, s katerimi bodo lahko tudi v prihajajočem šolskem letu dosegali zavidljive rezultate.

Učenci so v tem obdobju spoznali, kako pomembni so vsi člani v skupnosti, kako pomembno je, da vsak udeleženec opravi svojo nalogo in je zanjo tudi odgovoren.

LITERATURA IN VIRI

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[3] Golli, D. (1991): Opismenjevanje v prvem razredu. Novo mesto: Pedagoška obzorja.
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Uporaba spletnega orodja BookWidgets za preverjanje in ocenjevanje znanja pri pouku nemščine

Using the BookWidgets online tool to evaluate and assess knowledge in German lessons

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POVZETEK

V prispevku je predstavljeno delo s spletno aplikacijo BookWidgets pri pouku nemščine v 6., 7. in 8. razredu v namen preverjanja in ocenjevanja znanja.

V šolskem letu 2020/21 smo se učitelji in učenci ponovno znašli v situaciji, ko se je za obdobje skoraj treh mesecev klasični pouk v učilnicah ponovno spremenil v virtualno učenje na daljavo. Učitelji smo prišli do spoznanja, da virtualni pouk ne bo mogel za takšno dolgo obdobje zajemati le podajanje in utrjevanje nove učne snovi, temveč bo potrebno zajeti tudi del preverjanj in ocenjevanj znanja. Kot učiteljica nemščine v osnovni šoli sem iskala spletno orodje, ki bi mi omogočilo preprosto kreiranje testov in po možnosti tudi avtomatsko korekcijo odgovorov. Učenci so do sestavljenih testov in nalog dostopali s klikom na povezavo v spletni učilnici, za samo uporabo orodja pa niso potrebovali svojega uporabniškega računa ali gesla. Ko so bile naloge pregledane in dopolnjene s sprotnimi komentarji, so bile posredovane učencem na njihov elektronski naslov. Učenci so na tak način dobili hitrejšo povratno informacijo o njihovem znanju, meni pa je aplikacija omogočila bolj organiziran pregled nad velikim številom kreiranih nalog in doseženimi rezultati pri posameznih učencih.

Zaradi možnosti kreiranja raznovrstnih tipov nalog, dobre preglednosti in preproste uporabe, je orodje BookWidgets za delo na daljavo motiviralo tako mene kot tudi moje učence pri pouku nemščine.

KLJUČNE BESEDE

BookWidgets, spletno orodje, preverjanje in ocenjevanje znanja

ABSTRACT

The article presents the usage of online application BookWidgets in German lessons in 6th, 7th, and 8th grade for the purpose of evaluating and assessing knowledge.

In school year 2020/21, teachers and students once again found themselves in a situation where, for a period of almost three months, classical classroom teaching was once again transformed into virtual distance learning. Teachers have come to the realization that virtual teaching will not only be able to cover the explanation and revision of new learning material for such a long period, but it will also be necessary to evaluate and assess student's knowledge. As a primary school teacher of German, I was looking for an online tool that would allow me to easily create tests and possibly also automatically correct answers. Pupils accessed the composite tests and assignments by clicking on the link in the online classroom and did not need their own user account or password to use the tool. Once the assignments were reviewed and supplemented with comments, they were forwarded to the pupils at their email address. In this way, my pupils received a faster feedback on their knowledge, and I as their teacher was provided with a more organized overview of the large number of created tasks and the results achieved by individual pupils.

Due to the possibility of creating various types of assignments, good transparency, and ease of use, the BookWidgets tool was a way of motivation for me and my pupils during the distance learning of German.

KEYWORDS

BookWidgets, online tool, evaluating and assessing knowledge

1. UVOD

Preverjanje in ocenjevanje znanja predstavlja učitelju zahtevnejši del pedagoškega procesa, na katerega se je potrebno dobro pripraviti. Pomemben del učne ure je ravno tako utrjevanje snovi, ki služi kot pokazatelj doseženega znanja in temelj za nadaljnjo preverjanje in ocenjevanje. Na kakšen način bo preverjanje in ocenjevanje izvedeno je odvisno od namena, cilja in vsebine [1].

V šolskem letu 2020/21 v času pouka na daljavo sem se kot učiteljica nemščine in angleščine v osnovni šoli znašla pred velikim izzivom, in sicer na kakšen način hitro in preprosto preveriti, predvsem pa oceniti znanje pri učencih. V običajnih razmerah, ko pouk poteka v učilnici, učitelj najhitreje dobi povratne informacije o znanju učencev z ustnim preverjanjem in ocenjevanjem, ki ga lahko vključi k vsaki učni snovi [1]. V času pouka na daljavo pa je ravno ta način meni osebno vzel največ časa za izvedbo in celotno organizacijo. Povrhu vsega pa takšen način ocenjevanja na daljavo ni bil tako kakovosten. Pri vključevanju digitalne tehnologije v namen preverjanja in ocenjevanja znanja je potrebno načrtovati uporabo IKT za formativno spremljanje in sumativno ocenjevanje znanja. Ob tem je pomembna tudi » ustreznost digitalnega ocenjevanja, pristopov in prilagajanja strategij« [6]. Učitelj mora biti v ta name usposobljen zbirati, kritično vrednotiti in tolmačiti digitalne podatke o dosežkih učencev, prilagajati strategije za podporo učencem ter posredovati povratne informacije [6].

Moj cilj je bil poiskati spletno orodje, ki bi mi omogočilo avtomatsko popravljanje nalog in s tem tudi pridobitev pisne ocene pri učencih, ki so obiskovali neobvezni in obvezni izbirni predmet nemščina. Odločila sem se za plačljivo spletno orodje BookWidgets, ki sem ga uporabila za kreiranje kratkih vaj za utrjevanje ter preverjanj in ocenjevanj znanja. Orodje sem uporabila pri učencih 6. – 8. razreda. Reševanje nalog se je za učence izkazalo za zelo preprosto, saj učenci za dostop ne potrebujejo uporabniškega računa. V spletni učilnici so lahko z enim samim klikom na povezavo dostopali do vaj in testov. Po koncu reševanja so za uspešno oddajo morali vpisati svoje ime ter elektronski naslov, kamor so po potrebi prejeli mojo povratno informacijo o izkazanem znanju ali rezultat pisnega ocenjevanja. Kot učiteljica sem imela z uporabo BookWidgets orodja organiziran, preprost in hiter vpogled v dosežke znanja pri pouku nemškega jezika.

2. DIGITALNA PISMENOST PRI POUKU NEMŠČINE V OSNOVNI ŠOLI

V učnem načrtu za nemški jezik v osnovni šoli [3] je med splošnimi cilji pouka nemščine navedena tudi *digitalna pismenost*, kar pomeni, da » Učenci pri pouku nemščine kritično uporabljajo informacijsko-komunikacijsko tehnologijo za pridobivanje, vrednotenje in shranjevanje informacij, za njihovo tvorjenje, predstavitev in izmenjavo ter za sporazumevanje in sodelovanje v mrežah na svetovnem spletu.« [3]. Učenci razvijajo digitalne kompetence na različne načine, kot so:

- uporaba spletnih slovarjev
- pridobivanje podatkov s spleta in uporaba brskalnikov in iskalnikov v nemščini
- uporabljanje IKT za komunikacijo v nemščini (npr. socialna omrežja, klepetalnice, blog, forum, ipd.)
- predstavljanje svojih izdelkov v nemškem jeziku (grafično, slikovno, večpredstavno, itd.) [3]

3. TEHNIČNE LASTNOSTI SPLETNIH ORODIJ ZA PREVERJANJE IN OCENJEVANJE ZNANJA

V zadnjem desetletju so izobraževalni sistemi po vsem svetu sprejeli hiter razvoj tehnologije in odkrili nove načine za uveljavljanje njihove uporabe, kar bi koristilo študentom in učiteljem. Ker je COVID-19 povzročil razburjenje v izobraževalnih sistemih, saj je motil tradicionalne razredne metode za širjenje znanja, je prišlo do potrebe nove tehnološke rešitve, ki bi podpirala vse osnovne funkcije globalnega izobraževalnega sistema. Ena od rešitev bi zato bila lahko spletna programska oprema za ocenjevanje kandidatov, ki jo je mogoče prilagoditi vsakemu oddelku ali stranki podjetij, izobraževalnih ustanov do vladnih institucij za najem, testiranje in vrednotenje posameznih uspešnosti na daljavo [4].

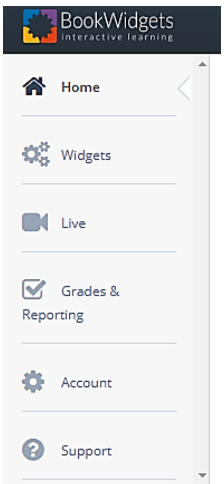
Spletna stran ProProfs [4][5] navaja nekaj najpomembnejših funkcij, ki so ključne pri iskanju spletnega orodja za preverjanje in ocenjevanje znanja:

- **preprosta navodila**, ki uporabniku omogočajo seznanitev z vsebino spletnega orodja za preverjanje in ocenjevanje znanja
- **dostopnost**: uporabnik kreira lastni račun, ki ga zaščiti z geslom za varno hrambo sestavljenih preverjanj in ocenjevanj znanja. Uporabnih lahko tudi omeji dostop samo za določene goste in tako do ocenjevanja dostopajo samo pooblaščeni
- **varna in enostavna prijava v spletno orodje**
- **knjižnica testov** po meri za enostavno dostopnost
- **široka paleta vprašanj,** ki pomaga ustvariti učinkovite in uspešne rezultate in analize, ki lahko delujejo kot celovit vpogled v udeležečeve uspešnosti in spretnosti
- **časovni opomnik**, ki pripomore k pravočasni oddaji preverjanja oz. ocenjevanja znanja
- **objavljeno ali natisnjeno**: udeležečevi odgovori in rezultat so lahko deljeni preko e-pošte ali natisnjeni na papir. Udeleženec lahko izbere, ali bo rezultat javno dostopen ali zaseben. Udeleženci lahko do svojih rezultatov dostopajo preko namizne ali mobilne platforme. S pomočjo povratnih informacij pa se učijo iz svojih napak
- **objava rezultatov**: uporabnik lahko izbere možnost, ali bo udeleženec videl svoj rezultat in rešitve takoj po končanem reševanju, ali pa bo le tega prejel s povratno informacijo, ker je morda potrebno še ročno razvrščanje

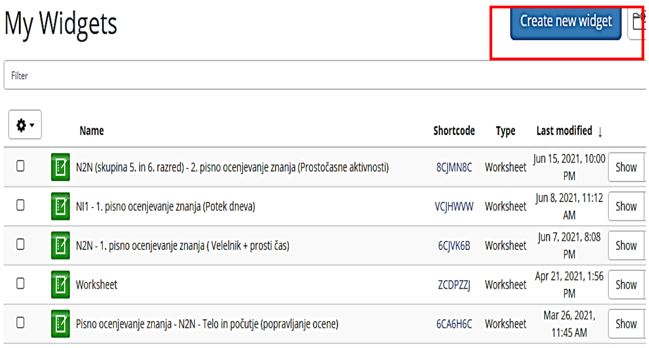
4. BOOKWIDGETS

BookWidgets je aplikacija, ki omogoča kreiranje interaktivnih vaj ter avtomatsko popravljanje nalog. S tem učitelju prihrani čas za ocenjevanje ter mu omogoča, da učencu poda povratno informacijo o njegovem znanju. Aplikacija omogoča 30-dnevno brezplačno poskusno uporabo, plačljiva verzija pa je na voljo tudi za skupino učiteljev [2].

Pri vstopu v aplikacijo ima registriran uporabnik pregled nad svojimi izdelanimi nalogami (v meniju na levi strani izberemo Widgets →My Widgets) (slika 1). Pri vsaki vaji je napisan tudi tip naloge, torej ali gre za delovni list, kviz, igro, itd., kdaj je bila naloga nazadnje spremenjena ter možnost za ponovni prikaz, spreminjanje, kopiranje, deljenje in brisanje naloge. Izdelane vaje lahko uporabnik razvrsti tudi v skupne mape (slika 2).



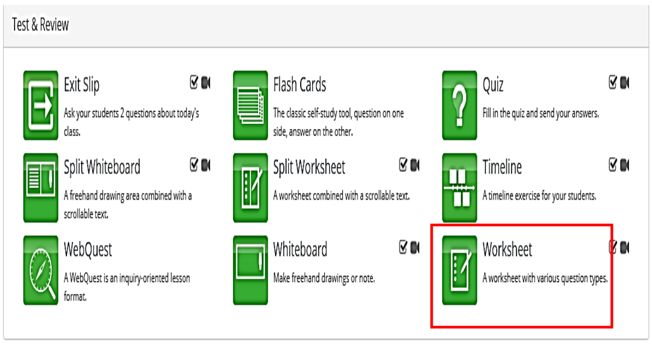
Slika 1: Začetni meni (Vir: https://www.bookwidgets.com/)



Slika 2: Primer začetnega prikaza kreiranih vaj (Vir: lasten, zajem zaslonske slike)

Ko želimo ustvariti novo vajo, kliknemo na modro ikono »Create new widget« (slika 2) in lahko izbiramo med različnimi vrstami nalog:

- Testi in pregledi snovi (delovni list, časovna premica, kviz, deljen delovni list, itd.)
- igre (vislice, spomin, križanka, iskanje parov, itd.),
- slikovne in video ponazoritve snovi
- matematične naloge



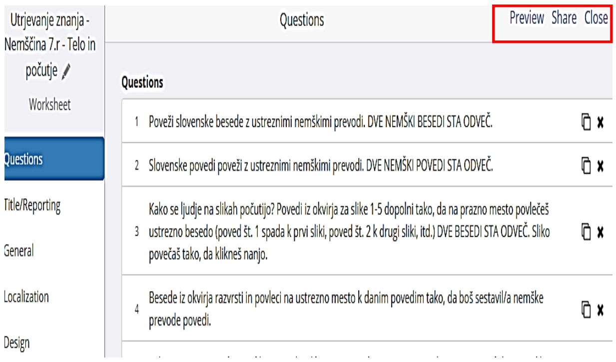
Slika 3: Različni tipi vaj za kreiranje testov in pregledov snovi (Vir: https://www.bookwidgets.com/)

4.1 Primer: kreiranja delovnega lista po korakih

Ko izberemo tip vaje »Worksheet« (slika 3) iz nabora možnosti za oblikovanje testov in pregledov snovi, se nam odpre nova menijska vrstica, ki ponuja naslednje:

- poimenovanje delovnega lista
- vprašanja (dodajanje vprašanj različnega tipa, kot so: besedilo, vprašanja odprtega tipa, dopolnjevanje, povezovanje, itd.).
- naslov/poročilo (omogočimo, da učenci pošljejo odgovore in po potrebi označimo, da dovoljujemo samo enkratno pošiljanje odgovorov; reševanje nalog lahko tudi časovno omejimo s funkcijo »exam mode«)
- splošne nastavitve (način prikaza pravilnih odgovorov, točkovanje posameznih vprašanj, vklop ali izklop jezikovnega preverjanja, nastavitev gesla za reševanje)
- lokalizacija (smer besedila, izbor jezika)
- izgled (barva ozadja in besedila, izbor slike za ozadje)

Preden objavimo končno povezavo do vaje, nam orodje omogoča, da celoten izdelek še enkrat vidimo v takšni obliki, kot bo ta prikazan učencem (klik na »Preview« zgoraj desno) (slika 4). Vprašanja lahko še vedno spremenimo, zbrišemo, kopiramo in delimo (klik na »Share« zgoraj desno) (slika 4). Povezavo do vaje lahko delimo ne samo z učenci, temveč tudi z ostalimi učitelji, ki so registrirani uporabniki tega orodja. Delitev z učitelji omogoča, da drugi učitelj kopira vaš izdelan »Widgets« v svojo zbirko in ga tudi lahko poljubno spreminja.



Slika 4: Prikaz sestavljenih vprašanj z menijsko vrstico (Vir: lasten, zajem zaslonske slike)

4.2 Prikaz rezultatov reševanja

Orodje BookWidgets v svojem začetnem meniju ponuja tudi možnost vpogleda v rezultate rešenih vaj (klik na Grades&Reporting → Student Work) (slika 1). Najprej je predstavljen povprečen rezultat reševanja posameznega vprašanja glede na celotno skupino učencev (slika 5) , nato pa ima učitelj še vpogled v dosežek pri posameznem učencu (slika 6). Pri vsakem posamezniku je zabeležen datum in čas reševanja, končni rezultat ter dosežene točke pri posameznem vprašanju. Obarvana okenca pri vprašanjih so pokazatelj, kako dobro je učencev rešil vprašanje (zelena- zelo dobro, rumena – dobro, rdeča – slabo).

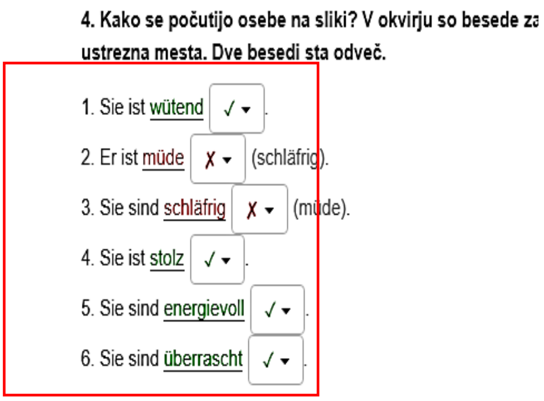
Slika 5: Prikaz povprečnega dosežka glede na skupino (Vir: lasten, zajem zaslonske slike)

Answers (11)

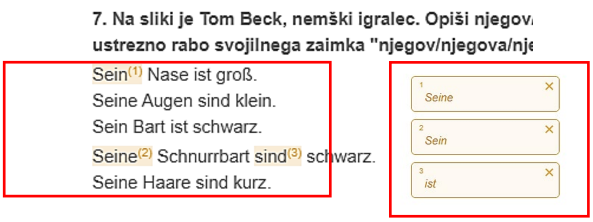
		Name	Date	Total Score	1	2	3	4	5
	☆	Alin	11. 2. 2021 11:45:42	24 / 26	10	8	1	4	1
	☆	Brina Bara Leban	6. 2. 2021 14:45:09	26 / 26	10	8	1	6	1
	☆	Filip Zemljič	6. 2. 2021 16:44:10	23 / 26	10	8	1	4	0
	☆	Katarina Porovne	5. 2. 2021 15:32:28	20 / 26	7	8	1	3	1
	☆	Lea Mlinar	12. 2. 2021 08:29:36	26 / 26	10	8	1	6	1
	☆	Lidija Prevc	5. 2. 2021 12:59:37	26 / 26	10	8	1	6	1
	☆	MATIC POVŠE	5. 2. 2021 12:01:32	26 / 26	10	8	1	6	1

Slika 6: Prikaz rezultata za posameznega učenca (Vir: lasten, zajem zaslonske slike)

S klikom na učenca se odpre vpogled v njegove odgovore, ki so že avtomatsko popravljeni (slika 7). Pri napačnih odgovorih se izpiše tudi pravilna rešitev. Popravke lahko ročno spremenimo (npr. dodelimo večje ali manjše število točk, označimo odgovor kot pravilen/napačen), k vsaki nalogi pa lahko dodamo tudi komentar. Pri vprašanjih, kjer učenci zapišejo daljše besedilo, lahko označimo napake direktno v besedilu in dodamo opombo (slika 8).



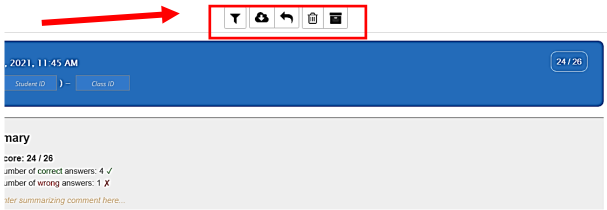
Slika 7: Avtomatski popravek odgovorov z vidnimi rešitvami (Vir: lasten, zajem zaslonske slike)



Slika 8: Naloga z daljšim odgovorom, označenimi napakami in dodatnimi opombami (Vir: lasten, zajem zaslonske slike)

4.3 Pošiljanje povratne informacije učencem

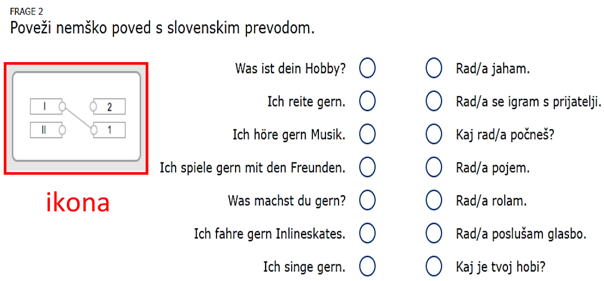
Po končanem pregledu naloge učenca nam orodje BookWidgets omogoča, da nalogo prenesemo kot PDF datoteko, jo s popravki pošljemo nazaj učencu, zbrišemo ali shranimo v arhiv (slika 9).



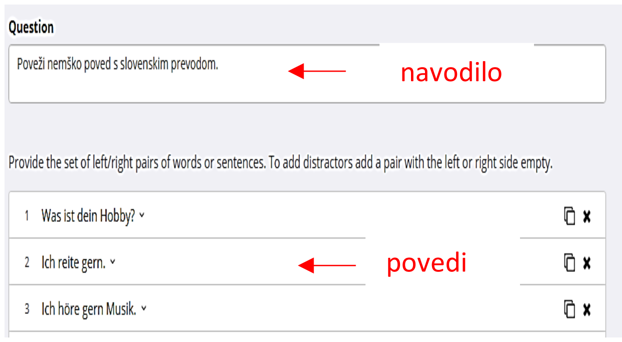
Slika 9: Pošiljanje povratne informacije učencu (Vir: lasten, zajem zaslonske slike)

4.4 Primer sestavljene naloge: Povezovanje nemških povedi s slovenskimi prevodi

Za kreiranje takšne naloge pri tipu ponujenih vprašanj izberemo ikono »Word match question« (slika 10). V prazno okence vpišemo navodilo naloge (slika 11), nato pa dodamo željene povedi, ki se bodo pojavile v levem in desnem stolpcu (slika 11).



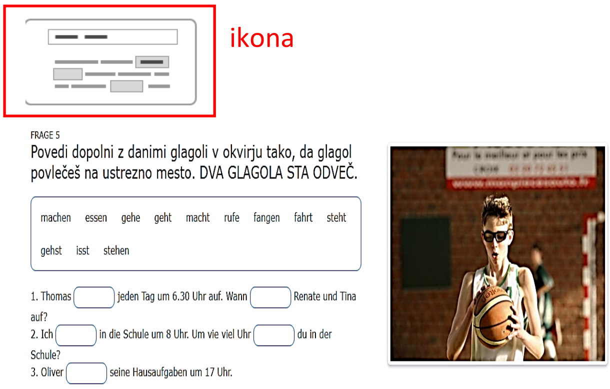
Slika 10: Primer naloge- povezovanje povedi s prevodi, 6.razred (Vir: lasten, zajem zaslonske slike)



Slika 11: Povezovanje povedi- oblikovanje naloge (Vir: lasten, zajem zaslonske slike)

4.5 Primer sestavljene naloge: Dopolnjevanje povedi z manjkajočimi besedami iz okvirja

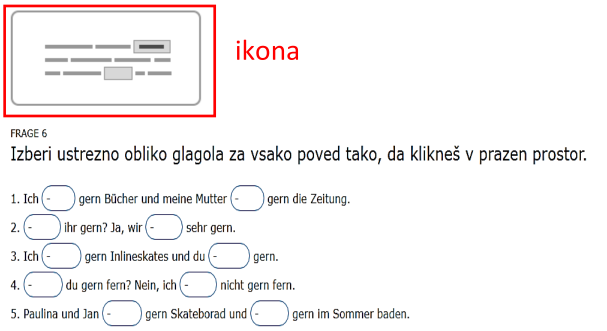
Za kreiranje takšne naloge pri tipu ponujenih vprašanj izberemo ikono »Drag words in sentence« (slika 12). V prazno okence vpišemo navodilo naloge. Nato dodamo besedilo v katerem besede, ki se bodo pojavile v okvirju »obdamo« z znakom <<>> (npr. <<machen>>). Na koncu lahko k nalogi dodamo še besede, ki bodo delovale kot t. i. distraktorji.



Slika 12: Primer naloge- dopolnjevanje povedi z manjkajočimi besedami iz okvirja, 7. razred
(Vir: lasten, zajem zaslonske slike)

Oblikovanje izgleda takole:
1. Thomas <<steht>> jeden Tag um 6.30 Uhr auf. Wann <<stehen>> Renate und Tina auf?
2. Ich <<gehe>> in die Schule um 8 Uhr. Um vie viel Uhr <<gehst>> du in der Schule?
3. Oliver <<macht>> seine Hausaufgaben um 17 Uhr.
4. Um 16 Uhr <<rufe>> ich meine Freundin Pauline an.
5. Wir <<essen>> um 19 Uhr zu Abend.
6. Am Montag <<fangen>> sie mit dem Unterricht um 9 Uhr an.
7. Er <<geht>> um 18 Uhr in die Turnhalle und spielt Basketball.
8. Zum Frühstück <<isst>> Susane ein Stück Brot mit Butter und Marmelade.

4.6 Primer sestavljene naloge: Dopolnjevanje povedi s ponujenimi odgovori



Slika 13: Primer naloge- dopolnjevanje povedi s ponujenimi odgovori, 6. razred
(Vir: lasten, zajem zaslonske slike)

Za kreiranje takšne naloge pri tipu ponujenih vprašanj izberemo ikono »Fill-in-the-blank(s) question« (slika 13). V prazno okence vpišemo navodilo naloge. Nato dodamo besedilo, kjer ponujene rešitve za manjkajoče besede »obdamo« z znakom <<>> in navedemo manjkajoči del z besedo »select«, pravilno rešitev pa zapišemo na prvem mestu (npr. <<select: lese##liest##lesen>>).

Oblikovanje izgleda takole:
1. Ich <<select: lese##liest##lesen>> gern Bücher und meine Mutter <<select: liest##lesen##lest>> gern die Zeitung.
2. <<select: Malt##Malen##Male>> ihr gern? Ja, wir <<select: Malen##Malt##Male>> sehr gern.
3. Ich <<select: fahre##fahren##fährt>> gern Inlineskates und du <<select: tanzst##tanzt##tanzen>> gern.
4. <<select: Siehst##Sehe##Sehen>> du gern fern? Nein, ich <<select: sehe##seht##siehst>> nicht gern fern.
5. Paulina und Jan <<select: fahren##fahrt##fährst>> gern Skateborad und <<select: gehen##geht##gehe>> gern im Sommer baden.

5. ZAKLJUČEK

Uporaba spletnega orodja BookWidgets za namen preverjanja in ocenjevanja znanja pri pouku nemščine v 6., 7. in 8. razredu med poukom na daljavo se je izkazala kot primer zelo dobre prakse. Učenci so hitro osvojili način reševanja različnih tipov nalog ter pošiljanje končnih odgovorov učiteljici. Za delo v takšni aplikaciji so bili motivirani, saj je reševanje potekalo veliko hitreje kot pa pisanje odgovorov v zvezek in skeniranje izdelkov ter pošiljanje v spletno učilnico. Da same naloge niso bile tako »neprivlačne« na prvi pogled, sem jih obogatila s slikami in včasih tudi kratkimi video posnetki, ki so učence še dodatno spodbudili k reševanju. Dostop do reševanja preverjanj in ocenjevanj znanja je bil zelo preprost. Potrebovali so samo povezavo, ki je bila objavljena v spletni učilnici. Pošiljanje odgovor učencem ni delalo večjih preglavic, saj so za uspešno oddajo potrebovali vpisati le svoje ime in elektronski naslov. Učenci so v aplikaciji reševali tudi vmesna krajša utrjevanja znanja, kjer so se jim po končnem reševanju, ki ni bilo omejeno na čas, izpisale rešitve. Tako so dobili takojšen vpogled v svoje znanje, kar nam je v času pouka preko video konferenc velikokrat prihranilo čas za preverjanje rešitev.
Spletno orodje BookWidgets ni bilo preprosto za uporabo le za moje učence pri pouku nemščine, temveč tudi zame kot učiteljico. Ponuja velik izbor različnih naborov nalog za oblikovanje, istočasno pa je oblikovanje le teh dokaj preprosto, saj vsak tip naloge vsebuje jasna in kratka navodila za kreiranje. Po vrhu vsega mi je uporaba tega spletnega orodja olajšala delo z avtomatskim pregledovanjem in vrednotenjem odgovorov, enostavnim pregledom nad rezultati učencev in pošiljanjem povratnih informacij. Aplikacija BookWidgets je po mojem mnenju dovolj preprosta za uporabo, da bi jo lahko učitelj predstavil tudi učencem v 4. in 5. razredu osnovne šole, kjer imajo otroci v času digitalizacije že dovolj kompetenc za osvojitev omenjenega spletnega orodja.

6. LITERATURA IN VIRI

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Vpliv uporabe digitalnih sredstev na motivacijo in uspešnost učenja

The impact of the use of digital resources on motivation and learning success

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POVZETEK

V raziskovalni nalogi smo raziskali vpliv digitalnih sredstev na motivacijo in uspešnost v digitalnem okolju izobraževanja. Želeli smo izvedeti, kakšno je stališče učencev, ki so se morali prilagoditi na takšno učno okolje, še posebej v času epidemioloških ukrepov in opravljanje učnega procesa na daljavo preko digitalnih sredstev. Raziskavo smo izvedli s pomočjo spletnega anketnega vprašalnika z namenom zbiranja podatkov iz različnih starostnih skupin, ki hkrati vedo tudi najbolje ovrednotiti raziskano stališče, kot so učenci 8. in 9. razreda devetletne osnovne šole, dijaki poklicnih in gimnazijskih srednješolskih programov ter univerzitetne in višješolske študente. S pomočjo rezultatov smo prišli do zaključka, da so učenci, ki so pri svojem izobraževanju pogosto ali redno uporabljali digitalna sredstva bistveno bolj uspešni in motivirani za delo v digitalnem učnem okolju. Ta ugotovitev izobraževalcem in izobraževalnim ustanovam predstavi, da so tovrstni načini izobraževanja lahko enako ali bolj učinkoviti od tradicionalnih metod, učence pa seznani s pomembnostjo uporabe digitalnih sredstev pri učenju.

KLJUČNE BESEDE

Digitalno učenje, e-učenje, notranja motivacija, uspešnost učenja

ABSTRACT

In our research assignment we have studied the effect of digital resources on motivation and success in digital learning enviroment. We wanted to learn the standpoint of students, who had to adapt to such learning environment, especially in time of epidemy and to carry out the learning process on distance with the help of digital resources. We performed the research with the use of an online questionnaire with the intention of collecting data from participants of different age groups, who also know to properly evaluate the researched grounds, such as students of 8^{th} and 9^{th} grade of nine-year primary school, students of vocational and secondary school and students at various university and post-secondary programs. With the help of the results, we have concluded that students, who in their education often or regularly use digital resources, are much more successful and motivated for work in digital learning environment. This finding presents the educators and educational institutions that the following methods of education are similarly or more efficient than the traditional methods, and it also introduces the students with the importance of using digital resources for learning.

KEYWORDS

Digital learning, e-learning, internal motivatiom, learning success

1 UVOD

S čedalje večjim premikom izobraževanja na spletne platforme se pri mnogih pojavljajo dvomi o učinkovitosti tovrstnega načina izobraževanja. V trenutnih razmerah in epidemiji virusa COVID-19 pa so takšni načini ključni za uspešno delovanje šolstva. V sledeči nalogi raziskujemo, s kakšnim stališčem se srečujejo trenutni osnovnošolci, dijaki in študenti. Tako želimo dobiti vpogled na uspešnost tovrstnega izobraževanja.

V obstoječih raziskavah je bilo že kar nekaj poskusov, da bi našli razlike med učnimi okolji in uspešnosti njihovega delovanja. Pri tem je bil uspešen Stefan Kulakow (2020), ki je v svoji raziskavi pokazal, da je okolje, ki se osredotoča na lastno učno sposobnost, pozitivno vplivalo na višjo akademsko sposobnost in višjo motivacijo za uspeh, medtem ko druga raziskava (Hietajärvi in drugi, 2020) ni odkrila močne povezave med digitalnimi učnimi vsebinami in motivacijo učencev. V nekaterih primerih kaže, da lahko digitalno izobraževanje celo škodi učenčevemu uspehu. Tretja raziskava (Cidral in drugi, 2018) prav tako meri uspešnost učencev v digitalnem okolju, vendar se osredotoči bolj na dejavnike, ki so najpomembnejši pri elektronskem izobraževanju.

Ker te raziskave niso prišle do enotnih ugotovitev glede vpliva digitalnega izobraževanja na uspešnost in motivacijo učencev, se nam zdi smiselno opraviti podobno raziskavo, ki je hkrati v drugem geografskem okolju. Prav tako ni bilo razvidno, kako zadovoljni so posamezniki z digitalnimi vsebinami, če so opravili obvezni in popoln prehod iz tradicionalnih načinov izobraževanja. Trenutno stanje širjenja virusa COVID-19 je povzročilo edinstveno situacijo, kjer je veliko učencev prisiljeno k uporabi digitalnih sredstev za učenje, kar lahko vpliva na kakovost učne vsebine in s tem tudi motivacije učencev do vključevanja v te vsebine in e-učenje. Naša študija bo te

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probleme rešila z vprašalnikom, ki bo preverjal zadovoljstvo in uspešnost učencev pred in med obveznim izobraževanjem preko uporabe digitalnih orodij.

V današnji informacijski družbi je veliko dejavnikov, ki vplivajo na nenehno spreminjanje načinov izobraževanja. Kot študentje smo priča tem spremembam, saj skozi leta opažamo vedno večjo in bolj pogosto uporabo digitalnih sredstev, ne le pri poučevanju, temveč tudi pri učenju. Razširila se je uporaba spletnih učilnic, kot sta Moodle in Sakai, spletnih virov in videoposnetkov za pomoč pri učenju in poučevanju, od učencev pa se je začelo pričakovati znanje pripravljanja predstavitev s programi, kot je Microsoft Powerpoint. V zadnjem letu se je zaradi izredne situacije, ki jo je povzročila pandemija koronavirusa (SARS-CoV-2), mnogo šolskih sistemov po svetu odločilo za izobraževanje na daljavo s pomočjo videokonferenčnih programov, kot sta Microsoft Teams in Zoom. Nekateri učenci so se lažje prilagodili na nove tehnologije, medtem ko so drugi ostali pri svojih tradicionalnih metodah poučevanja.

V sledečem poglavju smo opisali našo strategijo iskanja podobnih virov in napisali teoretični okvir. V tretjem poglavju pregledujemo sorodna dela. Za boljšo izpeljavo naše študije smo v teh delih iskali podobnosti, hkrati pa njihove pomanjkljivosti, ki smo jih lahko odpravili v naši raziskavi. Četrto poglavje je namenjeno metodologiji in je sestavljeno iz več tabel, ki prikazujejo seznam spremenljivk, naša raziskovalna vprašanja in hipoteze. V tem poglavju se nahaja tudi raziskovalni model. V petem poglavju povzamemo rezultate raziskave in jih analiziramo. Sledi še šesto poglavje, kjer so navedeni cilji raziskave, razloženi rezultati in primerjane vzporednice s sorodnimi študijami. V zaključku pa so izpostavljeni prispevki študije, omejitve in čemu služi študija. Navedenih pa je tudi nekaj priporočil za prihodnje sorodne študije.

2 Teoretični okvir in ozadje

2.1 Opis strategije iskanja za konceptualni pregled literature

Uporabljena literatura v naši raziskovalni nalogi izhaja predvsem iz znanstvenih raziskovalnih del, strokovnih nalog, ter diplomskih in magistrskih nalog. Gradivo iščemo v bazi člankov Science Direct, saj vsebuje navezujoče članke iz držav po celem svetu. Poskusili smo najti knjižno literaturo v sistemu COBISS, vendar nam je epidemiološko stanje Covid-19 otežilo dostop do iskanja želenega gradiva. Za ključne besede iskanja smo določili:

digitalna delitev, učna motivacija, digitalno učenje, digitalne učne strategije, izobraževanje, elektronsko učenje, uspešnost učenja, e-učenje.

V angleškem jeziku se te glasijo:

digital divide, learning motivation, digital learning, digital learning strategies, education, electronic studying, studying success, e-learning.

Te ključne besede smo razvrstili v skupine in po njih bomo opravljali iskanje temeljnih virov:

"digital divide" OR "digital learning" OR "education" OR "e-learning" OR "electronic learning"

AND "motivation" OR "learning motivation" OR "inner motivation" OR "outer motivation" OR "studying motivation" OR "digital motivation" OR "student motivation"

AND "success" OR "learning success" OR "digital success" OR "student success".

Ker se izobraževanje digitalizira predvsem v zadnjem desetletju, smo za časovni obseg določili, da iščemo vire po letu 2010. Zaradi hitreje spreminjajočih razmer se med drugim lažje osredotočimo na vire, izdane po letu 2018.

2.2 Teoretični okvir

Področje oblikovanja in tehnologije poučevanja se razvijajo in pojavljaj se alternativni pristopi k učenju po kognitivnih in konstruktivističnih teorijah, ki močno odstopajo od tradicionalnih praks, kot so vedenjski modeli. Novi poudarki, kot so elektronski sistemi za boljše delovanje, spletna navodila in sistemi za upravljanje znanja, niso samo pretresli bazo znanja s tega področja, temveč tudi razširjajo obzorje na podjetja in industrijo, vojsko, zdravstvo in izobraževanje po vsem svetu (Nanjappa in Grant, 2002). Avtorica Wheeler (2012) je E-učenje, ali elektronsko učenje, imenovala "tehnološko-izboljšano učenje", kasneje tudi "digitalno učenje". E-učenje je nabor tehnološko posredovanih metod, ki se lahko uporabljajo za podporo učencem pri učenju, ki vključuje elemente ocenjevanja, tutorstva in poučevanja. Avtorji Cidral idr. menijo, da je namen e-učenja širjenje informacij in znanja za izobraževanje in usposabljanje. Razumevanje vpliva e-učenja na družbo in njegovih koristi je pomembno za povezovanje sistemov digitalnega učenja z njegovimi gonilnimi silami. Avtorji Keengwe, Onchwari G. in Onchwari J. so v svoji študiji leta 2009 napisali, da bi bilo treba reformirati programe izobraževanja z uvedbo aktivnih učnih okolij, ki podpirajo in izboljšujejo globino in obseg učenja učencev. Natančneje, učitelji bi morali učencem zagotoviti intelektualno močna okolja, osredotočena na učenca in tehnološko bogata okolja, ne da bi pri tem ogrožali dobre pedagoške prakse. E-učenje ljudem omogoča fleksibilen in njim prilagojen način učenja. Iz tega lahko mi pri naši raziskavi pričakujemo pozitiven vpliv e-učenja na motivacijo učenca (H3) in na njegov učni uspeh (H1). Pojavljajo se številne ključne tehnologije za olajšavo načrtovanja in izvajanja sistemov e-učenja, ki lahko imajo velik vpliv na učenje. (Cidral idr., 2018)

Motivacija je interni proces, ki predstavlja enega izmed glavnih dejavnikov, ki vplivajo na uspešnost učenja (Levpušček in Zupančič, 2008). Avtorja Makewa in Ngussa (2015) se ne strinjata, da je motivacija zgolj notranji, temveč tudi zunanji proces. Dodajata tudi, da so učitelji najboljši vir motivacije pri interakciji med poučevanjem in učenjem. Svinicki in Vogler (2012) pravita da je motivacija proces interakcije med učencem in okoljem, ki ga zaznamujejo izbor, iniciacija, povečanje ali vztrajnost ciljno usmerjenega vedenja. Obravnava se jo lahko kot lastnost posameznika, situacijo ali dejavnost, s katero se posameznik ukvarja. Avtor Karim (2012), povzeto po Lin, Chen in Liu (2017) pa meni, da je učna motivacija lastno prepričanje, ki vodi posameznikove učne cilje, spodbuja njegovo učno vedenje k nenehnemu trudu, krepi kognitivno zgodovino in poveča uspešnost učenja. Podobno hipotezo smo si postavili tudi mi, saj predvidevamo, da bo predvsem zunanja motivacija učenca imela pozitiven vpliv na uspešnost digitalnega učenja (H2), zanima pa nas tudi, kako se bo primerjala z notranjo. Block idr. (2013) so omenili, da lahko začetne in ozke faze učenja vodi zunanja motivacija. Ko postane učenje avtonomno, so zunanje spodbude nepotrebne, vendar se spremenijo v avtonomno učenje. Tako bi se notranja in zunanja motivacija dopolnjevali. Po drugi strani pa učenje zahteva tudi nekaj gonilne sile in zunanje motivacije, saj se posamezniki pogosto učijo zaradi pričakovanja staršev, drugih ciljev in za pridobitev določenih spodbud. Avtorja Seifert in Sutton (2012) pravita, da so razlike v motivaciji pomemben vir raznolikosti v razredih. Primerjamo jo lahko v predhodnem znanju, sposobnostih ali razvojni pripravljenosti. Pri šolskem učenju pa motivacija učencev dobiva še poseben pomen, saj zgolj prisotnost učencev pri pouku seveda ni zagotovilo, da se učenci res želijo učiti. To je samo znak, da živijo v družbi, ki zahteva, da mladi obiskujejo šolo. Ker je sodobno izobraževanje obvezno, učitelji motivacije učencev ne morejo jemati kot samoumevne in so odgovorni za spodbujanje učencev.

Uspešnost učenja je rezultat posameznikove vztrajnosti, motivacije, pridobitev, osebnostnega razvoja in dosežkov (Cuseo, 2007). Podobno opisuje definicija, da je uspeh odvisen od individualnih in kontekstnih faktorjev, ki jih posameznik pod pravim vodstvom pridobi in s tem dela na osebni izboljšavi in veselju. Večina definicij obravnava uspeh učenja kot celoto spletno-izobraževalne platforme ali učnega sistema posamezne ustanove in je tako težko določiti točen pomen uspeha, ki ga te zagotavljajo (Hyvärinen in Uusiautti, 2021). Uspešnost učenja je običajno merjena kot nek končni rezultat, ki ga posameznik opravi na testu oziroma preverjanju znanja oziroma drugih ocenjevalno vrednotenih dejavnosti. Ker za raziskavo nimamo dovolj časa, da bi lahko primerjali znanje učencev glede na ocene in ker nam razmere v državi tega ne dopuščajo, bomo se morali v naši raziskavi zanašati na samooceno anketiranih učencev. Slednji je lahko močno odvisen od družbenega okolja, v katerem se posameznik nahaja in ali ima zagotovljen dostop in finance do kredibilnih virov učenja.

3 Pregled sorodnih del

Cidral in drugi so v brazilski empirični raziskavi želeli najti dejavnike, ki vplivajo na zadovoljstvo, uporabo in individualni vpliv e-učenja med uporabniki. Uporabili so kvantitativno metodo spletnega anketnega vprašalnika, na katerega je odgovorilo 301 anketirancev. Ugotovili so, da sta uporaba in zadovoljstvo uporabnikov pri e-učenju medsebojno odvisna in imata pozitiven vpliv na uspešnost posameznika. Zraven zadovoljstva sta pri e-učenju pomembna dejavnika tudi kakovost sodelovanja in kakovost informacij. Zato avtorji predlagajo, da bi platforme digitalnega učenja morale omogočati artikulacijo komunikacije in kolaboracije med študenti in s tem vplivati na študentovo uporabo in zadovoljstvo. Prav tako bi spletne vsebine morale biti dostopne, uporabne, razumljive, zanimive in zanesljive. Raziskava nam pove, da je posameznikova uspešnost posledica zaznane kakovosti sistema učencev. Če je sistem enostaven in ima dobro strukturirano vsebino in funkcionalnosti, bo to povečalo zadovoljstvo in uporabo sistemov za e-učenje. Prednost študije je, da pri preverjanju vpliva zajema veliko različnih dejavnikov, vendar pa se osredotoča le na notranjost e-učenja in ga ne primerja s tradicionalnim učenjem. Zanimivo pa bi bilo videti podobno raziskavo tudi v državah z drugačno kulturo ali razširjenostjo uporabe tehnologije pri izobraževanju.

Raziskava finskih študentov (Hietajärvi in drugi, 2020) je želela pokazati, kako vključevanje finskih učencev v digitalne učne vsebine vpliva na njihove zastavljene cilje izobraževanja. Glede na digitalne učne vsebine so se opredelili na posameznikove učne preference, željo po digitalnem učenju ter odklanjanje šolskega dela in spanca zaradi uporabe Interneta. Učenci imajo na Finskem dober dostop do digitalnih učnih vsebin, vendar se izobraževalni sistem še vedno trudi vzpostaviti učinkovit in specifičen tehnološko usmerjen učni program. V raziskavi je sodelovalo 1,482 učencev med 15. in 16. letom starosti iz 26 različnih šol, za pridobitev podatkov pa so uporabili individualni anketni vprašalnik (ang. Self-reported questionnare). S sledečimi rezultati so nato po analizi latentnega profila (analiza, s katero poskušamo identificirati skupine posameznikov glede na zaporedje ponavljajočih identifikatorjev, ki jih pridobimo na podlagi njihovih odgovorov) poskušali odkriti profile glede na zastavljene učne cilje učencev, ter s tem določiti razlike med profili s spoštovanjem do digitalnega vključevanja.

Pridobljene in analizirane odgovore so ločili na štiri skupine z različnimi usmerjenimi profili:

- Mojstrsko usmerjeni profil: osredotočanje na učenje in povprečno šolsko delo,
- uspešnostno osredotočen profil: zagnanost k večjemu uspehu in boljših rezultatov od ostalih vrstnikov,
- povprečno osredotočen profil: posameznik nima določenih večjih ciljev,
- odklonljiv profil: posameznik se izmika učnemu delu.

Rezultati študije so pokazali, da učenci z mojstrsko usmerjenim in uspešnostno osredotočenim profilom želijo več digitalno usmerjenih vsebin za učenje, medtem ko učenci s povprečno osredotočenim profilom ne želijo odstopati od tradicionalnih metod izobraževanja. Tako se digitalno osredotočeno izobraževanje ne more upoštevati kot motivacija za učenje, in je treba pri implementaciji več digitalnih orodij v izobraževalni sistem upoštevati tudi motivacijski profil posameznikov. Odklanjanje šolskega dela zaradi uporabe Interneta je bilo negativno povezano z učnim uspehom, vendar so analizirani rezultati pokazali, da visoko motivirani učenci z visokim učnim uspehom tudi odklanjajo učna dela zaradi prepogoste uporabe Interneta.

Raziskava je dobro ovrednotila svoje področje raziskovanja in na podlagi rezultatov opredelila raziskovalna vprašanja. Ciljna skupina je bila jasno definirana in dosegli so dober vzorec za analizo problema. Reševanje vprašalnika je bilo individualno in anonimno, tako da so anketiranci odgovarjali čim bolj iskreno na vprašanja, ki so tudi vezana na odklanjanje dela. Hkrati pa je pokazalo, da rezultati lahko odstopajo od posameznikove osebne motivacije in ne moremo točno določenih skupin asociirati s podobnimi posamezniki.

Stefan Kulakow je v raziskavi preverjal teorijo, ki pravi, da akademska sposobnost deluje kot povezava med izobrazbo in motivacijo za doseganje ciljev, ter kako različna izobraževalna okolja vplivajo na to povezavo. Na vzorcu učencev iz Nemčije primerja učno okolje, ki ga vodi učitelj in okolje, ki se osredotoča na lastno učno sposobnost učenca. Namen slednjega okolja je ustvariti čim večjo raznolikost učenja, ki temelji na predhodnem znanju učencev. Raziskava je pokazala, da je bistveno višjo akademsko sposobnost pokazalo okolje osredotočeno na učence. Pokazala je tudi, da v tem okolju zaznana podpora učenčevim sposobnostim deluje kot posrednik med akademsko samopodobo in motivacijo za uspehe. Akademska samopodoba je večdimenzionalni konstrukt, ki se nanaša na individualno vrednotenje osebnih kognitivnih sposobnosti v kontekstu akademskih dosežkov. Dokazuje, da je taki način učenja najbolj primeren za učence z nizko akademsko samopodobo saj zmanjša povezavo med le to in podpiranjem učenčevih sposobnosti za doseganje ciljev. Največja pomanjkljivost raziskave je, da temelji na samo-poročanih podatkih sodelujočih, prav tako pa starostne skupine niso bile statistično enako porazdeljene. Zanimivo bi bilo mogoče vključiti in preveriti rezultate hibridne skupine, v nadaljnjih študijah pa bi lahko raziskali, če je mogoče takšno učno okolje vzpostaviti preko spleta.

4 Metodologija

Zanimalo nas je:

1. Ali obstaja statistično značilna povezava med uporabo elektronskih sredstev pri učenju in motivacijo učencev?
2. Ali zunanja in notranja motivacija učenca vplivata na samooceno uspešnosti digitalnega učenja?
3. Ali uporaba elektronskih sredstev vpliva na samooceno uspešnosti digitalnega učenja?

Tabela 4.1: Seznam merljivih spremenljivk

Ime spremenljivke	Vrednosti spremenljivke	
Spol	0 1	Moški Ženski
Starost	0 1 2 3	13-15 16-19 20-26 27+

Tabela 4.2: Seznam latentnih spremenljivk

Ime spremenljivke	Vir	Indikatorji
Uporaba elektronskih sredstev pri učenju	Caglar & Turgut, 2014	V301: Upravljanje časa V302: Učinkovitost poučevanja e-učenja V303: Potreba po naprednih tehničnih sposobnostih V304: Prilagodljivost urnika V305: Zmanjšanje stroškov V306: Izbira učenja V307: Izbira preverjanja znanja
Notranja motivacija	Lin, Chen & Liu, 2017 Schreiber, 2016	V401: Kreativnost V402: Vztrajnost V403: Cilj V404: Uporabnost V405: Zadovoljstvo V406: Izziv V407: Samostojnost V408: Radovednost
Zunanja motivacija	Ng & Ng, 2015; Lin, McKeachie in Kim, 2002	V501: Starši V502: Zahtevnost V503: Cilj V504: Pomembnost
Samoocena uspešnosti digitalnega učenja		V601: Ocena V602: Pozornost V603: Učinkovitost V604: Vključenost

4.2 Vzorčenje in udeleženci raziskave

Naša raziskava se navezuje predvsem na motivacijo in zadovoljstvo z uporabo spletnih učnih vsebin, zato smo izbrali tudi ustrezne ciljne skupine. Za populacijo smo določili učence 8. in 9. razreda osnovnih šol, dijake srednjih šol in študente višješolskih in univerzitetnih programov, torej so naše enote vzorčenja učenci, dijaki in študentje.

Naš merski instrument je v obliki spletnega vprašalnika, nismo pa morali pridobiti seznama vseh osnovnošolcev, srednješolcev in študentov. Poslužili smo se metod priložnostnega vzorčenja in modela snežne krogle, kjer smo anketo delili med vrstniki in jih naprosili, naj jo delijo še med svojim poznanstvom, ki spada v okvir naše populacije raziskave.

4.3 Postopek raziskave

Pridobitev podatkov z uporabo ankete smo izvajali na spletu, učence, dijake in študentke pa smo k sodelovanju povabili preko družbenih omrežij in poznanstev v panogi javnega izobraževanja. Pred izvajanjem ankete so sodelujoči morali potrditi, da vprašalnik izpolnjujejo prostovoljno, kar zadostuje etičnim zahtevam za izvedbo spletne ankete. Raziskavo smo izvajali med 4. 1. 2021 in 18. 1. 2021.

Raziskava je spoštovala etične kodekse. Po zahtevah kodeksa ameriškega združenja psihologov APA (APA, 2010) smo upoštevali človekove pravice, poskrbeli za zasebnost in varno hranjenje podatkov. Podali smo tudi informirano soglasje, s katerim so se udeleženci morali strinjati kot pogoj za reševanje raziskave. Za zasebnost smo poskrbeli z anonimnim pristopom reševanja, zbirali pa smo le najnujnejša demografska podatka (spol in starost), brez katerih analiziranje podatkov ne bi bilo mogoče. Sodelujoči so bili obveščeni o obdelavi podatkov v raziskovalne namene, omogočili pa smo jim, da lahko kadarkoli izstopijo iz raziskave. Pred izvedbo raziskave smo sodelujoče seznanili z namenom raziskave, na njihovo željo pa jim bodo posredovani tudi drugi podatki raziskave, po opravljenem reševanju vprašalnika. Po končani izvedbi raziskave bodo lahko pridobili tudi povratne informacije o rezultatih raziskave.

Pripravljen merski instrument smo najprej posredovali mentorici v pregled. Ta nam je predlagala popravke na podlagi obrazložitve etičnosti naloge, obrazložitve pojmov in pričakovanih informacij od udeležencev ter slovničnih napak. Spletni anketni vprašalnik smo nato v predtest posredovali manjši izbrani skupini posameznikov, ki so rešili naš vprašalnik. Povratnih informacij niso podali, zato vprašalnika nismo nadaljnje prilagodili.

4.4 Merski instrument

Za metodo zbiranja podatkov smo izbrali anonimni spletni vprašalnik. Razlog za ta izbor je preprosta deljivost, reševanje in obdelava pridobljenih podatkov. Hkrati je to tudi najvarnejši pristop zbiranja podatkov glede na trenutno epidemiološko stanje v Sloveniji.

V uvodu vprašalnika smo sodelujoče seznanili s temo in namenom zbiranja podatkov v okviru raziskave, ter jih seznanili s pogoji sodelovanja. Merski instrument vsebuje štiri sklope vprašanj z uporabo intervalnih pet stopenjskih lestvic, pri katerih udeleženci ocenjujejo svoje strinjanje s podanimi trditvami in dva sklopa vprašanj zaprtega tipa z izborom odgovora, ki pridobivajo splošne demografske informacije. Pred začetkom reševanja intervalnih lestvic smo udeležencem podali krajši teoretični okvir, ki se navezuje na pričakovane trditve in odgovore.

5 REZULTATI

Analiza zbranih podatkov je pokazala, da so učenci, ki uporabljajo več elektronskih sredstev pri učenju bolj uspešni pri digitalnem učenju.

Tabela 5.1: Uspešnost e-učenja glede na uporabo elektronskih sredstev pri učenju

Group Statistics		
	Samoocena uspešnosti e-učenja	
Uporaba elektronskih sredstev pri učenju (skupina)	Manjša	Večja
N	46	50
Mean	23.424	31.900
Std. Deviation	.68182	.79789
Std. Error Mean	.10053	.11284

V tabeli 5.1 lahko razberemo, da je v skupini z manjšo uporabo elektronskih sredstev pri učenju imela pri samooceni uspešnosti digitalnega učenja povprečno vrednost 2,34, skupina z večjo uporabo elektronskih sredstev pri učenju pa 3,19.

Pri testu neodvisnih vzorcev smo izvedeli, da je dvosmerna (ang. 2-tailed) signifikanca enaka 0,000, kar pomeni, da obstaja statistično značilna razlika med učenci z nižjo in višjo uporabo elektronskih sredstev pri učenju pri samooceni uspešnosti digitalnega učenja.

Tabela 5.2: Rezultati testa neodvisnih vzorcev

Independent Samples Test				
			Samoocena uspešnosti e-učenja	
			Equal variances assumed	Equal variances not assumed
Levene's Test for Equality of Variances	F		2.143	
	Sig.		.147	
t-test for Equality of Means	t		-5.572	-5.609
	df		94	93.508
	Sig. (2-tailed)		.000	.000
	Mean Difference		-.84761	-.84761
	Std. Error Difference		.15212	.15113
	95% Confidence Interval of the Difference	Lower	-114.965	-114.769
		Upper	-.54557	-.54753

S tem lahko odgovorimo na RV3: Ali uporaba elektronskih sredstev vpliva na samooceno uspešnosti digitalnega učenja? Da, uporaba elektronskih sredstev vpliva na samooceno uspešnosti digitalnega učenja.

Prav tako lahko potrdimo H1: Uporaba elektronskih sredstev pri učenju pozitivno vpliva na samooceno uspešnosti digitalnega učenja. To pomeni, da večja kot je uporaba elektronskih sredstev pri učenju posameznega učenca, večja bo tudi njegova samoocena uspešnosti pri digitalnem učenju

6 ZAKLJUČEK

S to raziskavo smo želeli dobiti vpogled v mišljenje osnovnošolcev, dijakov in študentov glede digitalnega načina izobraževanja. Predvsem nas je zanimalo kako uporaba elektronskih sredstev pri učenju vpliva na motivacijo in uspešnost učencev pri takšnem izobraževanju.

Ugotovili smo, da je v praktičnem primeru, ko imajo učenci na voljo le digitalno izobraževanje, pomembno da je tudi njihova uporaba elektronskih sredstev čim večja, saj bo tako njihovo izobraževanje tudi bolj uspešno. Pri tem je pomembno kako e-učenje vpliva na njihovo upravljanje s časom, učinkovitost, prilagodljivost njihovih urnikov in kateri način učenja, spremljanja pouka in izvajanja testov jim je ljubši. Tisti, ki so bolj navajeni učenja z digitalnimi sredstvi bodo v digitalnem okolju imeli veliko prednost.

Ugotovitve študije služijo kot odgovor na vprašanje “kako uporaba elektronskih sredstev vpliva na uspešnost digitalnega učenja?” in je potrdilo, da tovrstne metode prinašajo bistveno izboljšavo rezultatov v določenem okolju. Podatki so uporabni za izobraževalne ustanove, ki morda dvomijo v efektivnost elektronskih sredstev. Dvomi so seveda še lahko upravičeni, vendar se bo lahko z večanjem razširjenosti elektronskih sredstev in njihovo uporabo, izobraževanje nagibalo vedno bolj k digitalnemu, kjer bo uporaba elektronskih sredstev imela velik vpliv. Te ugotovitve služijo tudi učencem, da se bolj zavedajo kako uporaba digitalnih učnih sredstev vpliva na njihov uspeh.

Glavna omejitev naše raziskave je, da smo izvedli le anketni vprašalnik s priložnostnim vzorčenjem, kar pomeni da naš vzorec ni nujno reprezentativen na celotno populacijo učencev. Rezultati anketnega vprašalnika pa so lahko subjektivni in nenatančni, saj udeležencem nismo mogli merit uspešnosti (npr. ocen). Prav tako je naš vzorec relativno majhen (N=96).

Še ena omejitev je, da v naši raziskavi nimamo kontrolne skupine, ki bi bila izpostavljena tradicionalnemu izobraževanju, saj tako ne moremo videti vpliva uporabe elektronskih sredstev na uspešnost tradicionalnega učenja. To bi bilo dobro raziskati v prihodnosti.

Menimo, da bi v prihodnjih raziskavah bilo zanimivo uporabit drug merski instrument, na primer laboratorijski eksperiment, v katerem bi lahko nadzorovano primerjali vpliv uporabe elektronskih sredstev z uspešnostjo. Prav tako bi prihodnje raziskave lahko iskale korelacije med karakteristikami učencev (npr. motivacija) in uspešnostjo pri digitalnem učenju. In kot smo že omenili, bi bilo dobro vključiti objektivne spremenljivke, ne le mnenj učencev.

7 ZAHVALA

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Primeri dobre prakse poučevanja tujega jezika na daljavo

Distance teaching second language – examples of good practices

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POVZETEK

Poučevanje tujega jezika na daljavo je svojevrsten izziv, saj je potrebno uporabiti učinkovite metode za poučevanje vseh štirih jezikovnih spretnosti – govorno in pisno sporočanje, bralno in slušno razumevanje. Potrebno je najti nove učinkovite načine, ki so enako učinkoviti kot delo v dvojicah in skupinah, konverzacijo, dober način spremljanja vseh učencev, pri katerem učitelj ne pregori, in motivirati učence, da aktivno sodelujejo pri pouku.

Didaktiko poučevanja in spremljanje napredka pri bralnem in pisnem sporočanju je relativno enostavno prilagoditi na daljavo. Več inovacij je potrebnih za pripravo e-gradiv – pripravljena morajo biti tako, da lahko ciljna skupina z njimi dela samostojno. V članku so opisane glavne smernice za pripravo e-gradiv, ki so se izkazale za učinkovite.

Zahtevno je vzpostaviti učinkovite načine za poučevanje in preverjanje na področju slušnega razumevanja in govornega sporočanja. V prispevku predstavljam didaktiko in orodja, ki so se izkazala za uspešna.

Pri klasičnem pouku v razredu so pogosto ure pouka načrtovane tako, da so spoznavanje z novo snovjo, utrjevanje, preverjanje in dajanje povratne informacije razdrobljeni na več učnih ur. Učinkovite ure pouka na daljavo so zasnovane tako, da je vsaka ura pouka samostojna enota, pri kateri se učenci z učnim ciljem spoznajo, ga usvojijo in ga učitelj preveri oz. ovrednoti znotraj iste učne ure.

Predstavljene metode dela, organizacija in uporaba aplikacij je na daljavo pripomogla, da so učenci ohranili motivacijo in pridobili kvalitetno znanje, ne da bi pri samostojnem delu potrebovali pomoč staršev. Predstavljen način dela je zagotovil tudi, da sem lahko ločila služben čas od zasebnega, ne da bi trpela kvaliteta opravljenega dela.

KLJUČNE BESEDE

Poučevanje na daljavo, e-gradiva, slušno razumevanje, govorno sporočanje, izgorelost

ABSTRACT

Teaching a foreign language is a unique challenge because it demands teaching all four language skills – speaking, reading, listening, and writing. Since pair work, group work or conversation are not easy to translate to distance teaching it is necessary to find new efficient ways to teach these skills. It is also important to find ways of monitoring every student to avoid teacher burnout. Another challenge is to motivate students to be active participants.

Didactics of teaching and monitoring reading and writing skills is easily adaptable to distance teaching. A more innovative approach is needed to prepare e-materials. These must enable students to use them easily without help. In the reminder of the paper there are some guidelines discussed that have proven efficient.

Efficient ways of teaching and monitoring listening and speaking skills are difficult to decide on. The article bellow analyses some didactics and applications that have been successfully used.

Traditionally, lesson plans are often made so that a certain learning topic is covered during several lessons. Experience has shown that every distance lesson must be planned so that it forms a complete individual lesson. It must include presenting a new topic, practice, evaluation, and feedback.

Therefore, the article shows that students remained motivated for schoolwork and did not need parents' help with school materials. Also, despite good teaching I have managed to avoid burnout. This was achieved by certain principles which are the topic of the article bellow.

KEYWORDS

Distance teaching, e-materials, listening comprehension, oral communication, burnout

1 UVOD

V spomladanskem prehodu šolanja na daljavo smo se srečevali z drugačnimi izzivi kot v drugem valu. Izzivi prvega obdobja šolanja na daljavo so bili predvsem tehnične narave – organizacija pouka, iskanje ustreznih orodij, izbira računalniške opreme, spodbujanje k računalniški pismenosti, obvladovanje orodja za komunikacijo in podobno. V zadostni meri smo jih premostili, da smo v jesenskem valu začeli spretneje.

Večji izziv je jeseni predstavljala vsebina – didaktika poučevanja na daljavo, priprava e-gradiv, struktura učne ure, cilji in vsebina učne ure, načini spremljanja učencev. Po daljšem obdobju smo se borili tudi z izgorelostjo in padanjem motivacije tako učiteljev, učencev kot tudi staršev. V nadaljevanju opisujem primere dobrih praks in orodij, s katerimi sem se uspešno spopadla z zgoraj naštetimi izzivi – padec motivacije učencev, kvalitetno poučevanje vseh štirih spretnosti tujega jezika na daljavo, ohranitev meje med delovnim in prostim časom, samostojnost učencev in izključitev potrebe sodelovanja staršev pri šolskem delu njihovih otrok.

2 POUK NA DALJAVO

2.1. Dolžina učne ure

Psihologi, ki se ukvarjajo s tako imenovanim fenomenom »Zoom utrujenosti« (orig. Zoom Fatigue), pojasnjujejo, da so naše kognitivne sposobnosti bolj obremenjene med videokonferenco kot med komunikacijo v živo. [1] Zato je nesmiselno načrtovati pouk, pri katerem bomo polno skoncentrirani 45 minut. Ura pouka na daljavo mora biti bodisi časovno krajša bodisi dinamično razdeljena tako, da zahteva od udeležencev aktivno sodelovanje in praktično delo.

2.2. Vsebinska struktura ure

Učne ure na daljavo sem načrtovala v vsaj treh različnih delih.

Prvi del – frontalno podajanje snovi
Začetek ure je bil vedno načrtovan kot najkrajši, okvirno dolg deset minut. Vedno je vseboval tudi seznanitev učencev s potekom, cilji in predvidenimi dejavnostmi tiste učne ure.

Drugi del – demonstracija uporabe
Glavni del ure je bil namenjen usvajanju nove učne snovi. Uporabo oz. način usvajanja nove snovi sem na vsaj treh primerih demonstrirala sama ali pa v paru oz. skupini z določenimi učenci. Če smo na primer jemali novo slovnično strukturo, sem s tremi različnimi učenci izpeljala kratek voden pogovor po modelu, katerega del je bila struktura. Cilj je bil, da vsi v skupini vedo, kako je potrebno vaditi, da novo snov usvojijo.
Ko smo bili vsi prepričani, da vemo, kako učenje poteka, sem jih s pomočjo Microsoft Teams Breakout Rooms razdelila v pare ali skupine, kjer so se učili po danem zgledu. Med učenjem sem se vključila v vsako ločeno skupino ali par, jih spremljala ali pa jim nudila dodatno pomoč.

Zadnji del – formativno spremljanje in povratna informacija
Zadnji del videokonference je bil najpomembnejši. Vedno je bil sestavljen tako, da so učenci na koncu ure v živo preizkusili in pokazali usvojeno znanje tiste učne ure. Odvisno od učnih ciljev tiste ure so rešili interaktivno preverjanje znanja. To je bil pogosto interaktiven test, ki je vseboval različne tipe vprašanj ali nalog, ki so ustrezno preverjale cilje tiste učne ure. Pomembno je bilo, da so morali interaktivne vaje rešiti v živo, dokler so bili še vključeni v videokonferenco, saj sem jih ob tem spremljala na kameri oz. sem sledila poteku reševanja testa posameznih učencev. Zahtevala sem, da test rešujejo toliko časa, da dosežejo vsaj 90 % možnih točk oz. dokler nove učne snovi ne usvojijo.
S tem je bilo poskrbljeno, da so vsi sproti napredovali, da sem imela pregled nad tistimi, ki so v danem trenutku potrebovali dodatno pomoč in predvsem, da niti oni niti jaz nismo redno imeli dodatne domače naloge.

2.3. Bonton med poukom na daljavo

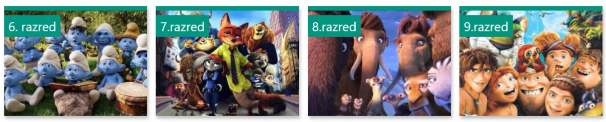
Pouka preko videokonference so se učenci seveda lahko udeleževali tudi navidezno, torej so se npr. vključili v konferenco in ji ne sledili oz. bili dejansko prisotni. Zato je veljalo, da morajo učenci imeti ves čas sestanka vklopljene kamere. Če je kdo ni imel, se je vklopil preko telefona ali pa so starši pisno potrdili težave s kamero, ki smo jih na šoli poskusili rešiti. Učence sem med poukom naključno vabila k sodelovanju, odziv sem pričakovala v roku petih sekund. Učence, ki se niso v razumnem roku odzvali, izklopili kamere ali kako drugače motili pouk, sem za tisto uro odstranila iz videokonference. V spletno učilnico smo namreč priprave na učne ure obešali tudi za tiste ure pouka, ki so bile izvedene na daljavo prek videokonference, tako da jim pravica do izobraževanja ni bila odvzeta. Učenci so zelo hitro ugotovili, da je potrebnega manj časa in napora, če delaš z razredom kot pa sam, s pomočjo priprave v spletni učilnici.

3 PRIPRAVA GRADIV ZA SAMOSTOJNO DELO

3.1. Preglednost spletne učilnice

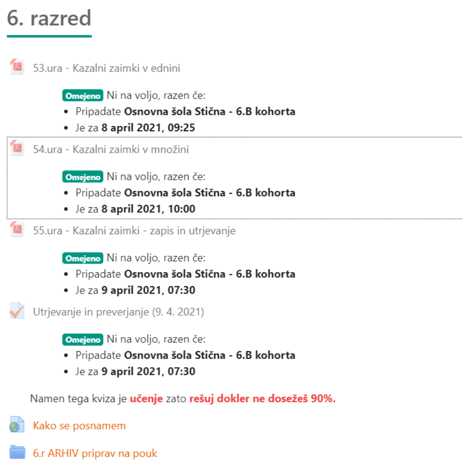
V spletnih učilnicah se zelo hitro nabere veliko povezav in drugega gradiva. Če je gradiva preveč, učence demotivira. Če je slabo organizirano, porabijo preveč časa za navigacijo in manj za učno snov.
Zato sem gradiva in spletno učilnico organizirala kar se da pregledno.

Organizacija spletne učilnice
Arnesove spletne učilnice so izredno učinkovito orodje, ki nadomestijo šolski prostor. Ker je lahko virov in povezav v njej zelo veliko, lahko navigiranje v tem prostoru postane zamudno in begajoče. Prvi korak k motivaciji za delo je bila torej ploščična organizacija spletne učilnice. Vsak razred je na svoji ploščici imel tudi drugačno sličico (Slika 1), kar jim je olajšalo hitro navigacijo.



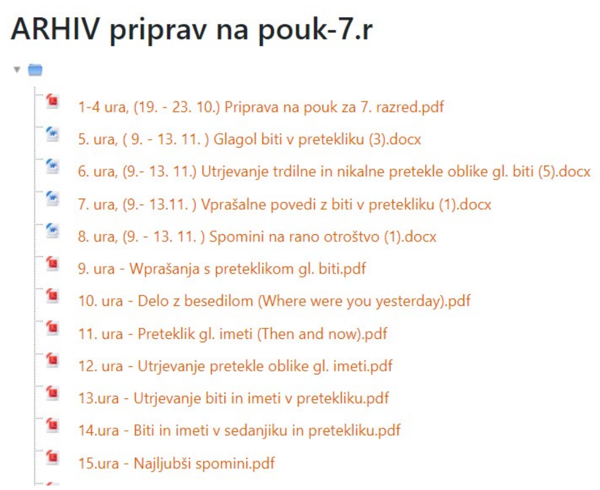
Slika 1: Organizacija spletne učilnice po razredih

Organizacija snovi znotraj razreda (ene ploščice)
Vsaka priprava na učno uro je bila oštevilčena in naslovljena (Slika 2).
Za lažjo navigacijo je bilo pomembno tudi, da hkrati ni bilo v spletni učilnici posameznega razreda obešenih več priprav kot štiri, kar pomeni, da ni bilo treba koleščkati na dno strani. Zaporedno številčenje se je izkazalo za mnogo preglednejši in uporabnejši sistem kot datiranje za sledenje zaporedju arhiviranih priprav.



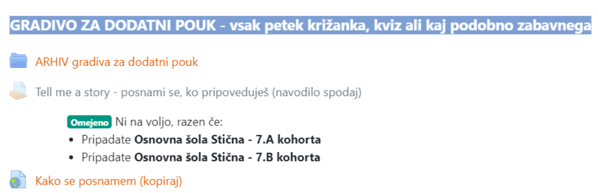
Slika 2: Organizacija snovi znotraj enega razreda (ene ploščice)

Na koncu tekočega tedna sem priprave pospravila v mapo z naslovom ARHIV priprav na pouk, kjer so učencem vedno na voljo. Arhivirane priprave v mapi ARHIV si sledijo po kronološkem redu in jim je zato lahko slediti (Slika 3).



Slika 3: Organizacija mape ARHIV priprav

Pomembno je bilo tudi ločiti obvezno snov rednega pouka od dodatnih aktivnosti. Te sem z oznako jasno označila z napisom pod mapo arhiva priprav (Slika 4).



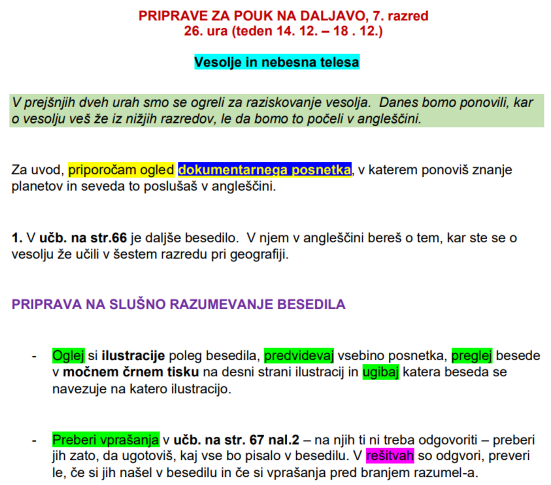
Slika 4: Ločevalna oznaka z napisom

3.2. Kvalitetna priprava na pouk

Čeprav smo velik del pouka izvajali na daljavo prek videokonferenc, smo priprave za pouk obešali v spletno učilnico za vse ure pouka. Priprave, ki so bile predvidene za pouk na daljavo, so bile na voljo šele po izvedeni uri prek videokonference, po potrebi med njo. To je bilo pomembno, zato da so vsi učenci pouku sledili enako zbrano.

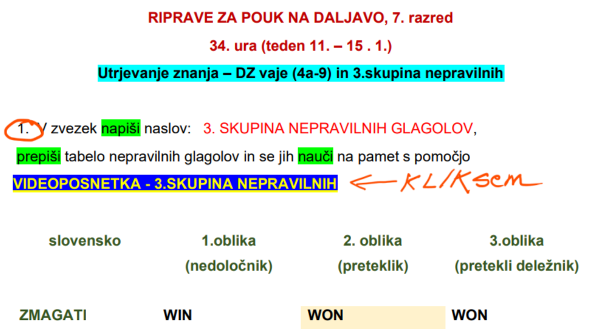
Priprava je morala biti napisana tako, da jo je učenec lahko uporabil samostojno. Pri tem so se poleg številčenja izkazale koristne barvne kode, številke korakov, posnetki zaslona in videoposnetki delov razlag.

Barvne kode in oštevilčeni koraki
V navodilih za samostojno delo sem v pripravah uporabljala barvne kode. Premišljeno barvno kodiranje spodbuja organiziran tok misli. [2] Z živo zeleno barvo sem opozorila na del navodil, ki so zahtevala neko aktivnost učencev. Povezave do videoposnetkov so bile označene temnomodro, uvodni del, ki ni bil del učnih ciljev, svetlo zeleno, neobvezne aktivnosti rumeno, rešitve z vijolično (Slika 5). To je učencem pomagalo, da so se že ob bežnem skeniranju besedila hitro orientirali.
Na isti sliki je tudi vidno, da so koraki za delo po pripravi oštevilčeni. Tudi to je učencem prihranilo trud, sploh če se niso držali vrstnega reda dejavnosti.



Slika 5: Uporaba barvnih kod

Videoposnetki
Kadar je bilo smiselno, sem namesto napisane razlage in navodil ustvarila videoposnetek. Čeprav je lahko priprava kvalitetne video razlage časovno bistveno zahtevnejša od napisane priprave, je to investicija v prihodnost. Kvaliteten videoposnetek snovi, ki jo vsako leto obravnavamo, nam lahko pride prav tudi v prihodnosti, kot npr. zaposlitev za nadomeščanje, dopolnilni pouk ipd.
V spletno učilnico sem vgradila pisno pripravo, ki je vsebovala povezavo do tega posnetka. Samostojno vgrajevanje URL povezave ni bilo smiselno, ker se povezave ne da pospraviti v mapo ARHIV.
Kratka povezava namesto obširne pisne razlage je že na pogled spodbudila učence, ker so videli, da bo snov količinsko obvladljiva. Tudi za učence je bilo lažje spremljati zvok, sliko in ustaviti ali pohitriti videoposnetek. Na ta način tudi staršem ni bilo treba predelovati pisnih priprav, da bi otroku interpretirali navodila (Slika 6).



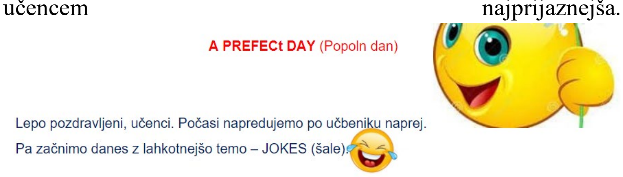
Slika 6: Del priprave na pouk – navodila in razlaga v obliki videoposnetka, del navodila napisan na roko

Moteč del pisnih priprav
Del ure pouka je vedno tudi običajna komunikacija, ki ni povezana z učnimi cilji. Pisna priprava za samostojno delo ne more biti nadomestek za pouk v razredu, zato je v pisni pripravi na pouk vse, kar niso kratka in jasna navodila ali razlaga, moteče. Sčasoma smo z učenci ugotovili, da pri pisnih pripravah za samostojno delo moti ves balast, s katerim smo želeli nadomestiti pomanjkanje vzdušja v razredu. Emotikoni, dekorativne sličice, spodbudni nagovori, humorne domislice in celo pozdravi so se izkazali za moteče. Skoraj vse naštete poskuse, da bi pristno komunikacijo in vzdušje v razredu prenesla v pisno obliko, sem opustila. Da bi priprave vseeno ne bile popolnoma brezosebne, sem suhoparnost popestrila s kakšnim stavkom navodila, ki sem ga, namesto natipkala, napisala na roko in pa seveda namesto pisne razlage posnela video (Slika 6).

Emotikoni
Emotikoni so v elektronski komunikaciji nekaj običajnega, v pripravi pa motijo koncentracijo. Učenci razmišljajo, kakšno povezavo v zvezi s snovjo oz. navodilom signalizirajo. Vesel emotikon bi lahko pomenil, da del razlage, poleg katerega je, ni obvezen, potrt emotikon pa, da je snov pretežka za povprečnega učenca (Slika 7).

Dekorativne ilustracije
Pouk v razredu je za vsakega udeleženca doživetje. Poleg samega podajanja, sprejemanja in usvajanja snovi je čar pouka atmosfera, ki jo soustvarjamo skupaj z učenci. Včasih se kdo spontano pošali ali pa nas nepričakovane asociacije zapeljejo stran od začrtane strukture ure. Pri pisnih pripravah na samostojno delo smo s kolegicami sprva poskusile ta del vzdušja nadomestiti s prijaznimi ilustracijami. Podobno kot emotikone so slikovni del učenci razumeli kot ponazoritev razlage, kar je oteževalo razumevanje.

Spodbudni nagovori, domislice, pozdravi
Razne dobronamerne prijaznosti v smislu »Pozdravljeni učenci, upam, da ste lepo preživeli praznike ...« demotivirajo, ker zasedajo prostor na strani in tako je priprava že na pogled daljša in zamudnejša. Učenca, ki se take priprave loti po npr. treh videokonferencah in dveh pisnih pripravah na samostojno delo pri drugih predmetih, lahko zamori, ker že na pogled deluje, da bo snovi preveč.
Čeprav so jedrnata in konkretna, pregledno označena in barvno zakodirana navodila morda na videz brezosebna, so vendarle učencem najprijaznejša.



Slika 7: Primer balasta v pripravi

4 IZGORELOST IN PREVENTIVNI UKREPI

Pri delu na daljavo smo učitelji v nevarnosti, da izgorimo. [3] K občutku, da nimamo več nadzora nad svojimi obremenitvami, prispeva precej posebnosti pouka na daljavo. Ena je nenaravna komunikacija, ki povzroča »Zoom utrujenost«. Druga so številna orodja, ki omogočajo nadzor nad vsako dejavnostjo vsakega učenca. Če nas to zapelje, da pretirano sledimo njihovemu napredku in preveč ažurno ponujamo pomoč, lahko ta preobremenitev prispeva k izgorelosti, saj je učencev bistveno več kot učiteljev. Nenazadnje pa so tu še komunikacijska orodja, prek katerih smo dosegljivi staršem in učencem za celostno podporo tudi v prostem času. Preventivni ukrepi, ki so se obnesli, so bili v glavnem dobra organizacija časa, uporaba aplikacij, ki reducirajo oz. skrajšajo odvečno delo, in pa spoznanje, da je potrebno del bremena tudi delegirati oz. vsaj deliti. [4]

4.1. Organizacija časa

V času pouka na daljavo me je poleg didaktičnih procesov obremenjevala tudi stalna komunikacija s starši, kolegi in učenci. Straši so mi pisali elektronsko pošto z nujnimi obvestili, prošnjami in raznoraznimi vprašanji vse dni in ure v tednu. Učenci so mi pisali prek Microsoft Teams sporočila v klepet ob vseh mogočih urah in na vse dni v tednu. Sprva sem se odzivala na vse takoj, kasneje pa ugotovila, da se čutim dolžna izven delovnega časa odzivati le v dveh primerih, in sicer ko gre za tehnično podporo, da lahko učenec sledi pouku, ali pa ko gre za hudo čustveno stisko.
Po premisleku sem se odločila, da bom v tehnično in učno podporo učencem in staršem vsak delovni dan ob isti popoldanski uri dosegljiva prek videokonference. Povezavo sem vgradila v spletno učilnico. Že v prvem tednu je bilo lažje za vse – vsi so vedeli, da lahko po nasvet ali pomoč pridejo ob 19. uri, zato me za tovrstno pomoč niso več obremenjevali po drugih kanalih.
Težje pa je bilo omejiti komunikacijo z učenci, ki so se name obračali v hudih čustvenih stiskah tudi sredi noči. Te učence sem povabila na individualne pogovore, ko je kriza minila. Z vsakim takim učencem sva se dogovorila, da bova ustanovila skupinico, v katero bosta poleg naju vključena še dva delavca šole, ki jima učenec zaupa. Tako nas ni skrbelo, da bo učenec v krizi ostal sam, pa še kot ekipa smo bili boljša pomoč od posameznika.

4.2. Povratna informacija učencem

V razredu včasih že iz govorice telesa in interakcije v družbi vemo, kako in koliko učenci delajo samostojno, na daljavo pa nam ta vpogled manjka in nas skrbi. Zato sem v začetku zahtevala, da so mi v elektronski obliki redno pošiljali fotografije svojih izdelkov. Ker je bilo dnevno pregledovanje in pošiljanje povratnih informacij cca 100 izdelkov dnevno prezahtevno, sem poiskala boljše načine.

Obilica orodij in aplikacij, ki omogočajo vpogled v praktično vsako dejavnost vsakega posameznega učenca, nas lahko hitro zapelje v to, da ves prosti čas učitelji porabimo za pregledovanje zapiskov, domačih nalog, spisov in podobnih izdelkov. Seveda je potrebno spremljati napredovanje učenca, vendar po principu manj je več in kvaliteta pred kvantiteto. V nadaljevanju navajam nekaj aktivnosti, ki so se dobro obnesle.

Pregled zapiskov v živo
Pisanje zapiskov v zvezek in reševanje pisnih vaj so učenci pred vklopljenimi kamerami izvajali pri pouku v živo. Preden sem jim videokonferenco dovolila zapustiti, so mi prepisano snov in rešene vaje pokazali v kamero. Pred tem dogovorom učenci zapiskov niso vsi niti ustvarili ali pa so jih preprosto prekopirali iz priprave.

Pregledovanje pisnih izdelkov
Pregledovanje pisnih sestavkov je poteklo na enak način. Že s tem, ko so pisne sestavke pisali v živo, sem poskrbela, da je to storilo veliko več učencev, kot če bi morali to narediti sami izven pouka. Poleg tega sem jim bila med pisanjem tudi na voljo prek klepeta za morebitne zadrege.
Kar je bilo ustvarjalnega pisanja, so mi učenci še vedno oddajali zapiske v spletno učilnico, če sem se odločila preverjati pravopis. Pogosto pa sem se odločila preverjati samo vsebino, slovnico, izgovorjavo in besedišče, zapisa besed pa ne. V tem primeru so mi v spletno učilnico oddali zvočni zapis svojega izdelka. Poslušanje posnetka branja njihovega ustvarjalnega izdelka je bilo mnogo hitrejše in tudi moja povratna informacija, ki sem jo prav tako oddala v spletno učilnico v obliki zvočnega zapisa, je bila nazornejša. Poleg tega so učenci poleg pisanja povadili tudi branje in izgovorjavo.

4.3. Preverjanje znanja

V jesenskem delu šolanja na daljavo nisem več pregledovala preverjanj znanja, ki bi mi jih učenci oddajali v npr. pdf obliki. Namesto tega sem se naučila v spletni učilnici ustvariti teste oz. tako imenovane kvize, kjer učenci dobijo povratno informacijo takoj. Časovni vložek v učenje sestavljanja različnih tipov nalog je velik, saj je bil cilj znati sestaviti različne tipe nalog, s katerimi bi lahko preverila vse štiri sporazumevalne spretnosti. Na dolgi rok me je pridobljeno znanje rešilo pred izgorelostjo. Naloge se avtomatično popravijo same, ob napaki se učencu izpiše tudi razlaga. Še vedno pa sem pregledala tiste tipe nalog, kjer so odgovori prosti – npr. dolgi odgovori pri bralnem razumevanju, spis ali govorna prestavitev.
Poleg prihranka časa imajo kvizi v spletnih učilnicah še dve prednosti, vredni poudarka.
Prva je ta, da učenca prisili k učenju. Kot omenjeno, če je naloga zastavljena tako, da npr. preverja znanje novega besedišča, se ob vsakem reševanju naloge pojavi naključen nabor besed po naključnem vrstnem redu. Če od učenca zahteva, da nalogo reši trikrat zapored, dokler ne doseže določenega odstotka pravilno rešenih primerov, se že prek teh poskusov snov nauči.
Po mojih izkušnjah je to učinkovitejši način, da učenca spodbudiš k učenju, kot če napoveš ocenjevanje.
Druga prednost kvizov v spletni učilnici pa je enostavno pridobivanje konkretnih podatkov, s katerimi lahko staršem in razrednikom realno poročamo o napredku in delu učencev. Ko so učenci vpisani v spletno učilnico, program sledi vsaki učenčevi dejavnosti in napredku. Izpišemo lahko raznovrstna poročila o vsaki njihovi aktivnosti. Tako je formativno spremljanje učenca olajšano, prav tako izpis poročil s konkretnimi informacijami.

5 ZAKLJUČEK

Pouk tujega jezika na daljavo je kompleksnejši od poučevanja večine drugih predmetov, saj morajo učenci napredovati tudi pri spretnostih, ki se jih ne da naučiti frontalno. Didaktika učenja konverzacije, izgovorjave in uporabe besedišča ter slovničnih struktur v razredu ni enostavno prilagoditi učenju na daljavo. S primernimi orodji in didaktičnimi načini lahko vodimo učence, da napredujejo tudi na teh specifičnih področjih. Ob daljšem šolanju na daljavo tako učencem kot učiteljem pade motivacija. Temu se lahko v veliki meri izognemo, če so učenci v pouk vključeni aktivno in sodelovalno. Staršem je potrebno omogočiti, da se lahko umaknejo iz učnega procesa. Zato je potrebno pripraviti in organizirati e-gradiva tako, da jih je vsak učenec sposoben uporabiti samostojno, brez pomoči. Z dobro organizacijo in vlaganjem časa v učenje možnosti, ki mi jih ponujajo spletna orodja, se učitelji lahko izognemo izgorevanju, saj lahko napredku učencev sledimo natančno in časovno učinkovito.

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Poučevanje na daljavo v prvem razredu

First grade distance teaching

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POVZETEK

Opisuje potek izvajanja pouka na daljavo z uporabo sodobnih informacijsko-komunikacijskih tehnologij. Učinkovitost in prednost predhodnih izobraževanj ter usposabljanja učiteljev za izvedbo pouka na daljavo. Usposabljanje staršev za prenos učiteljevih navodil pri uporabi spletnih učilnic. Pomen osveščanja varnosti na internetu ter spletni bonton. Vpliv komunikacije na razvoj osebnosti. Posledice socialne izoliranosti ter soočenje s stresom. Prednosti in slabosti pouka na daljavo.

KLJUČNE BESEDE

Komunikacija, poučevanje na daljavo, uporaba sodobnih tehnologij in e/i-gradiv, stres, vrednotenje znanja

ABSTRACT

Describing the way of online teaching with the support of information - communication technologies. Effectiveness and advantage of previous way of education and training of teachers to perform online teaching. Parents training to apply teacher instructions when using online classrooms. The importance of awareness of online safety and online etiquette. The influence of communication on personality development. Consequences of social isolation and stress handling. Advantages and disadvantages of distance learning.

KEYWORDS

Communication, education, online teaching, use of modern technologies and materials, stress, evaluation of knowledge

1 UVOD

Posledica pandemije in posledično globalnih sprememb današnjega časa, je poučevanje otrok na daljavo. Učenje na daljavo je prineslo nove oblike izvajanja pouka. Od učitelja se je naenkrat pričakovalo, da obvlada interaktivna področja. Večletna nadgradnja in usposabljanje učiteljev iz področja informacijsko-komunikacijske tehnologije je pokazala svoje pozitivne rezultate. Začetna negotovost glede poteka poučevanja na daljavo je hitro prerasla v učinkovito, uspešno in rutinsko opravilo. Ob začetku izvajanja pouka na daljavo se je postavljalo ogromno vprašanj. Sama izvedba je od učitelja zahtevala neprimerno več dela, ogromno novih smernic pri načrtovanju, usklajevanju ter izvedbi pouka. V veliko pomoč učitelju so bili interaktivni učbeniki, vsebine ter smernice in priporočila vseh deležnikov pri poučevanju na daljavo. Vsekakor pa so ključno vlogo pri mlajši populaciji šolskih otrok odigrali starši. Za izvedbo pouka na daljavo je bilo ključno dobro sodelovanje med starši, učitelji in učenci. Porodila so se nova spoznanja, novi načini poučevanja in spremljanje učenčevega napredka direktno iz učiteljevega v učenčevo domače okolje.

2 UČINKOVITOST POUČEVANJA IN UČENJA Z UPORABO SODOBNIH NAPRAV IN APLIKACIJ

Način poučevanja na daljavo je za učitelje predstavljal velik izziv. Šolske institucije so omogočale različna izobraževanja iz področja informacijsko-komunikacijske tehnologije. Učitelji smo se seznanili z različnimi spletnimi platformami, sistemi in orodji za učenje na daljavo. Seznanitev in končno poznavanje orodij za poučevanje na daljavo, je bilo nujno potrebno za spletna srečanja ter njihovo nadgradnjo. V času pouka na daljavo se je obrestovalo večletno postopno vključevanje informacijsko-komunikacijske tehnologije v učni proces. Ravno tako so se v osnovnih šolah izvajala izobraževanja iz področja računalništva za vse generacije ucencev.

Ure računalništva za obvladovanje osnov računalniškega opismenjevanja so marsikateremu otroku olajšala spletna srečanja. Kljub temu, da smo v razcvetu uporabe in dostopnosti do različnih komunikacijskih tehnologij in veščin, uporaba teh še zdaleč ni dosegljiva vsem, ki bi si to želeli, bodisi iz naslova finančne nezmožnosti ali slabšega omrežnega dostopa do digitaliziranega območja. Problemi so zlasti pri tistih učencih, ki izhajajo iz šibkejšega socialnega okolja in v domačem okolju niso imeli ali nimajo prave možnosti dostopa in seznanitve z uporabo računalniške tehnologije.

Pri pouk na daljavo, je bilo potrebno na začetku usvojiti nekatera pravila bontona iz obnašanja pred računalnikom. Dogovor z učenci in njihovimi starši je vključeval, da se pred začetkom videokonference uredimo, pripravimo svoj delovni prostor, šolske pripomočke in učbenike ter se pravočasno vključimo v videokonferenco. Dogovor je vključeval tudi, da odstranimo vse moteče dejavnike, se med videokonferenco ne prehranjujemo, uporabljamo ikono za dvig roke ter se ne sprehajamo po prostoru ali igramo.

Ravno tako so na daljavo potekale tudi učiteljske konference, izobraževanja in usposabljanja učiteljev. Na šoli, kjer poučujem, je bila vpeljana praksa medgeneracijske pomoči med učitelji pri usvajanju interaktivnih veščin ter pomoč pri začetni izpeljavi pouka na daljavo. Vzpostavila se je tudi spletna različica pogovornih ur ter roditeljskih sestankov. Vsekakor so pogovorne ure in roditeljski sestanki v fizični obliki najboljši in najprimernejši komunikacijski stik med starši in učitelji.

2. 1 Varna raba interneta

Varna raba interneta je pomembna za vse uporabnike, tako za najmlajše, kot tudi za starejše uporabnike spleta. Danes je življenje otrok in odraslih povezano in prepleteno z uporabo sodobnih tehnologij, različnih medijev, ki oglašujejo svoje storitve in nas vpletajo v svet različnih aplikacij in spletnih storitev. Seveda pa so najmlajši uporabniki najranljivejša skupina in so lahko hitro žrtev spletnih prevar in zlorab. Zato je ozaveščanje o pasteh in nevarnostih na spletu izrednega pomena. Zlasti je pomembno ozaveščati najmlajšo in najranljivejšo generacijo otrok.

Veliko prvošolcev zna osnovno uporabljati sodobne komunikacijske naprave, telefon, tablični računalnik. Risanke, filmi, računalniške igrice so njihove najbolj priljubljene vsebine. Vsakodnevno igranje igric lahko povzroči odvisnost in čustvene motnje. Strokovnjaki opozarjajo, da naj bi učenci prve triade osnovne šole, preživeli pred zaslonom v prostem času, največ eno uro na dan. Pomembno je nenehno osveščanje staršev in učiteljev na škodljivost pretirane uporabe sodobnih naprav. Zlasti učitelji opozarjamo otroke na tovrstne nezdrave razvade. Pogosto je domače okolje tisto, ki lahko zavira ali spodbuja tovrstna dejanja. Otroke opozarjamo na pomembnost zdravega življenjskega sloga, z zagotavljanjem dobrega fizičnega in psihičnega počutja učencev. Osveščamo jih o pomenu prijateljstva, druženja z vrstniki, prijatelji, sorojenci.

2. 2 Izzivi v poučevanju

Poučevanje v prvem razredu temelji predvsem na konkretnih primerih in izkustvenem učenju. Ko smo prešli iz klasičnega načina poučevanja v razredu na pouk na daljavo je bilo potrebno razmisliti tudi o prenosu in izvedbi učnih vsebin, ki so pri klasičnem poučevanju vsebovale konkretno in izkustveno učenje. Porajala so se tudi vprašanja, kako in na kak način podajati oziroma posredovati znanje na daljavo, da bo cilj usvojen in ga bo možno kasneje tudi vrednotiti. Kako narediti pouk prijeten in hkrati učinkovit, kako vključiti dovolj in ne preveč slikovnega in glasovnega materiala ter kako vplivati na gibalni, čutni del pouka.

Pouk na daljavo je vključeval tudi pripravo in izdelavo različnih didaktičnih pripomočkov tako iz naravnih, kot drugih materialov, ki so bili učitelju in učencem v pomoč pri didaktičnih vsebinah. Primer; Pri spoznavanju okolja smo se pogovarjali o prvih znanilcih pomladi. Učitelji smo preko videokonference z učenci predstavili in opisali rastline, prinešene iz narave, kot so zvonček, kronica, trobentica, žafran, teloh. Vsako rastlino smo natančno opisali, povedali kje raste… Pred zaključkom videokonference so posamezni učenci ponovili poimenovanje rastline ter jo opisali. Učitelji smo tako dobili povratno informacijo o znanju. Zanimivo je bilo, da so nekateri učenci ob naslednjem srečanju pokazali ostalim učencem rastline, ki so jih sami nabrali v naravi in jih opisali. Pomembno je, da učenci tako spremljajo lastni napredek, razvijajo spretnost komuniciranja, poglabljajo pozitiven odnos do učenja ter si krepijo samozavest. Nadgradnja obravnavane snovi so bile naloge v delovnem zvezku ter učni listi. Starši so naloge poslikali ter jih naložili v spletno učilnico v vpogled učitelju, kot povratno informacijo o učenčevem delu in napredku.

Učitelji prve triade smo bili pri pouku na daljavo odvisni od staršev, njihovega sodelovanja in pomoči otroku. V prvi fazi je bilo potrebno preveriti ali imajo vsi otroci možnost, da spremljajo pouk na daljavo. Šola je poskrbela, da nihče ni ostal brez računalnika. Večje število učencev je pouk spremljalo v dopoldanskem času. Otroci tistih staršev, ki niso službovali od doma, pa so imeli pouk v popoldanskem času. Kljub prilagojenemu načinu izvedbe pouka, je bilo potrebno vključiti še ostale deležnike, ki so prispevali svoje učne vsebine (dodatni in dopolnilni pouk, krožke, angleščino, učno pomoč…) in jih časovno umestiti v tedenski koledar. Ob vsem prilagajanju smo učitelji ugotovili, da tak način poučevanja za učence in učitelje predstavlja dnevno dopoldansko in popoldansko obvezo.

Potrebno je bilo izobraziti starše učencev. Zaradi različne računalniške pismenosti, socialne neenakopravnosti pri dostopu do informacijsko-komunikacijskih tehnologij, so šole organizirale več spletnih izobraževanj za vzpostavljanje komunikacijskih kanalov in nudile glede na različne družinske razmere tudi individualni pristop do usposabljanja osnovnih računalniških veščin. Na razredni stopnji se prvi stik z učenci vzpostavlja preko staršev. Njihova vloga je, da poskrbijo za prenos navodil učencu. Z vpeljavo stalnice videokonferenčnih rutin se vloga in prisotnost staršev zmanjšuje. Preko spletnih učilnic in elektronske pošte so starši komunicirali z učitelji, učenci pa preko spletnih učilnic spremljali pouk. Učitelji so nalagali v spletne učilnice različno učno gradivo, ki so ga starši otrokom lahko večkrat predvajali ali glede na vsebino natisnili. Razlaga snovi v obliki PowerPointov je bila bolj pregledna in vsebinsko bogata. Učiteljeva razlaga je bila po potrebi tudi posneta, da so si učenci lahko večkrat pogledali posnetek in s tem hitreje in lažje usvajali znanje. Pomemben je bil neposreden stik učenca z učiteljem. Ob koncu vsake videokonference so imeli učenci priložnost, da so se med seboj pogovorili, spraševali, se dogovarjali in je med njimi potekala komunikacija. Preglednost spletnih učilnic je bila učinkovita in praktična ter je nudila povratno informacijo učitelju, ko so starši pošiljali v spletno učilnico tedenske izdelke otrok. Starši so imeli vpogled v Teamsov koledar, kjer so bile dnevno zabeležene učne in druge dejavnosti njihovih otrok. To je predstavljalo olajšanje staršem in učiteljem. Starši učencev so lahko nemoteno preko spletnih učilnic pošiljali predstavitve knjig iz naslova različnih bralnih značk ali pa učiteljici ter knjižničarki kar v živo preko spleta predstavilili izbrano knjigo ali pesmico za bralno značko.

Ravno to sodelovanje in usklajevanje med starši in učitelji je še poglobilo vez v trikotniku: učitelj – starš – učenec. Kot učiteljica sem začutila, da nam starši sedaj pripisujejo višjo vrednost našega dela in poklica, kot je ta predstavljal pred poučevanjem na daljavo. Marsikateri starš je ob tovrstnem poučevanju bolje razumel naravo učiteljevega poslanstva in s spoštljivostjo vrednotil trud, poučevanje ter nenazadnje same priprave učnih sklopov ter njihovo izvedbo.

Šola, na kateri poučujem, se je odločila za uporabo aplikacije Microsoft Office in Teams. Gre za celovito digitalizirano učno okolje. Vključuje sistem upravljanja učenja z vsemi potrebnimi orodji. Učiteljem in staršem je navedena aplikacija omogočala lažjo dostopnost in preglednost do vseh ostalih aplikacij in orodij. Preko nje so starši lahko komunicirali z učitelji ter nalagali opravljene naloge svojih otrok v odprte datoteke. Učitelji smo imeli omogočen vpogled in pregled nad opravljenimi nalogami ter s kljukico v datoteki označili, da je naloga opravljena in pregledana. Veliko podporo spletnemu poučevanju so omogočili interaktivni učbeniki in delovni zvezki ter interaktivni zvezki. S pomočjo teh je bilo veliko lažje predavati in zapisovati snov. Učencem je bila omogočena večja preglednost nad zapisi v delovnih zvezkih in zvezkih. Direkten vpogled nad učiteljevim izvajanjem zapisov je vzpodbujal učence k zbranosti, večji učinkovitosti in pomnenju učne snovi ter lažjo sledljivost pri pouku. Učitelj pa je z zapisi v delovni zvezek ali zvezek lažje sledil in preverjal znanje učencev. Povratna informacija je bila tako obojestranska in učinkovita. Spletni portali z elektronskim učnim gradivom so bili v veliko pomoč učiteljem in ti so lahko gradiva prilagajali po svojem okusu. Gradiva različnih založniških hiš so bila nadgradnja tiskane izdaje z enakim naslovom. Vsa gradiva so ponujala orodjarno s številnimi uporabnimi orodji, nekatere izmed njih pa so bogatile še z interaktivnimi nalogami, avdio- in videoposnetki, s spletnimi povezavami ter drugimi multimedijskimi dodatki.

Ob tem Brodnik (2013, str. 356) izpostavlja, da »so postala e-gradiva sestavni del pouka (tudi pri poučevanju v živo, op. avt.). Izdelujejo, posodabljajo, objavljajo in uporabljajo jih učitelji, vzgojitelji, ravnatelji, računalnikarji, vse bolj pa tudi učenci ter dijaki. Na voljo so tudi številna vnaprej pripravljena e-gradiva, ki jih pojmujemo kot vsa digitalna gradiva za doseganje učnih ciljev. E-gradiva zanesljivo prispevajo k večji kakovosti pouka in k izgradnji bolj poglobljenega znanja, saj multimedijski elementi omogočajo bolj poglobljeno in kakovostno obravnavo učne snovi, interaktivnost pa prispeva k večji aktivni vlogi učencev in dijakov. E-gradiva omogočajo kakovostno sodelovalno učenje na daljavo, reševanje problemov, raziskovanje in ustvarjanje.«

V prvem razredu je tehnika poučevanja prilagojena učnim vsebinam. Učni načrt vključuje različne metode in oblike poučevanja, ki so primerne za mlajše otroke. Razlaga in prikaz temelji na izkustvenem učenju, podkrepljenem na konkretnih primerih. Učitelja spodbuja, da išče odgovore na vprašanja, kako spodbuditi učence k večji miselni dejavnosti, hkrati pa ga opozarja, da so čustva, osebni cilji, radovednost, težnja po uveljavljanju svojih zmožnosti, samouresničevanju, ustvarjanju in osebnem smislu pri učenju enako pomembni kot čisto intelektualni procesi (Marentič Požarnik, 2003).

3 SOCIALNA IZOLIRANOSTI PRI POUKU NA DALJAVO TER SOOČANJE S STRESOM

Cilji osnovne šole so omogočiti učenkam in učencem osebnostni razvoj v skladu z njihovimi sposobnostmi in zakonitostmi razvojnega obdobja (pri tem je potrebno uravnotežiti spoznavni, čustveni in socialni razvoj), posredovati temeljna znanja in spretnosti, ki omogočajo neodvisno, učinkovito in ustvarjalno soočenje z družbenim in naravnim okoljem in razvijanje kritične moči razsojanja (Nišandžić D., 2011).

V prvi triadi osnovne šole je učno izobraževalni sistem usmerjen v proces opismenjevanja, usvajanja spretnosti in sposobnosti branja ter pisanja. V tem obdobju se razvijajo tudi sposobnosti prenosa sporočanja ali razvijanje komunikacije, ki vpliva na razvoj osebnosti. S tega vidika naj bi torej potekal jezikovni razvoj in razvijanje jezikovnih sposobnosti učencev najprej s pomočjo razvijanja temeljnih komunikacijskih spretnosti in sposobnosti, šele nato naj bi se otrok pričel spoznavati s strukturo jezika (Pečjak, S., 2009).

V tem obdobju je proces socializacije izredno pomemben. Zato je druženje z vrstniki, prijatelji, učitelji ter drugimi izrednega pomena. Socialni stiki se krepijo ob igri in druženju. S prihodom otrok v prvi razred, se krepijo nova ter utrjujejo stara poznanstva iz vrtca.

Socialne izkušnje in interakcije med otroci so se z zaprtjem šol povsem spremenile. Otroci so bili v času šolanja na daljavo prikrajšani za stike s svojimi sošolci. Zato se na področju socialnega razvoja lahko pojavijo zaostanki zaradi pomanjkanja interakcij izven družinskega okolja. Zaskrbljujoči so tudi podatki o fizičnem zdravju otrok. Glede gibalnega razvoja otrok je veliko polemik sprožila slovenska študija, katere rezultati že kažejo na poslabšane dosežke otrok pri športno vzgojnem kartonu (SLOfit, 2020).

Vsaka vojna ali kriza pusti pečat pri ljudeh. Vsak različno doživlja krizna obdobja v svojem življenju. Zagotovo bo tudi pandemija Covida-19 dolgoročno pustila posledice tako na učnem, kot vedenjskem področju novodobnih generacij otrok.

Najmanj posledic bodo občutile generacije najmlajših. Generacija otrok v zgodnjem in poznem otroštvu pa več. Vrstniki so pomemben dejavnik v njihovem življenju. Prikrajšanost za stike z vrstniki, bo pri nekaterih pustila posledice pri vzpostavljanju stikov, sporazumevanju, timskem delu ter na čustvenem področju. Zaradi povečane uporabe sodobnih komunikacijskih naprav, se krepijo z računalniškim znanjem podprte generacije. Prednosti pouka na daljavo bodo dolgoročno vidne v obliki izpopolnjenih informacijsko-komunikacijskih veščin otrok. Bogatenje usvajanja teh veščin bo pozitivno v kasnejšem obdobju, ko se bo ta generacija otrok pojavila na trgu dela. Po drugi strani se povečuje trend dela od doma, kar gre sigurno na roko sedanji generaciji bodočih iskalcev zaposlitve.

Žal, sodobne naprave in aplikacije ne morejo nadomestiti človeške bližine, pristnosti in pogovora, zaradi katerih bodo prikrajšane novodobne generacije. (Jeriček, H., 2010) pravi, da smo ljudje med seboj povezani in vplivamo drug na drugega s svojim počutjem in razpoloženjem. Zato je vsak, ki dela ali živi v šolskem okolju pomemben, saj prispeva k ozračju v šoli.

Spraševanje in preverjanje znanja, slabe ocene, govorni nastopi, konflikti z učenci in učitelji so tipične stresne situacije v šoli, ki zahtevajo od učitelja veščine in znanja ter dodatna izobraževanja, da lahko prepreči nastanek marsikatere težave. Z dobro komunikacijo lahko rešimo marsikaj (Jeriček, H., 2010). Tudi družinske razmere in okolica vplivata na otrokovo obnašanje in odzive. Nenavadno ali spremenjeno obnašanje ter nenadzorovani odzivi so alarm, da se z otrokom nekaj dogaja. Učitelji so zagotovo tisti, ki med prvimi opazijo spremembe v otrokovem obnašanju.

Ob sprejetju ukrepov za zajezitev epidemije Covid-19 so se ljudje srečevali z različnimi stresnimi situacijami. Te so vplivale na življenje ljudi, družin in otrok. Veliko teh negativnih stresnih situacij je ostalo skritih za štirimi stenami.

4 ZAKLJUČEK

Pouk na daljavo je spremenil načine poučevanja. Smatram, da je dolgoročno gledano taka izvedba pouka pustila tudi pozitivne rezultate. Veliko učiteljev se je dodatno izobraževalo in izpopolnjevalo svoje informacijsko-komunikacijsko znanje. Učenci so napredovali pri usvajanju računalniškega znanja. Res je, da sem kot učiteljica pogrešala fizično prisotnost otrok, razred, šolo. Na začetku pouka na daljavo se se porajala vprašanja, kako bo tak način poučevanja na dolgi rok uspešen in kako se bo ovrednotilo znanje otrok. Bili so pomisleki, Koliko samostojnega dela bo prvošolec vložil v svoje delo, kakšen bo starševski nadzor in vmešavanje v samostojno delo otrok. Danes vidim, da so bili moji strahovi odveč. Pri večini otrok je bil napredek izrazito viden. Zlasti je bil opazen napredek pri grafomotoriki in samostojnosti. Slabši je bil napredek pri besednem zakladu in komunikaciji. Pri povratku v šolo se je primanjkljaju posvetilo več pozornosti. Kot posledica prekinjenega neposrednega šolskega socialnega stika, je bil opazen slabši napredek pri usvajanju slovenskega jezika otrok, katerih materni jezik ni slovenski. Tem otrokom so bile v času pouka na daljavo nudene ure dodatne strokovne pomoči. Med poukom na daljavo je potekala tudi diferenciacija pouka. Vsekakor pa je pomembno dejstvo, da si učenci ob povratku v šolo niso več želeli imeti pouka na daljavo. Pogrešali so svoje sošolce in svoje učiteljice.

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Učiteljevi izzivi med šolanjem na daljavo pri pouku geometrije

Teacher challenges during distance learning in geometry lessons

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POVZETEK

Članek opisuje s kakšnimi izzivi sem se srečala v času šolanja na daljavo, in sicer pri sklopu geometrije pri matematiki. Učitelji na naši šoli smo se nekako izogibali geometrije na daljavo, zato smo dajali prednost aritmetiki. V nekaterih razredih to zaradi učnega načrta ni bilo izvedljivo, zato se je bilo treba soočiti z izzivom. V tem članku bom predstavila na kakšne načine sem prikazala geometrijske vsebine svojim učencem.

KLJUČNE BESEDE

Matematika, geometrija, učenje na daljavo

ABSTRACT

The article describes the challenges I faced during distance learning, namely in the field of geometry in mathematics. The teachers at our school somehow avoided geometry, so we preferred arithmetic. In some classes, this was not possible due to the curriculum, so a challenge had to be faced. In this article, I will present the ways in which I have shown geometric content to my students.

KEYWORDS

Mathematics, geometry, distance learning

1. UVOD

Trenutni in sodobni čas od nas zahteva, da se vsi učitelji prilagajamo, sledimo novim spremembam, se prilagajamo in ves čas evalviramo svoje delo in načrtujemo kako napredovati pri svojem delu. Gledati moramo, da delamo kakovostno in da to pomeni, da spodbujamo znanje, nenehno učenje in pridobivanje novih veščin in spoznavanje sodobnih orodij za poučevanje matematike. To velja tako v običajnih pogojih , v času poučevanja na daljavo pa še toliko bolj.

Že v učnem načrtu je s splošnimi cilji opredeljen pouk in namen poučevanja matematike. [1]

Učenci pri pouku matematike:

- razvijajo matematično mišljenje: abstraktno-logično mišljenje in geometrijske predstave;
- oblikujejo matematične pojme, strukture, veščine in procese ter povezujejo znanje znotraj matematike in tudi širše;
- razvijajo uporabo različnih matematičnih postopkov in tehnologij;
- spoznavajo uporabnost matematike v vsakdanjem življenju;
- spoznavajo matematiko kot proces ter se učijo ustvarjalnosti in natančnosti;
- razvijajo zaupanje v lastne (matematične) sposobnosti, odgovornost in pozitiven odnos do dela in matematike;
- spoznavajo pomen matematike kot univerzalnega jezika;
- sprejemajo in doživljajo matematiko kot kulturno vrednoto.

2. GEOMETRIJA

V osnovni šoli v tretji triadi so cilji pri področju geometrije znani. Zapisani so v učnem načrtu, ki je osnova za učiteljevo delo. [2]

Učenci v tretjem vzgojno-izobraževalnem obdobju:

- utrjujejo pretvarjanje merskih enot in jih povežejo z reševanjem geometrijskih nalog;
- razvijajo geometrijske predstave v ravnini in prostoru;
- razvijajo uporabo geometrijskega orodja pri načrtovalnih geometrijskih nalogah;
- razvijajo strategije geometrijskih konstrukcij z uporabo geometrijskega orodja;
- opisujejo postopek geometrijske konstrukcije;
- razvijajo natančnost in spretnost pri računanju neznanih količin pri likih in telesih.

3. GEOMETRIJA NA DALJAVO

Pri obravnavi poglavij, ki vključuje geometrijo je potreben popolnoma drugačen način predstavitve učne snovi. Pri nekih računskih postopkih je dovolj, da vso zadevo napišeš na ekran, sproti razlagaš in ponoviš na novih primerih. Zadeva funkcionira brez težav. Ko pa pridemo do geometrije pa naletimo na tisoč in eno oviro. Kako prijeti geometrijsko orodje? Kam ga postaviti? Kako razvijati geometrijske predstave? Kako opredeliti prostor in v njem osnovne geometrijske elemente? Še in še je vprašanj, ki se nam postavijo ob novih situacijah v katerih smo se znašli.

4. NAČINI PREDSTAVITEV

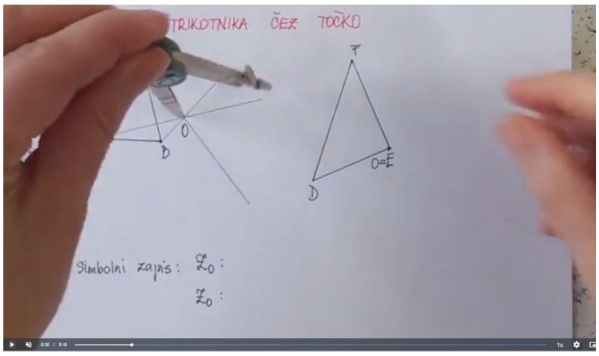
V našem aktivu smo imeli veliko idej, na kakšen način pripraviti ure za naše učence. Naše ure smo pripravljali skupaj, poenotene, za vseh 7 do 8 oddelkov istega razreda enake priprave. Ker smo imeli ure v živo ob različnih dneh so imeli učenci sicer vedno na razpolago tudi napisano pripravo v spletni učilnici. Pri urah v živo pa smo razložili zapisano še za nazaj in za tekočo uro.

Na začetku smo pripravljali video posnetke, tako, da smo posneli naše roke z uporabo geometrijskega orodja in naša navodila za delo. Krasno. Ti video posnetki so dobri za pripravljene ure, ki si jih lahko učenci sami pogledajo, za ure v živo tudi, vendar z eno težavo. Učencu težko pokažemo oziroma ga usmerjamo z vrtenjem videoposnetka, kaj mora storiti, na kaj mora biti pozoren. To se je pokazalo pri urah dopolnilnega pouka, pa tudi pri urah v živo.

Iskali smo nek približek situaciji v razredu, učitelj stoji pred tablo kjer drži ravnilo in šestilo. Imeli smo željo po nekem programu z geometrijskim orodjem. Najprej smo našli program OpenBoard, kasneje pa Smart Notebook.

4.1 Video posnetki

Video posnetke smo delali na različne načine. Če so bili namenjeni samostojnemu ogledu učenca, potem so to odličen vir informacij za učenca, lahko si ga tudi večkrat ogleda. Pri urah v živo je bila uporaba videa dobra podlaga za uro, ni pa bila vedno uspešna. Večkrat smo si samo delček postopka ogledali skupaj in snov ustno večkrat ponovili, poudarili …



Slika 1. Prikaz načrtovanja s šestilom na list papirja

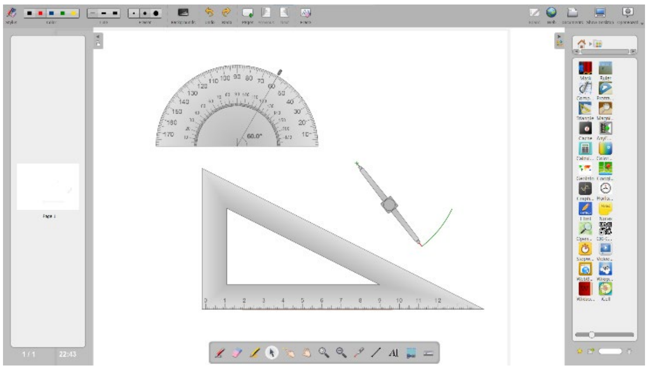
Slika 2. Prikaz načrtovanja z geotrikotnikom na list papirja

4.2 Open Board

Open Board je program, ki je dostopen vsem. Vsebuje več različnih orodij, tudi geometrijska. Na spodnji sliki so prikazana kotomer, s katerim lahko nakažemo in narišemo določene kote. Z njim lahko tudi kote merimo. Ravnilo je dobro orodje. Šestilo je pa zares neobičajno.

Prav to orodje me je zmotilo do te mere, da sem se lotila raziskovanja in iskanja novga, boljšega programa. S tem kotomerom težko ponazorimo postopek načrtovanja npr. simetrale daljice, če je njegova oblika popolnoma drugačna kot jo imajo učenci v roki. Že tako smo imeli učitelji dovolj dela z motiviranjem učencem in sledenjem snovi in ostalimi težavami na katere niti nismo imeli vpliva.

Zato smo želeli orodje, ki bo samo po sebi primerljivo z uporabo orodja na tabli, enako učinkovito, izdelek pa pregleden in natančen. Cilj mi je bil uporabljati orodje, kot je na interaktivnih tablah, ki jih imamo v šoli. S takim pogledom so učenci seznanjeni, kar bi pomenilo dodaten plus za poučevanje.



Slika 3. Prikaz orodja v programu OpenBoard

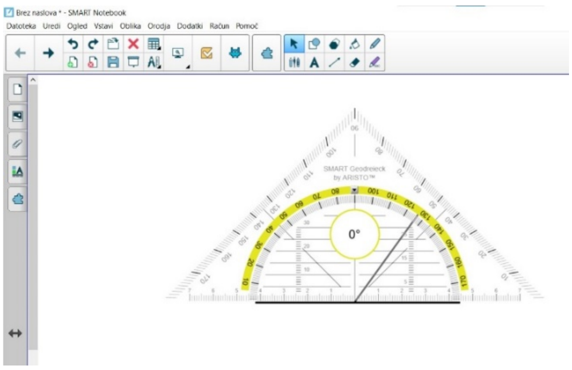
4.3 Smart Notebook

Program Smart Notebook je program, ki se ga uporablja na interaktivnih tablah. Lahko ga imamo nameščenega tudi na prenosnik. Lahko uporabljamo odprto verzijo ali verzijo z licenco. Slednja ima več možnosti, funkcij in je brez vodnega žiga.

Uporabljamo lahko vse vrste pisal, oblik, pisav – to ni nič novega. Nova je pa oblika geotrikotnika in šestila. Oboje ima takšno obliko, kot je znana učencem.

Ravnilo - geotrikotnik

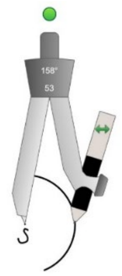
Geotrikotnik ima enak videz, kot ga imajo učenci doma. Z njim lažje ponazorim določene postopke konstruiranja, kot drugače. Enostavno ga lahko uporabim za načrtovanje črt, kotov, merjenje kotov … saj jim je vse to že domače iz siceršnjega šolskega dela. Všeč mi je, ker lahko trikotnik premakneš okoli 0, ga zavrtiš, povečaš, zmanjšaš …



Slika 4. Geotrikotnik v programu Smart Notebook

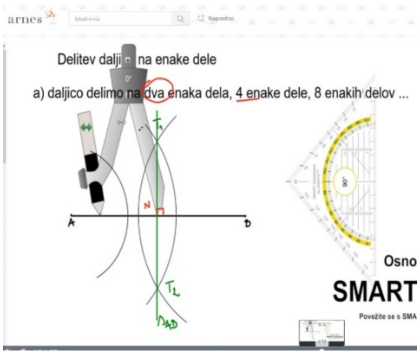
Šestilo

Ker vemo, da imamo različne tipe učencev (avditivni, vizualni in kinestetični) [3] je zelo pomembno pri določenih snoveh, da imamo res vse učence pod okriljem. Nekateri vse razumejo že po ustni razlagi, nekateri še po vidni razlagi, gibalno razlago pa smo uporabili z premikanjem orodja po ekranu hkrati z učenčevim sodelovanjem doma. Torej, če je učenec gledal in hkrati še poslušal navodila – je to zmaga za vse.



Slika 5. Šestilo v programu Smart Notebook

Šestilo v tem programu ima dejansko realno podobo. Z njegovim dinamičnim premikanjem sem lahko prikazala vse korake načrtovanja. Konstruiranje nekega postopka je bilo zaradi tega mnogo lažje. Prezentacija mnogo uspešnejša. S tem smo pridobili na času, ki smo ga lahko koristneje uporabili za utrjevanje znanja in s tem uspešneje usvojili snov.



Slika 6. Uporaba šestila pri načrtovanju.

Na desni strani Slike 6 je viden tudi vodni žig, ki je sicer samo v osnovni različici programa. Sicer deluje vse kot je pričakovano.

Snemalnik

Dobra stran tega programa je bil tudi že vgrajen snemalnik. U bistvu si imel vse na enem mestu in uporabil lahko kadarkoli. Brez dodatnih programov in dodatnega iskanja.

Pri snemalniku si lahko nastavil področje snemanja, lahko si ga tudi uredil.

5. ZAKLJUČEK

Pri mojem delu mi je bilo najbolj pomembno, da je bil moj čas učinkovito izkoriščen z uporabo primernih tehnologij. Načrtovalne naloge so bilo uspešno opravljene zaradi teh orodij. Vsa ta orodja so enostavna za uporabnika. Upravljanje z videoposnetki in njihova montaža pa je bila nova motivacija za nova izobraževanja. Na spletnih portalih je bilo veliko možnosti za učenje le tega. Sedaj ko imam znanja tudi o tem, bodo videoposnetki s pomočjo tega programa še boljši. Širjenje učiteljevega znanja je naložba v prihodnost.

6. VIRI

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[2] Učni načrt za matematiko, 43, https://www.gov.si/assets/ministrstva/MIZS/Dokumenti/Osnovna-sola/Ucni-nacrti/obvezni/UN_matematika.pdf (uporabljeno, 14. 8. 2021)

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Učenci v vlogi učiteljev

Pupils in the role of teachers

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POVZETEK

Šolsko leto 2020/2021 nam bo za vedno ostalo v spominu, saj je potekalo na daljavo. Vsak učitelj se je moral znajti po svoje. Naš pouk je potekal preko aplikacije ZOOM. V prispevku predstavljamo primer pouka na formativen način, v katerem so učenci udeleženi pri načrtovanju pouka. Sami so izrazili željo, da se preizkusijo v vlogi učiteljev. Razdelijo se v štiri skupine. Vsaka skupina izbere eno Prešernovo pesem iz učnega načrta za slovenščino za osmi razred in jo analizirajo po učiteljičinih smernicah. Pogoj za pripravo učne ure je bil, da bodo sošolci pri obravnavanju samostojno raziskovali in bili aktivni, tudi z uporabo sodobne tehnologije. Učiteljica je bila pri tem pouku mentorica, učenci pa so samostojno raziskovali.

KLJUČNE BESEDE

Didaktika, formativno spremljanje, informacijska tehnologija, slovenščina

ABSTRACT

The 2020/2021 school year will forever remain in our memory, as it took place at a distance. Every teacher is morally important in their own way. Our lessons were conducted through ZOOM applications. In this paper, we present an example of a lesson in a formative way in which students participated in lesson planning. They themselves expressed a desire to test themselves in the role of teacher. They were divided into four groups. Each group selected one of Prešeren's poems from the curriculum for Slovene for the eighth grade and analyzed it according to the teachers' guidelines. The condition for the preparation of the lesson was that the classmates would independently research and be active in reading, also using modern technologies. The teacher was a mentor during this lesson, and the students researched independently.

KEYWORDS

Didactics, formative assessment, information technology, Slovene

1 UVOD

V preteklosti je pouk potekal drugače kot danes. Učitelji so poučevali bolj ali manj frontalno, znanje pa se je ocenjevalo s pisnimi testi, ustnimi ocenjevanji in delnim ocenjevanjem (z znaki) brez preverjanja znanja pred ocenjevanjem. Sodoben način poučevanja postavlja v ospredje učenca, aktivnega učenca. Učenci so udeleženi pri načrtovanju pouka, namenov učenja in kriterijev uspešnosti. Učitelj je tisti, ki organizira in spremlja proces učenja, učence usmerja, jim daje povratne informacije, da lahko svoje delo dopolnjujejo, popravljajo. Pri vrednotenju izdelkov sodelujejo tudi sošolci (medvrstniško vrednotenje) na podlagi dogovorjenih kriterijev.

2 FORMATIVNO SPREMLJANJE

Sodoben način poučevanja postavlja v ospredje učenca, ki je pri pouku aktiven in sodeluje pri načrtovanju, medtem ko učitelj spremlja učenčev napredek, mu daje kvalitetne povratne informacije in možnost za napredovanje in izboljševanje svojega dela.

Pri formativnem načinu pouka gre za stalno spremljanje napredka in doseganja ciljev pri učencu po v naprej zastavljenih kriterijih uspešnosti [1]. Učenci sodelujejo pri oblikovanju namenov učenja in kriterijev uspešnosti. S tem želimo doseči, da bodo učenci pri pouku aktivni in na ta način bolj motivirani za učenje. Učitelj ni več učitelj, ki frontalno podaja učno snov, ampak učence podpira, spodbuja in usmerja. Pri formativnem načinu pouka je najbolj pomembna povratna informacija, na podlagi katere učenec izboljšuje svoje znanje. Povratno informacijo si lahko dajejo učenci med seboj, kar imenujemo medvrstniško vrednotenje, ali učitelj. Na podlagi povratne informacije učenec svoje dosežke izboljšuje. Pri tovrstnem pouku ima učenec veliko možnosti za izražanje svoje individualnosti: iskanje osebnega smisla, načrtovanje in udejanjanje svojih poti, ki so prilagojene njegovim načinom učenja, uveljavljanje svojih zmožnosti in interesov, ohranjanje radovednosti in ustvarjanje [2].

Formativno spremljanje bi moralo postati sestavni del procesa učenja in poučevanja. Njegov namen je natančna in specifična povratna informacija, ki prinaša učencu odgovore na vprašanja:

- Kaj sem dosegel v odnosu do učnih ciljev in standardov znanja oz. pričakovanih dosežkov/rezultatov?
- Kako napredujem?
- Kaj mi uspeva, kaj pa manj? Katera so moja močna področja, katera pa bi moral še razviti in izboljšati?
- Kje imam še rezerve?

Učitelj pa se glede na povratno informacijo sprašuje:

- Kako napreduje proces učenja?
- Kako ga moje poučevanje podpira?
- Kako naj svoje poučevanje spremenim oziroma prilagodim, da bom učence še bolj podprl v procesu učenja in izboljševanja znanja? [3].

Učenje ni le razumski proces, njegova učinkovitost je odvisna tudi od motivacije učencev in njihovih čustev [4]. Učitelji morajo ustvariti tako razredno klimo, da si bodo učenci upali sodelovati, odgovarjati, tvegati, se tudi zmotiti in delati napake.

Najbolj pomembno je, da učencem učne vsebine približamo in jim damo možnost sodelovanja pri načrtovanju pouka. Včasih nas s svojimi idejami presenetijo. Najbolj pomembno pa je, da se veliko več naučijo in zapomnijo, če so pri pouku aktivni.

3 OBRAVNAVA OBDOBJA ROMANTIKE PRI SLOVENŠČINI

3.1 Načrtovanje obravnave učnega sklopa

V 8. razredu pri pouku slovenščine obravnavamo obdobje romantike na Slovenskem. Glavni predstavnik tega obdobja je France Prešeren. Obravnavamo štiri njegova dela: Povodnega moža, Turjaško Rozamundo, Apela in čevljarja ter Krst pri Savici.

Učenci so najprej samostojno raziskovali obdobje. Pomagali so si lahko s priročniki, ki jih imajo doma, in s svetovnim spletom. Obdobje so morali umestiti na časovni trak, izpisati značilnosti in predstavnike obdobja ter njihova dela.

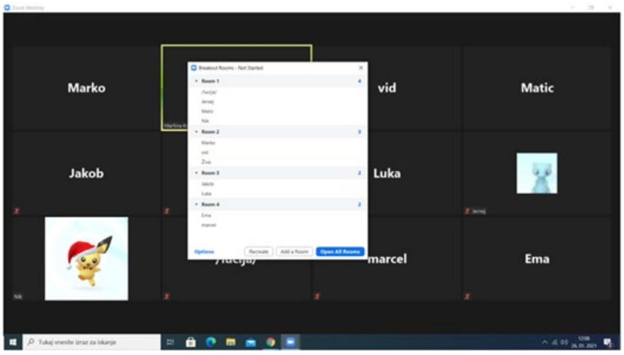
Naslednjo šolsko uro smo pregledali miselne vzorce, jih dopolnili in se pogovarjali o samem obdobju. Učenci so prišli na idejo, da se sami preizkusijo v vlogi učiteljev in bodo za svoje sošolce pripravili obravnavo pesmi.

Učiteljica je za vsako skupino sestavila vprašanja oz. smernice, s katerimi so si učenci pomagali pri raziskovanju pesmi. Smernice za pomoč pri raziskovanju pesmi:

- Kdaj je Prešeren napisal pesem in kje je bila objavljena?
- Razišči okoliščine nastanka pesmi (komu jo je posvetil, kje je našel snov za pesem …).
- Pesem preberite in naredite zunanjo in notranjo zgradbo ter analizo vsebine.
- V katero literarno vrsto in zvrst spada pesem in kaj je zanjo značilno.
- Razmislite, na kakšen način boste oblikovali učno uro, pri čemer naj bodo sošolci čim bolj aktivni.
- Za sošolce sestavite nalogo poustvarjanja pesmi in dodajte kriterije uspešnosti.

3.2 Načrtovanje učnih ur na daljavo

Z učenci smo se lotili dela. Sami so se lotili brskanja po spletu. Vsako uro slovenščine smo se po urniku dobili preko aplikacije ZOOM. Slika 1 prikazuje razdelitev učencev po skupinah po sobah, ki so med sabo sodelovali, raziskovali in iskali ideje. Učiteljica se je sprehajala med sobami in pomagala, če so se pojavila vprašanja. Za načrtovanje smo porabili sedem šolskih ur.



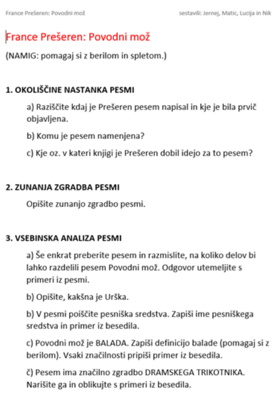
Slika 1: Razdelitev učencev po sobah

Prvi dve šolski uri je vsaka skupina analizirala svojo pesem. Odgovarjali so na učiteljičina vprašanja, ki so jim bila v pomoč tudi za kasnejše načrtovanje, ter brskali in iskali informacije na spletu. Naslednje štiri ure so se učenci posvetili načrtovanju pouka za sošolce. Lotili so se oblikovanj delovnih listov in kvizov z različnimi aplikacijami. Svoje načrtovanje, osnutke, delovne liste so po vsaki zaključeni uri poslali učiteljici v pregled, da jim je dala povratno informacijo oz. smernice za nadaljnje delo.

4 UČENCI SE PREIZKUSIJO V VLOGI UČITELJA

4. 1 Povodni mož

Prva šolska ura je vedno namenjena branju in vsebinski analizi pesmi. Skupina, ki je obravnavala Povodnega moža, je želela, da sošolci najprej sami tiho preberejo pesem in izpišejo neznane besede. Te so s pomočjo Slovarja slovenskega knjižnega jezika in berila razložili. Nato so pesem prebrali še glasno, in sicer je vsak učenec prebral eno kitico. Z branjem pesmi so imeli veliko težav, saj je potrebno besede pravilno naglaševati, zato je ena od učenk, ki je bila del skupine, še enkrat prebrala pesem. Naslednjo uro je sledila vsebinska analiza pesmi. Vsako kitico posebej smo razložili in jo obnovili s svojimi besedami. Učili smo se razlikovati mnenja od dejstev, od podatkov, ki jih v besedilu sicer ni, ampak lahko na podlagi le-teh določene stvari sklepamo. Tretjo šolsko uro so se učenci razdelili v skupine in se še bolj podrobno ukvarjali s pesmijo. V spletni učilnici jih je čakal delovni list (Slika 2), s katerim so si pomagali pri analizi besedila. Pomagali so si lahko s svetovnim spletom, berilom in literaturo, če jo imajo doma. Po končanem skupinskem delu smo pregledali rešitve. Skupine so poročale, se med seboj dopolnjevale in urejale zapiske v zvezku.



France Prešeren: Povodni mož — sestavili: Jernej, Matic, Lucija in Nik

France Prešeren: Povodni mož

(NAMIG: pomagaj si z berilom in spletom.)

1. OKOLIŠČINE NASTANKA PESMI

a) Raziščite kdaj je Prešeren pesem napisal in kje je bila prvič objavljena.

b) Komu je pesem namenjena?

c) Kje oz. v kateri knjigi je Prešeren dobil idejo za to pesem?

2. ZUNANJA ZGRADBA PESMI

Opišite zunanjo zgradbo pesmi.

3. VSEBINSKA ANALIZA PESMI

a) Še enkrat preberite pesem in razmislite, na koliko delov bi lahko razdelili pesem Povodni mož. Odgovor utemeljite s primeri iz pesmi.

b) Opišite, kakšna je Urška.

b) V pesmi poiščite pesniška sredstva. Zapiši ime pesniškega sredstva in primer iz besedila.

c) Povodni mož je BALADA. Zapiši definicijo balade (pomagaj si z berilom). Vsaki značilnosti pripiši primer iz besedila.

č) Pesem ima značilno zgradbo DRAMSKEGA TRIKOTNIKA. Narišite ga in oblikujte s primeri iz besedila.

Slika 2: Delovni list

Povodni mož (ljudska)

Fantje ples napravljajo,
Miciko prosijo na ples.
Micika mi tako govori:
»Mati, jez pojdem drevi na ples!«
Mati ji ni pustila it:
»Micika, ostani mi doma,
ne hodi drevi mi na ples!«

Micika ni nič marala:
»Mat, jez pojdem vendar drevi na ples!«
»Ker ti ne maraš zame nič,
pojd, de te vzame povodni mož!«

Micika pleše s fantmi tam,
pride k nji še kje mlad gospod:
»Micika, al greš plesat z menoj?«

Micika še gre plesat z njim.
On ji stiska roké močnó,
Micika tako pravi, govori:
»Ne stiskaj mi rok tak močnó!«
On jo stiska čedalje bolj,
da ji izza nohtov kri kaplja.
Micka zavpije premočno:
»Pome je prišel povodni mož!«

Micka tega ne zgovori,
povodni mož z njo ven zleti,
venkaj zleti na sred vodé.
V glažovnato hišo prideta
in se lepo tam menita:
»Kedaj boš pustil me domu?«

»Ti pred ne pojdeš mi domu,
da boš imela sinka malega.
Ti pa po hiši pometaj,
de boš babci dala plačil:
k boš po hiši pometala,
boš tiste smeti spravila.«
Ona je dala babci plačil;
babica pa pride domu,
prinese polno mošnjo tolarjov.
»Kaj te prosim, ljubi moj mož!
Pusti me, da grem k materi domu!«
»Jest te pa bom pustil domu;
pa ne hodi, koder ogenj delajo,
ne hodi na deteljo spat,
ti se ne kad s šmarnicami,
o svetem telesi žegnanim: sveto telo
scer ne morem do tebe več.«

Ta je šla vesela domu.
Še pride klicat jo povodni mož:
»Micika, jez sem že pote prišel,
tvoj sin se joka premočno.«
»Do zdaj sem ga zibala jez,
zdaj ga ne bodem nikdar več.«

»Micika, če nečeš sinka celega,
ga bova imela vsaki pol.«

Še v drugo kliče: »Micika, pojdi domu!«
On ga pretrgal je čez pol:
»Ga bova imela vsaki pol!«

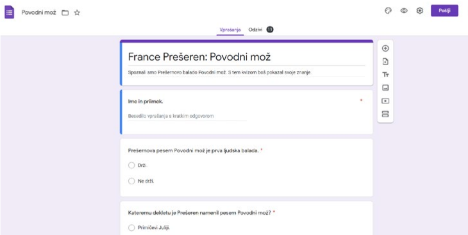
Vir: Slovenske ljudske pesmi, izbral in uredil Boris Merhar, Mladinska knjiga (Knjižnica Kondor), Ljubljana, 1961.

Slika 3: Povodni mož (ljudska)

Učenci so med raziskovanjem odkrili ljudsko različico Povodnega moža (Slika 3) in prišli na idejo, da bi pesmi med seboj primerjali. Učenci so se zopet razdelili v skupine in primerjali pesmi med seboj. Iskali so podobnosti in razlike. Precej težav jim je povzročalo razumevanje ljudske različice, saj vsebuje neobičajne stavčne in skladenjske strukture ter starinski jezik.

Ena od najpogostejših dejavnosti, ki sledi obravnavi umetnostnega besedila, je literarno poustvarjanje. Skupina učencev, ki je raziskovala Povodnega moža, je dobila navodilo, da morajo za sošolce oblikovati tudi poustvarjalno nalogo skupaj

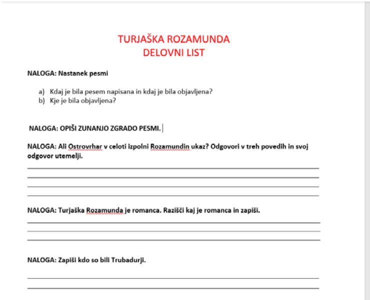
s kriteriji uspešnosti. Učenci so si zamislili, da se bodo postavili ali v vlogo Urške ali povodnega moža in pisali o njunih občutkih. Oblikovali so tudi kriterije uspešnosti. Da bodo uspešni, morajo besedilo členiti na odstavke, upoštevati pravopisna pravila, pisati v prvi osebi ednine, zapis mora biti čitljiv in izviren. Učenci so svoje izdelke oddali v spletno učilnico. Po znanih kriterijih so sošolcu ovrednotili njegovo delo in ga nato ponovno popravili oz. dopolnili.
Za konec so učenci sestavili kviz (Slika 4) v Googlovih obrazcih, da so ponovili svoje znanje.



Slika 4: Kviz

4. 2 Turjaška Rozamunda

Prvo uro smo pesem prebrali in jo vsebinsko analizirali. Prestavili smo se v čas srednjega veka, ko so bili gradovi in vitezi. Učenci, ki so bili v vlogi učiteljev, so svoje sošolce razdelili v skupine, se porazdelili po sobah in so reševali delovni list (Slika 5), ki so ga pripravili zanje in ga nato skupaj pregledali.



TURJAŠKA ROZAMUNDA
DELOVNI LIST

NALOGA: Nastanek pesmi

a) Kdaj je bila pesem napisana in kdaj je bila objavljena?
b) Kje je bila objavljena?

NALOGA: OPIŠI ZUNANJO ZGRADO PESMI.

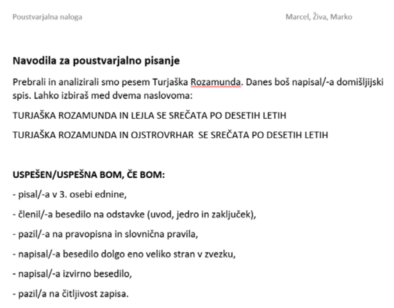
NALOGA: Ali Ostrovrhar v celoti izpolni Rozamundin ukaz? Odgovori v treh povedih in svoj odgovor utemelji.

NALOGA: Turjaška Rozamunda je romanca. Razišči kaj je romanca in zapiši.

NALOGA: Zapiši kdo so bili Trubadurji.

Slika 5: Delovni list

Skupina učencev je oblikovala tudi poustvarjalno nalogo. Izbrali so si pisanje domišljijskega spisa. Učenci so lahko izbirali med dvema naslovoma. Za pisanje so oblikovali tudi kriterije uspešnosti. Slika 6 prikazuje navodila, ki so jih učenci prejeli v spletni učilnici, kamor so tudi oddali svoj spis. Kasneje so spise medvrstniško vrednotili in sošolcu podali povratno informacijo glede na zastavljene kriterije uspešnosti.



Poustvarjalna naloga Marcel, Živa, Marko

Navodila za poustvarjalno pisanje

Prebrali in analizirali smo pesem Turjaška Rozamunda. Danes boš napisal/-a domišljijski spis. Lahko izbiraš med dvema naslovoma:

TURJAŠKA ROZAMUNDA IN LEJLA SE SREČATA PO DESETIH LETIH

TURJAŠKA ROZAMUNDA IN OJSTROVRHAR SE SREČATA PO DESETIH LETIH

USPEŠEN/USPEŠNA BOM, ČE BOM:

- pisal/-a v 3. osebi ednine,
- členil/-a besedilo na odstavke (uvod, jedro in zaključek),
- pazil/-a na pravopisna in slovnična pravila,
- napisal/-a besedilo dolgo eno veliko stran v zvezku,
- napisal/-a izvirno besedilo,
- pazil/a na čitljivost zapisa.

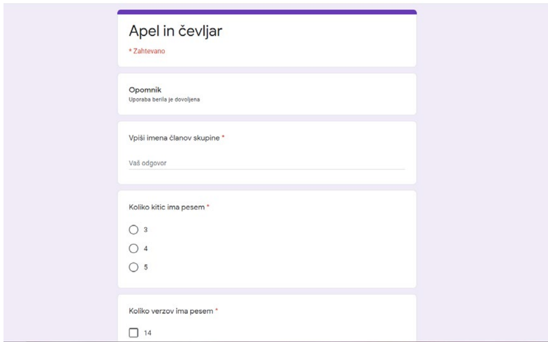
Slika 6: Navodila za ustvarjalno pisanje

Zadnjo šolsko uro so učenci v vlogi učiteljev svojim sošolcem pripravili kviz v aplikaciji Kahoot (Slika 7). Vsak učenec se je prijavil s svojim imenom preko svojega pametnega telefona. Nad kvizom so bili zelo navdušeni in tekmovalni.

Slika 7: Kviz oblikovan z aplikacijo Kahoot!

4. 3 Apel in čevljar

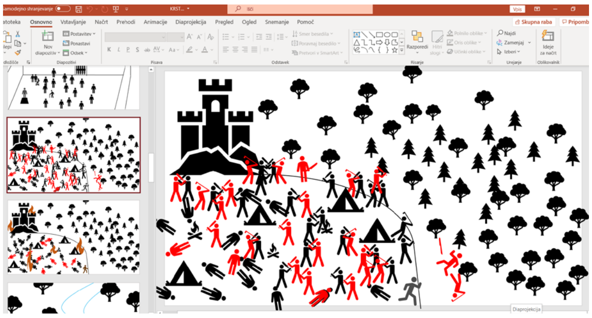
Skupina učencev v vlogi učiteljev je od sošolcev zahtevala, da pesem preberejo tiho, nato jo je eden od sošolcev prebral glasno. Najprej so skupaj pregledali in razložili neznane besede. Nato so se razdelili po sobah in raziskovali, čemu je Prešeren pesem napisal ter naredili zunanjo in notranjo analizo pesmi. Za domačo nalogo so morali rešiti kviz, ki ga je skupina oblikovala v Googlovih obrazcih (Slika 8), in se postaviti v vlogo pesnika Prešerna in Jerneju Kopitarju napisati pismo.



Slika 8: Kviz

4. 4 Krst pri Savici

Pesnitev Krst pri Savici je obsežna lirsko-epska pesnitev. Pri pouku obravnavamo samo Uvod, ki opisuje Valjhunovo obleganje Ajdovskega gradca, v katerega se je zatekel Črtomir s svojo vojsko, in končni boj med njima. Skupina teh učencev se je odločila, da bodo prebrali celotno Prešernovo pesnitev in jo sošolcem predstavili s pomočjo stripa, ki so ga oblikovali v programu PowerPoint (Slika 9). Učenci so predstavitev popestrili z animacijami. Figure so se premikale. Vsaka drsnica je predstavljala delček zgodbe, s katero so obnovili celotno pesnitev Krst pri Savici.
Učenci so nato skupaj analizirali pesem in oblikovali zapis v zvezek. Za domačo nalogo so se morali postaviti v vlogo Črtomirja in zapisati občutke, ki jih je čutil pred predajo. Pri pisanju so morali biti pozorni, da so pisali v prvi osebi ednine. Učenci so se razdelili v pare in vsak par je medvrstniško vrednotil zapis svojega sošolca in ga po potrebi izboljšal.



Slika 9: Strip, oblikovan v programu PowerPoint

5 ZAKLJUČEK

V času epidemije in dela na daljavo smo se učitelji znašli pred novimi izzivi. Pri obravnavi učne snovi smo morali biti iznajdljivi. Vsakodnevno smo se srečevali z vprašanjem, na kakšen način učno snov približati učencem, jih vključiti v načrtovanje pouka. V prispevku je predstavljen primer, ko so se učenci postavili v vlogo učiteljev in njihova najpomembnejša naloga je bila, da pesem predstavijo in analizirajo tako, da bodo njihovi sošolci pri pouku aktivni in uporabijo sodobno tehnologijo.

Učenci so se v vlogi učiteljev dobro znašli. Pri načrtovanju so jim bile v pomoč učiteljičine smernice. Vse skupine so oblikovale delovni list, s pomočjo katerega so učenci analizirali pesmi in različne aplikacije in programe, s katerimi so popestrili učno uro.

Učenci so bili s svojimi dosežki zelo zadovoljni in so se veliko naučili, ko so samostojno raziskovali in sestavljali naloge za svoje sošolce. Priznali so, da je načrtovanje učnih ur zahtevno, da pa je bila to za njih pozitivna izkušnja, iz katere so pridobili določena znanja, ki jim bodo koristila pri nadaljnjem šolanju.

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Enotna digitalna identiteta ArnesAAI

Unified online identity ArnesAAI

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POVZETEK

S povečano digitalizacijo vsakdanjega življenja se vse bolj srečujemo s potrebo po enotni digitalni identiteti uporabnika. Ta mu omogoča, da dostopa do več različnih storitev z eno samo identiteto, kar mu poenostavi in olajša uporabniško izkušnjo. Arnes ima za svoje uporabnike vzpostavljen sistem ArnesAAI, ki omogoča dostop do storitev zgolj z enim uporabniškim imenom in geslom.

KLJUČNE BESEDE

Enotna digitalna identiteta, Arnes, ArnesAAI, uporabnik, spletne storitve, uporabniška izkušnja, digitalizacija

ABSTRACT

With the increase of digitalization in everyday life, the need for a unified online identity has also increased. An unified online identity allows the user to access multiple services with a single identity, which eases and simplifies the user experience. ARNES provides its users the ArnesAAI system, which allows the user to access multiple services while using only one username and password.

KEYWORDS

Unified digital identity, ARNES, ArnesAAI, user, online services, user experience, digitalization

1 UVOD

Trenutno obdobje pospešene digitalizacije vsakdanjega življenja prinaša s seboj tudi določene težave pri prilagajanju posameznika na nove oblike uporabe spletnih storitev. Kljub temu, da naj bi uporabniku digitalizacija prihranila čas in olajšala življenje, se pogosto znajde v situacijah, ko mu predvsem neprijazna uporabniška izkušnja onemogoča učinkovito uporabo storitev, pri tem pa ga posledično tudi odvrača od nadaljnje uporabe drugih digitalnih storitev. Pogosta težava je veliko število uporabniških imen in gesel, saj v večini primerov vsaka posamezna storitev zahteva ustvarjanje specifične spletne identitete, ki uporabniku omogoča dostop do same storitve. Tako se mu hitro nabere veliko število identitet, med katerimi mora navigirati, da lahko uporablja različne storitve. Pri tem se uporabniki mnogokrat zatečejo k rešitvi, da za različne storitve uporabljajo enaka uporabniška imena in gesla. Tak pristop je problematičen s stališča spletne varnosti, saj lahko spletni goljufi s pridobitvijo uporabnikovega uporabniškega imena in gesla tako pridejo do dostopa do več storitev, ki jih uporablja posameznik, se tem pa se poveča tudi potencialna povzročena škoda. Veliko težav lahko reši enotna spletna identiteta, ki uporabniku bistveno izboljša uporabniško izkušnjo, pri tem pa tudi zagotavlja večjo spletno varnost.

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2 KAJ JE SPLETNA IDENTITETA

Spletna identiteta posameznika je identiteta, ki jo posameznik ustvari ob uporabi spletnih storitev [1]. Večina spletnih storitev od uporabnika zahteva, da vsaj v nekakšni obliki ustvari neko obliko spletne identitete, s katero ga nato prepozna kot uporabnika storitve. Lahko je uporabna zgolj kot ključ za vpis za uporabo storitve, v nekaterih primerih, denimo pri uporabi družbenih omrežji, pa je ta ustvarjena identiteta sama že del storitve. Prav tako je od namena uporabe odvisno, v kolikšni meri jo lahko uporabnik prilagaja svojim željam ali potrebam, Nekatere storitve omogočajo kreiranje avatarjev v obliki grafične podobe, ki nato predstavlja uporabnika v spletnem okolju [1]. Uporabnik ima v večini primerov različne spletne identitete za različne storitve, med katerimi mora navigirati, če želi uporabljati storitve.

3 POTREBA PO ENOTNI DIGITALNI IDENTITETI

Določen del uporabe spleta bo vedno vezan na to, da bo lahko posameznik med uporabo ostal anonimen. Namen enotne digitalne identitete ni želja po vzpostavljanju mreže nadzora nad uporabo spleta, temveč olajšati uporabniku njegovo izkušnjo predvsem pri storitvah, ki zahtevajo, da je njegova identiteta istovetna z identiteto iz vsakdanjega življenja. Večina uporabnikovih spletnih identitet je vezana na kontekst uporabe. Z drugimi besedami, informacije o identiteti uporabnika so nujne za ponudnika, da lahko uporabniku omogoči dostop do zahtevanih vsebin ali storitev [2].

Določene storitve že omogočajo vsaj delno povezavnje identitet. Tak primer je denimo Google, ki integrira uporabnikove Youtube, Gmail, Google drive in druge račune [1]. Ta možnost sicer uporabniku vsaj nekoliko izboljša uporabniško izkušnjo, vendar pa ne določi indentifikacijskih parametrov dovolj natančno, da bi bila uporabna za bolj občutljive storitve, kjer je nujno vzpostaviti posameznikovo istovetnost z resničnimi podatki.

Identiteta posameznika je bistvena predvsem v kontekstu njegove interakcije z državnimi službami in storitvami, kot so zdravstvo, finance, davki, volitve, izobraževanje [3].

V vsakdanjem življenju je najbolj legitimen porok za posameznikovo identiteto država. Ta z izdajo dokumentov, kot so rojstni list, osebna izkaznica, poročni list, mrtvaški list, potni list garantira za istovetnost osebe s tisto, ki je na dokumentu. Te dokumenti se uporabljajo za potrjevanje identetitete tako na državnem nivoju, kot na zasebnem, denimo z izkazovanjem državno izdane osebne izkaznice za potrebe identifikacije na banki [3].

Kot že omenjeno, si spletne identitete v veliki meri ustvarja posameznik sam prek raznih storitev, izdajajo pa jih ponudniki le-teh. Posledično v večini primerov nimajo enake kredibilnosti kot denimo državno izdani dokumenti. Prav tako pa se pri digitalnih identitetah srečamo še s problemom kraje identitetite, ki je bistveno lažja kot v nedigitalnem svetu. Tu se srečamo s paradoksom, ko so najbolj napredne in varne digitalne identitete tiste, ki lahko povzročijo posamezniku največ škode, če pridejo v napačne roke. Dostop do elektronskega potnega list v rokah nepridiprava bo lahko bistveno bolj prizadel posameznika kot ukradena osebna izkaznica. Težava je predvsem v neravnovevesju pri zaupanju digitalnim referencam. Več kot je varnostnih preverb atributov identitete, do več občutljivih podatkov lahko dostopamo. Nagrada za uspešen napad na kompleksno digtalno identiteto je tako bistveno večja, kot za napad na šibko [4].

4 ARNESAAI

Arnes AAI je primer enotne digitalne identitete na področju izobraževanja. Sistem omogoča uporabo enega uporabniškega računa za dostop do različnih storitev v slovenskem ter evropskem izobraževalnem in raziskovalnem okolju [5]. Uporabnik tako za uporabljanje vseh Arnesovih storitev potrebuje zgolj eno uporabniško ime in geslo, s katerim nato dostopa denimo do elektronske pošte, video portala, spletnih učilnic, videokonferečnih orodij…

ArnesAAI omogoča pridruženim organizacijam, da same dodeljujejo svojim članom uporabniško ime za dostop do različnih aplikacij, S tem vsaka organizacija postane varuh osebnih podatkov svojih članov, ponudnikom aplikacij pa se ni potrebno ukvarjati z dodeljevanjem uporabniških imen in kočljivim zbiranjem ter preverjanjem podatkov o uporabnikih [5]. Legitimnost identitete tako zagotavlja dejstvo, da je potrebno za dostop do ArnesAAI računa potrebno zadostovati pogojem za uporabo Arnesovih storitev, torej si je ne more ustvariti kdorkoli, temveč je dodeljena na podlagi upravičenosti.

ArnesAAI se uporablja na nivoju organizacij, končnih uporabnikov in upravljacev storitev.

Organizacije s priključitvijo v ArnesAAI omogočajo dostop do pridruženih storitev vsem svojim uporabnikom. Tako omogočijo., da vsi njeni uporabniki lahko dostopajo do Arnesovih in ostalih storitev z enim uporabniški imenom in geslom. Organizacija prav tako poskrbi za boljše varovanje osebnih podatkov, saj se obdelava izvaja na sami organizaciji in ne pri ponudniku spletnih storitev. Iste identitete se lahko uporabijo tudi za dodeljevanje dostopa do brezžičnega omrežja eduroam, ki je prisoten na veliki večini evropskih izobraževalnih ustavnov [6]. Identiteta je tako uporabna tudi v tujini, vezana je na izobraževalno ustanovo, ki zagotavlja, da bo uprabnik lahko s to identiteto koristil določene storitve tudi v organizacijah, ki jim ne pripada, ampak so del iste mreže.

Končni uporabniki tako pridobijo identiteto, ki jim omogoča dostop do večih storitev z enotnim vpisnim procesom. Poleg že omenjenih prednosti, je na nivoju posameznika potrebno izposatviti še dejstvo, da v primeru izgube ali zlorabe uporabniških podatkov te težave rešuje neposredno pri domači organizaciji [6]. V primeru težave tako točno ve, na koga se obrniti, prav tako pa ima organizacija vsa orodja, da mu lahko v takšen primeru pomaga.

Upravljalci aplikacij in ponudniki spletnih storitev lahko prav tako koristijo ArnesAAI in s tem povečajo doseg svojih storitev, saj s priključitvijo posanejo član sveta ArnesAAI. Prav tako se na ta način ponudniki storitev izognejo ustvarjanju identitet uporabnikov, saj jih ti pridobijo že na svoji domači organizaciji [6].

ArnesAAI tako olajša uporabo storitev uporabnikom, ponudnikom storitev in organizacijam pa omogoča, da enostavno in varno upravljajo z digitalno identiteto uporabnika.

5 POVEČANA UPORABA STORITEV MED EPIDEMIJO COVID-19

Ob začetku epidemije COVID-19 in posledičnem zaprtju šol ter vzpostavitve pouka na daljavo se je Arnes soočil s skokovitim porastom uporabe svojih storitev. Za uspešno izvedbo pouka na daljavo ne zadošča zgolj ena spletna storitev, temveč je potrebno imeti dostop do različnih orodij, kot so denimo videokonferenčni sistemi, spletne učilnice, elektronska pošta…Uporaba Arnesovih storitev se je v tem obdobju povečala za 10 do 100 krat[7].

Arnes se je na situacijo odzval z razširitvijo zmogljivosti svojih strežnikov, nadgrajevanjem ključnih storitev in širitvijo funkcionalnosti. Pri tem se je sledilo izraženim potrebam učiteljev, uredilo se je denimo integracijo videokonferenčnih storitev v spletne učilnice in nakupilo licence sistema Zoom za potrebe izobraževanja [7].

Ključno vlogo pri uspešnem in gladkem delovanju celotnega sistema je odigral ArnesAAI. Šole so lahko ažurno dodeljevale in vzdrževale digitalne identitete za potrebe svojih učencev [7]. Tako je lahko šola sama svojemu učencu uredila elektronski naslov in digitalno identiteto, s katero je nato enostavno dostopal do vseh potrebnih storitev, ki jih je potreboval za sodelovanje pri pouku na daljavo. Posebno pri mlajših učencih bi lahko prihajalo do večjih težav, če bi bi denimo potrebovali digitalno identiteto za vsako posamezno storitev. Z ArnesAAI so tako potrebovali samo eno uporabniško ime in pripadajoče geslo, da so lahko dostopali do željenih orodij.

Organizacije so lahko preko ArnesAAI same urejale potrebne identitete, ki so jih za delo s spletnimi orodji potrebovali učenci.To je pomenilo, da se jim ni bilo potrebno ukvarjati s tretjimi osebami, ki bi urejale to področje, temveč so imele v rokah vse potrebno, da samostojno zagotovijo in uredijo potrebne identitiete za svoje učence. Prav tako so jim lahko v primeru težav pomagale same, brez da bi potrebovale zunanjo pomoč.

Enako kot za učence so lahko organizacije same uredile digitalne identiete za učitelje. Z uporabo ArnesAAI je tako šola v primeru pouka na daljavo sama postala samozadostna pri urejanju in dodeljevanju digitalnih identitet, ki so omogočale dostop do storitev, potrebnih za takšno vrsto izobraževanja.

6 NADALJNJE MOŽNOSTI RABE ARNESAAI

Poleg najbolj očitnih prednosti ArnesAAI, ki so na strani uporabnikov uporaba enega uporabniškega imena in gesla za dostop do več storitev, ter na strani organizacij možnost samostojnega upravljanja in dodeljevalna enotnih digitalnih identitet, ostajajo še neizkoriščeni potenciali rabe.

Trenutno so dodeljene digitalne identiete prek ArnesAAI vezane na pripadnost določeni organizaciji, ki je opravičena do Arnesovih storitev. To omogoča, da je organizacija samozadostna pri ustvarjanju in upravljanju identitete. Pri razvijanju enotne digitalne identitete posameznika na področju izobražavanja bi bilo smiselno delovati v smeri, ki bi posamezniku omogočila, da isto identiteto obdrži skozi celoten čas vključenosti v izobraževalni sistem. Uporabnik sedaj ob zaključku izobraževanja v eni ustanovi in prehodu v drugo zamenja svoj ArnesAAI račun, saj je ta vezan na šolo, ki jo obiskuje. Tako mora denimo učenec ob prehodu iz osnovne šole v srednjo pridobiti na novi organizaciji novo digitalno identiteto.

V kolikor bi lahko svojo digitalno identiteto zgolj prenesel na novo organizacijo, bi tako ohranil isto identiteto, ki bi še pridobila na pomenu. Idealno bi lahko posameznik z njo urejal tudi stvari, kot so denimo vpis na srednjo šolo in fakulteto, dostop do spletnega referata in druge storitve, za katere mora trenutno uprabljati različne digitalne identitete.

Enotna digitalna identiteta za področje izobraževanja bi zelo pripomogla k splošni uspešnosti digitalizacije področja. Uporabniku bi se poenostavil dostop do vseh storitev, ki jih potrebuje, organizacije pa bi imele enoten sistem obdelave in upravljanja identitet. Arnes AAI ima potrebne karakteristike, da zagotovi uspešnost takšnega pristopa, izkušnje pa kažejo, da njegova uporaba organizacijam zelo poenostavlja delo.

7 ZAKLJUČEK

Potreba po vsaj nekakšni enotni digitalni identiteti bo s povečano digitalizacijo storitev s časoma postala nuja. ArnesAAI trenunto omogoča vsaj za del izobraževalnih procesov obliko takšne identitete. Uporabnik tako potrebuje samo eno geslo in uporabniško ime za uporabo storitev, organizacije lahko same izdajajo, upravlajajo in nudijo pomoč uporabnikom v zvezi z njegovo digitalno identiteto. ponudiki storitev pa se lahko vključijo v poenoten sistem prijave in dostopov. Prednosti ArnesAAI so se pokazale predvsem med epidemijo COVID-19, ko je bilo ključnega pomena za šole, da so lahko same dodeljevale in vzdrževale digitalne identitete, ki so učencem in učiteljem omogočale dostop do potrebnih spletnih storitev za izvajanje pouka na daljavo. V primeru vzpostavitve enotne digitalne identitete za celoten process izobraževanja posameznika, je ArnesAAI odlično izhodišče za ustvarjanje legitimne, enostavne in varne enotne digitalne idenitete.

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Analiza podatkov orodja za pomoč pri izbiri poklica »KamBi«

Data Analysis of Support Tool to Choose a profession “KamBi”

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POVZETEK

V prispevku so sistematično analizirani podatki, ki so del orodja »KamBi«. To orodje je namenjeno dijakom zaključnih letnikov za pomoč pri izbiri bodočega poklica oz. študijskega programa. Spletna aplikacija »KamBi« je dostopna od konca decembra 2020 dalje, uporablja pa 10 relacijskih tabel in deluje na platformi Oracle Apex. Te tabele popisujejo anketna vprašanja (78), področja kompetenc (26, to so osebnostne lastnosti, ki jih meri več vprašanj), odgovore anketirancev (136500), poklice (23) z njihovimi zahtevanimi lastnostmi (207) in možnimi izobraževalnimi ustanovami (37) in poklicna priporočila anketirancem (1750) za katerikoli poklic v bazi. Namen prispevka je obravnava treh sklopov podatkov: lastnosti (samoocene) anketirancev, lastnosti ankete in lastnosti poklicev. Med samoocenami anketirancev prevladujejo take, ki izražajo pozitivne lastnosti in pogostejše pozitivno obnašanje. Vprašanja z binarnim tipom odgovora (ne-da, 39 vprašanj) so anketiranci reševali hitreje kot vprašanja s pet stopenjsko Likertovo letvico (39 vprašanj). Poprečen čas za odgovor je bil 3.41 sekunde z odklonom 2.67 (pri 99% odgovorov; n=135137; 0 >= t > 24 s). Med odgovori in področji so šibke, statistično neznačilne povezave. Preverjanje konsistentnosti vprašalnika (interna veljavnost) je za skupine vprašanj Likertovega tipa pokazalo dobro konsistentnost za 3 področja, sprejemljivo za 3 področja, vprašljivo za 5 področij ter šibka za 2 področji. Konsistentnost je bila izračunana tudi za področja narave dela, ki temeljijo na vprašanjih binarnega tipa. Pri teh so izračunani koeficienti (Crombachov alfa) primerljivi le med seboj. Poklice v bazi podatkov smo klasificirali v gruče podobnih glede na lastnosti, ki so jih izobraževalne inštitucije le-tem določile. Optimalno število gruč je bilo 3, preskus z drugačnim številom (2-7) pa je podaja informacijo o stabilni pripadnosti poklica gruči ter diferenciaciji med poklici. Rezultati analize so koristni za anketirance, za pripravljavce ankete in za sodelujoče izobraževalne inštitucije.

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KLJUČNE BESEDE

Podatkovna analitika, razvoj kariere, aplikacija KamBi

ABSTRACT

The article analyses the data that are part of the tool "KamBi". The tool aims to help final year middle school students in choosing a study program for future profession. The KamBi web application has been available since the end of December 2020. It uses 10 relational tables and runs on the Oracle Apex platform. These tables describe the survey questions (78), the areas of competence (26, personality traits measured by several questions), the answers of the respondents (136500), the occupations (23) with their required characteristics (207) and possible educational institutions (37) as well as occupational recommendations to respondents (1750) for any occupation in the database. The purpose of the paper is to analyse three subsets of data: characteristics (self-assessment) of respondents, characteristics of the survey and characteristics of occupations. Respondents' self-assessment that indicate positive traits and more frequent positive behaviours predominate. Questions with a binary type of answer (no-yes, 39 questions) were solved faster than questions with a five-point Likert scale (39 questions). The mean response time was 3.41 seconds with a deviation of 2.67 (at 99% of responses; n = 135137; 0> = t> 24 s). There are weak, statistically insignificant correlations among responses and areas of competence. Checking the consistency of the questionnaire (internal validity) for a groups of Likert type questions showed good consistency for 3 areas, acceptable for 3 areas, questionable for 5 areas and weak for 2 areas. Consistency was also calculated for areas based on binary-type questions. These coefficients (Crombach’s alpha) are comparable only to among the binary-type groups. The professions in the database were classified into clusters according to the similarity of characteristics assigned by educational institutions. The optimal number of clusters was 3. The test with a different number (2-7) provides information on the stable affiliation of the profession and the differentiation between professions. The results of the analysis can be utilised by respondents, survey creators and participating educational institutions.

KEYWORDS

Data analytics, career development, KamBi application

1 UVOD

Po zaključenem srednješolskem izobraževanju so dijaki postavljeni pred odločitev, ki vplivajo ne le na njihov karierni razvoj, pač pa tudi na gospodarski razvoj okolja. Večina dijakov zadnjih letnikov srednjih šol še ni dovolj jasno poklicno profilirana, kar je lahko posledica šibkega zavedanja o svojih dejanskih sposobnostih in potencialih (vključno s precenjevanjem ali podcenjevanjem), pomanjkanja realnih informacij o svojem bodočem poklicu, izkušenj v realnem delovnem okolju pa tudi osebnostnih lastnosti.

Aplikacija KamBi je uradno zaživela 23. decembra 2020. Namenjena je dijakom zaključnih letnikov kot pomoč pri izbiri poklica oz. študijskega programa, ki najpogosteje vodi do določenega poklica [1]. Nastala je kot skupni projekt več podjetij, zavodov in izobraževalnih ustanov. Pri posameznih sklopih so sodelovali:

• **izdelava vprašalnika:** podjetje Competo, Karierni center Univerze v Ljubljani, Zavod za zaposlovanje Republike Slovenije

• **izdelava profilov diplomantov:** Fakulteta za elektrotehniko (UL), Fakulteta za elektrotehniko, računalništvo in informatiko (UM), Fakulteta za farmacijo (UL), Fakulteta za gradbeništvo in geodezijo (UL), Fakulteta za gradbeništvo, prometno inženirstvo in arhitekturo (UM), Fakulteta za kemijo in kemijsko tehnologijo (UL), Fakulteta za kemijo in kemijsko tehnologijo (UM), Fakulteta za matematiko in fiziko (UL), Fakulteta za matematiko, naravoslovje in informacijske tehnologije (UP), Fakulteta za naravoslovje in matematiko (UM), Fakulteta za organizacijske vede (UM), Fakulteta za pomorstvo in promet (UL), Fakulteta za računalništvo in informatiko (UL), Fakulteta za strojništvo (UL), Fakulteta za strojništvo (UM), Fizika in astrofizika (UNG), Gospodarski inženiring (UNG), Naravoslovnotehniška fakulteta (UL), Šolski center Kranj, Šolski center za pošto, ekonomijo in telekomunikacije Ljubljana in Zdravstvena fakulteta (UL). Višješolski in visokošolski zavodi so zahtevane lastnosti za »svoj« poklic določili sami.

• **izdelava aplikacije:** prototip Fakulteta za organizacijske vede (UM), končna verzija 1.5 podjetje The Right Thing Solutions.

• **gostovanje na spletu:** Oracle, Oracle Slovenija in Fakulteta za organizacijske vede (UM)

• **vodenje projekta:** podjetje Mediade.

V prispevku predstavljamo analizo podatkov, ki so nastali pred lansiranjem spletne ankete (vprašanja, struktura vprašanj, področja vprašalnika, poklici, zahtevane lastnosti poklicev) kot tudi zbrane anketne podatke (odgovori na vprašanja) do sredine junija 2021. Za posameznika, ki je sodeloval v anketi je sicer najpomembnejši del aplikacije poročilo o skladnosti njegovih samoocen ter zahtevanih lastnosti pri posameznem poklicu. Na ta način smo dijake želeli spodbuditi k razmisleku možnih kariernih poteh, predvsem o inženirskih poklicih. Analiza podatkov za aplikacijo KamBi lahko koristi izobraževalnim inštitucijam pri izostritvi lastnosti, ki jih določeni poklici zahtevajo, prav tako pa lahko prispevajo k spremembam študijskih vsebin. Ker pri vsaki meritvi nastopajo odstopanja od resničnih vrednosti, je smiselno pregledati tudi trenutno stanje merskega inštrumenta – ankete. Zato bomo v glavnem delu raziskave predstavili te tri sklope analize podatkov: lastnosti (samoocene) anketirancev, lastnosti ankete in lastnosti poklicev.

2 KRATEK PREGLED LITERATURE O KARIERNEM RAZVOJU

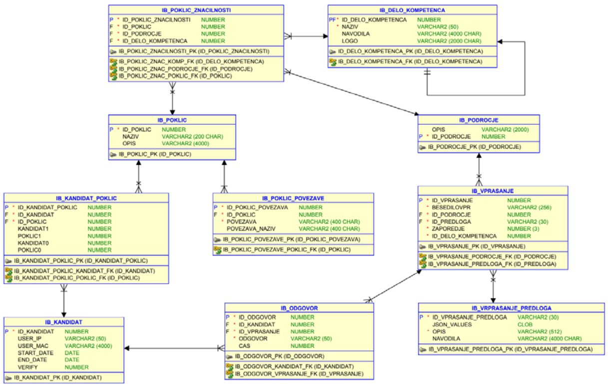
S problem izbire pravega poklica se literatura ukvarja že zelo dolgo. Frank Parsons [2] je postavil temelje poklicnega usmerjanja, ko je predlagal, da se zgradi seznam osebnih lastnosti posameznika, seznam zahtev delovnega mesta, nato pa se izmeri skladnost lastnosti posameznika z zahtevami delovnega mesta. Germeijs in Verschueren [3] sta ugotovila, da je nevroticizem v zaključnem letniku srednje šole najbolj povezan z neodločenostjo glede poklicne usmeritve. Ne glede na široko paleto izbire med visokošolskimi institucijami, dijaki težko opredelijo, kaj jih dejansko veseli in kaj bi bilo primerno zanje [4]. Ne glede na pomanjkanje inženirskega kadra v zahodnem svetu, se pogosto dogaja, da dijaki zaradi obetov po dobri zaposlitvi, inženirski poklic izberejo iz napačnih razlogov: ker so tovrstne izobraževalne ustanove boljše, ker študij odpira vrata in omogoča, da odločitve prestavimo na kasnejši čas, ker niso vedeli, kaj izbrati in kje se želijo zaposliti [5]. Po drugi strani pa raziskava med Belgijskimi študenti kaže, da so interesi študentov tehničnih ved veliko bolj usklajeni z njihovim študijskim programom, kot pa interesi študentov ne-tehničnih ved [6]. Dijaki si pod poklicem inženirja predstavljajo različne stereotipe, na primer mehanika, tehnika v proizvodnji, ki je praviloma moškega spola [7]. Prav zato je pomoč pri odločitvi za tovrstne poklice ključnega pomena. Visokošolske institucije lahko dijakom pomagajo pri sprejemanju odločitev o njihovi poklicni karieri v današnjem poklicnem okolju, ki je nestanovitno, negotovo in zapleteno.

Aplikacija KamBi je nastala z namenom mladim približati inženirske poklice [1]. S pomočjo aplikacije mladi z izrisom profila ujemanja pridobijo dodatne informacije o svojih kompetencah in poklicih ter se na ta način lažje odločijo za katerega od inženirskih poklicev.

3 METODOLOGIJA

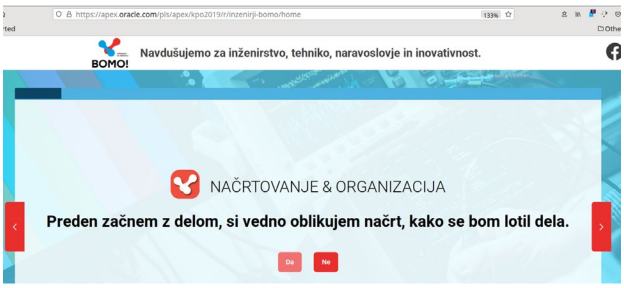
Spletno anketo v aplikaciji KamBi je v obdobju od konca decembra 2020 do sredine junija 2021 anonimno izpolnilo 1750 anketirancev v zaključnem letniku srednjih šol širom Slovenije. Vsak udeleženec je na osnovi svojih odgovorov dobil priporočilo za izbiro enega od 23 definiranih inženirskih poklicev. Kandidati lahko do svojih rezultatov dostopajo izključno z žetonom (39 mestna unikatna številka), ki se izpiše ob prikazu rezultatov o primernosti za poklice, vnesene v bazo podatkov.

V oblačni storitvi Oracle Application Express (APEX) se nahaja delovni prostor z baza podatkov in aplikacijo KamBi. V bazi podatkov je 10 relacijskih tabel, ki povezujejo: a) anketna vprašanja s predlogama odgovorov (binarni tip, Likertov tip), ter področjem, ki mu vprašanje pripada, b) anketiranca (kandidata) z njegovimi odgovori, izračunom skladnosti s poklici ter c) poklice z zahtevanimi lastnosti na področjih in izobraževalnimi ustanovami (slika 1).



Slika 1. Struktura baze podatkov

V bazi podatkov je tako shranjenih 78 vprašanj na 26 področjih, ki skupaj opredeljujejo 23 poklicev z 207 značilnostmi. Vseh 1750 anket je bilo v celoti izpolnjeno, saj aplikacija ne shranjuje nepopolno izpolnjenih anket. Primer enega vprašanja binarnega tipa prikazuje slika 2, primer vprašanja Likertovega tipa pa slika 3.



Slika 2. Primer vprašanja binarnega tipa v aplikaciji KamBi.

Slika 3 Primer vprašanja Likertovega tipa v aplikaciji KamBi.

V tej analizi smo uporabili jezik R [8] in vmesnik RStudio [9]. Na enak način, kot poteka logika preračunavanja v aplikaciji KamBi smo tudi v skripti jezika R besedne odgovore pretvorili v numerične vrednosti: »ne« v 0, »redko« v 0,25, »včasih ne, včasih da« v 0.5, »najpogosteje« v 0.75 ter »da« in »vedno« v 1. Zastavili smo si naslednje sklope raziskovalnih vprašanj:

- Kako so anketiranci odgovarjali na posamezna vprašanja in na področja vprašanj? Koliko časa so porabili za posamezna vprašanja, koliko za celoten vprašalnik? Kako so časi porazdeljeni? Kolikšno je optimalno število gruč podobnih odgovorov (na posamezna vprašanja ali področja) in kako gruče smiselno poimenovati?
- Kakšna je interna zanesljivost (konsistentnost) vprašalnika, če kot mero uporabimo koeficient Cronbachov alfa in vrednotimo področja, za katere je bil uporabljen Likertov tip vprašanj ter področja, ki jih opredeljujejo vprašanja binarnega tipa.
- Kako so fakultete določile zahtevane lastnosti za poklice in kakšne gruče podobnih poklicev so tako nastale?

V jeziku R (verzija 4.01) in vmesniku RStudio [9] smo za izvedbo analize uporabili razne knjižnice kot so rJava, RJDBC, sqldf, ggplot2, Rfast, psych, plyr, descr, Hmisc, corrplot, RColorBrewer, fitdistrplus, cluster, factoextra, vtree, DescTools, magrittr in knittr. S temi knjižnicami je bilo možno: dostopati do baze podatkov, izdelati in izvesti poizvedbe v SQL, izdelati opisno statistiko, proučiti prileganje teoretičnih distribucijam, izvesti analizo gruč ter prikazati rezultate v tekstovni in grafični obliki.

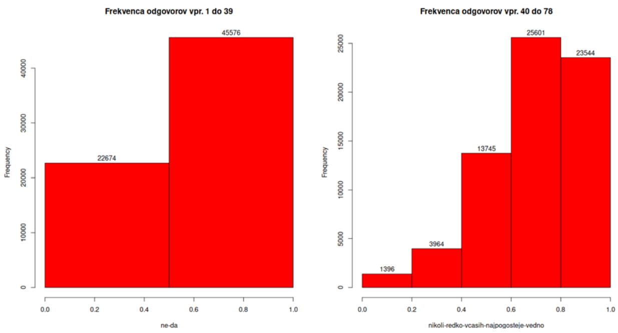
4 REZULTATI

4.1 Odgovori anketirancev

Z jezikom R smo izdelali opisno statistiko in izrisali histograme za vseh 78 vprašanj. Del izpisa prikazuje slika 4.

Slika 4. Histogrami odgovorov (izsek).

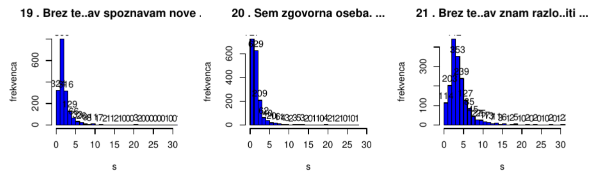
Za ta prispevek bi bilo navajanje opisne statistike in histogramov za vseh 78 vprašanj in 26 področij preobsežno, zato je na sliki 5 prikaz histogramov odgovorov na vprašanja binarnega tipa in vprašanja Likertovega tipa.



Slika 5. Histogram odgovorov na vprašanja binarnega in Likertovega tipa.

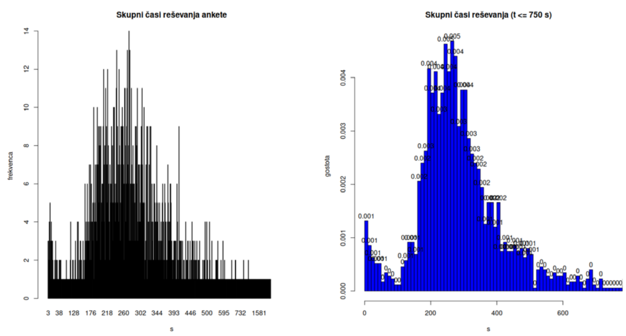
Med prvimi 39 vprašanji je odgovor DA pogostejši, razen pri vprašanjih: *3. Zanimajo me raziskave s področja varovanja okolja; 28. Sem 'geek'; 38. Čas raje preživljam notri* in *39. Nekoč bom imel svoj laboratorij*. Med vprašanji 40 do 78 prevladujejo odgovori, ki nakazujejo pogostejše pozitivno ravnanje. Najmanj pogosto ravnanje ($\overline{x} = 0{,}66$) je pri vprašanjih: *40. Pri delu si določim cilj in sestavim načrt, kako ga bom dosegel* in *65. Nimam težav s spoznavanjem novih ljudi.* Pri vprašanju *62. Spodbujam pozitivno vzdušje in dobre odnose je bilo najvišje poprečje* ($\overline{x} = 0{,}84$. Korelacijska analiza je pokazala, da so tako odgovori kot tudi področja šibko povezani, pri čemer niti ena povezava ni statistično pomembna na nivoju tveganja $p = 0.01$.

Čas, ki so ga anketiranci porabili za posamezen odgovor in celotno anketo je izraženo v sekundah.. Na sliki 6 je prikazan izsek izpisa le za tri vprašanja ($n = 1750$).



Slika 6. Porazdelitev porabljenega časa za odgovore (izsek).

Posamezni odgovori so trajali od 0 do 6872s, ($\overline{x} = 4{,}47s, SD = 47{,}24$), če pa postavimo mejo na 99. percentil ($0 \leq t \leq 24$) je$\overline{x} = 3{,}41s, SD = 2{,}67$. Mediana časa za odgovor na vprašanje *40. Pri delu si določim cilj in sestavim načrt, kako ga bom dosegel* je med vsemi vprašanji najvišja ($6s$), ker je to prvo vprašanje z drugačnim tipom odgovora. Skupni časi reševanja takih anket so v intervalu od $356.58s$ do $7078s$. Na sliki 7 je prikazana frekvenca in gostota porazdelitve skupnih časov reševanja ankete. Vrednosti skupnih časov, ki so manjše od 100 sekund zagotovo nakazujejo, da je okoli 5 % anketirancev zelo hitelo s klikanjem. Izsek izračuna opisne statistike po področjih je predstavljen na sliki 8. pri tem je potrebno upoštevati, da je 22 področij agregat 3 vprašanj (po dve področji sta opredeljeni z dvema oziroma štirimi vprašanji). Najvišjo srednjo vrednost pri agregatih s tremi vprašanji je doseglo področje *Delo z ljudmi*, največjo varianco pa področje *Uporaba orodij*.



Slika 7. Frekvenca in gostota porazdelitve skupnih časov reševanja ankete.

	vars	n	mean	sd	median	trimmed	mad	min	max	range
ODNOS DO OKOLJA	1	1750	2.17	0.75	2.00	2.25	1.48	0	3	3
RAZGIBAN DELAVNIK	2	1750	1.83	0.93	2.00	1.89	1.48	0	3	3
NAČRTOVANJE & ORGANIZACIJA	3	1750	1.75	1.05	2.00	1.81	1.48	0	3	3
SAMOSTOJNO DELO	4	1750	2.32	0.76	2.00	2.42	1.48	0	3	3
DELO V TIMU	5	1750	2.43	0.89	3.00	2.60	0.00	0	3	3
DELO Z LJUDMI	6	1750	2.65	0.65	3.00	2.80	0.00	0	3	3
PRODAJA	7	1750	1.91	1.07	2.00	2.01	1.48	0	3	3
VODENJE	8	1750	2.23	0.79	2.00	2.34	1.48	0	3	3
RAZVOJ NOVIH IZDELKOV	9	1750	2.04	0.98	2.00	2.15	1.48	0	3	3
UPORABA TEHNOLOGIJE	10	1750	1.56	1.07	2.00	1.58	1.48	0	3	3
UPORABA ORODIJ	11	1750	1.78	1.09	2.00	1.85	1.48	0	3	3
DELO NA TERENU	12	1750	2.10	0.90	2.00	2.20	1.48	0	3	3
DELO V ZAPRTEM PROSTORU	13	1750	1.27	0.85	1.00	1.22	1.48	0	3	3
CILJNA USMERJENOST	14	1750	2.88	0.69	3.00	2.92	0.74	0	4	4
KOMUNIKACIJSKE SPRETNOSTI	15	1750	2.28	0.54	2.25	2.32	0.37	0	3	3
NATANČNOST	16	1750	2.10	0.57	2.25	2.13	0.74	0	3	3

Slika 9. Izračun opisne statistike po področjih (izsek).

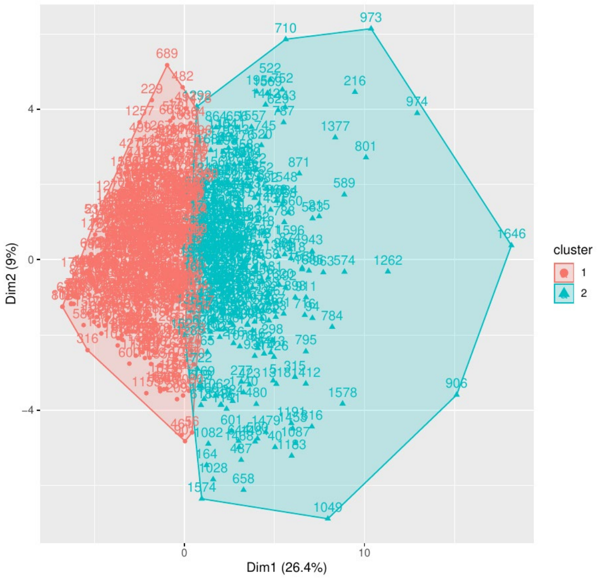
Pri porazdelitvi časov smo ugotovili, da aproksimacija s Poissonovo ali negativno binomsko porazdelitvijo ni ustrezna.. Analizo gruč smo najprej izvedli na vprašanjih Likertovega tipa, nato pa zaradi prekrivanja iz podatkov odstranili ankete z vrednostmi časov reševanja manj kot 214 s (1. kvaril) ter več kot 359 s (3. kvartil). Na obeh množicah podatkov (vse ankete, prečiščene ankete) smo tako odgovorih kot pri področjih ugotovili, da je optimalno število gruč 2. Gruči po vprašanjih in področjih se razlikujeta za manj kot 5 %. Slika 9 prikazuje gruči očiščenih podatkov po 39 vprašanjih Likertovega tipa.

Samo gručanje seveda še ne more dati natančnejšega opisnega imenovanja gruč, saj je naloga algoritma zgolj zmanjšanje števila dimenzij – v našem primeru 39 dimenzij (vprašanj) reduciramo na dve (koordinati x in y). Zato smo izbrali tri vprašanja binarnega tipa, za katere smo menili, da so dobri kandidati za razlikovanje tehnično usmerjenih od družboslovno usmerjenih: *33. V roke rad vzamem orodje in stvari naredim sam. 31. Zanima me, kako stvari delujejo* in *29. Vse funkcije na računalniku in telefonu dobro poznam*. Na sliki 10 je prikazano drevo gruče tehnikov (1) in gruče družboslovcev (2) pri prej navedenih vprašanjih. Med 545 člani skupine rdečih (pogojno tehniki) jih je trikrat odgovorilo pozitivno 186, dvakrat pa 211 (seštevek več vej), med 328 člani skupine turkiznih (pogojno družboslovci) pa jih je trikrat pozitivno odgovorilo 84, dvakrat pa 56 (seštevek več vej). Deleža vsaj dveh pozitivnih odgovorov sta 71 % in 29 %, kar kaže na podobno situacijo kot pri neprečiščenih odgovorih. Sklepamo, da ta tri izbrana vprašanja binarnega tipa vendarle izražajo razliko med skupino tehnično usmerjenih in družboslovno usmerjenih in smo zato rdeče obarvano večjo gručo utemeljeno imenovali tehniki, turkizno obarvano manjšo gručo pa družboslovci.

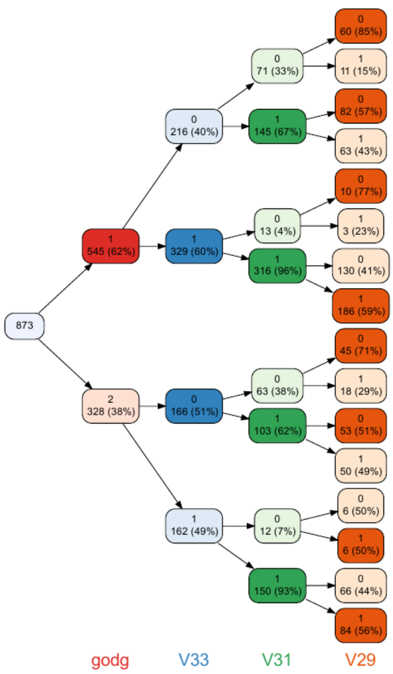
Moč definiranih gruč v realnosti pa je glede na večletne podatke o vpisih in diplomantih na slovenskih visokošolskih ustanova obratno. Po uradnih podatkih je bilo v letu 2015 34 % diplomantov družboslovnih študijev, 16 % tehniških programov in 9 % naravoslovnih programov. Tudi ob upoštevanju seštevka tehnikov in naravoslovcev imamo v Sloveniji prevladujoč delež družboslovcev. To odpira nova vprašanja kot so:

1. Ali so anketo večinsko izpolnjevali dijaki, ki jih bolj zanimajo tehniški, inženirski poklici (anketo je promovirala iniciativa Inženirji bomo), družboslovno usmerjeni pa so jo ignorirali? Če da, zakaj?
2. Ali dijaki kljub samooceni, ki kaže tehniško orientiranost, v procesu odločanja izberejo družboslovni študij? Če da, zakaj?
3. Ali nekateri študijski programi, ki so uradno deklarirani kot družboslovni, vendarle obsegajo določen delež tehniških vsebin, niso pa klasificirani v popolnoma ustrezne uradne predalčke? Če da, zakaj?

Prvi dve vprašanji sta vredni dodatnih raziskav, pri zadnjem pa je odgovor povezan z obsegom proračunskega financiranja visokega šolstva.



Slika 9. Gručanje očiščenih podatkov po 39 vprašanjih Likertovega tipa.

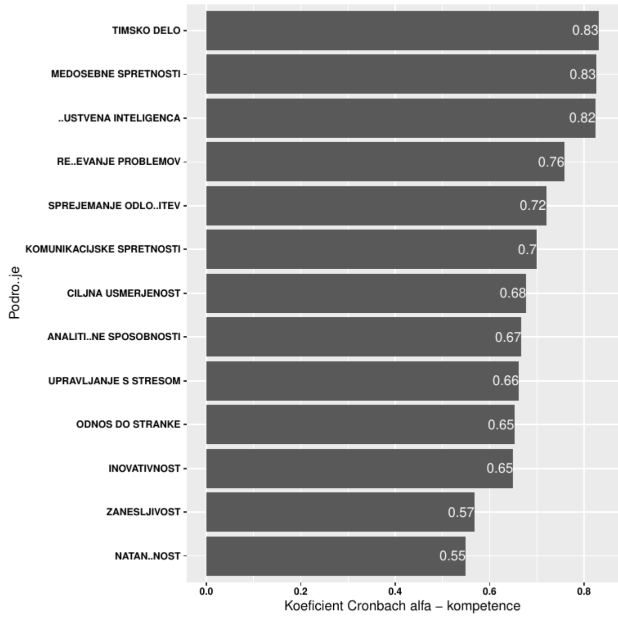


Slika 10. Drevo gruče tehnikov (1) in gruče družboslovcev (2) pri vprašanjih 33, 31 in 29.

4.2 Interna zanesljivost vprašalnika

Interno zanesljivost vprašalnika smo preverili s koeficientom, ki se imenuje Cronbachov alfa: v števcu je zmnožek števila pojavov ter poprečne kovariance (ta podaja samo smer povezave med pari spremenljivk) v imenovalcu pa seštevek poprečne korelacije (ta podaja smer in moč povezave med pari spremenljivk) in zmnožek števila pojavov zmanjšanega za eno ter poprečno kovarianco. Običajno so vrednosti med 0 in 1, vendar spodnja vrednost ni omejena. Višja vrednost načeloma pomeni večjo konsistentnost.

Na sliki 11 je prikaz koeficienta Cronbach alfa po področjih, ki jih opredeljujejo vprašanja Likertovega tipa.

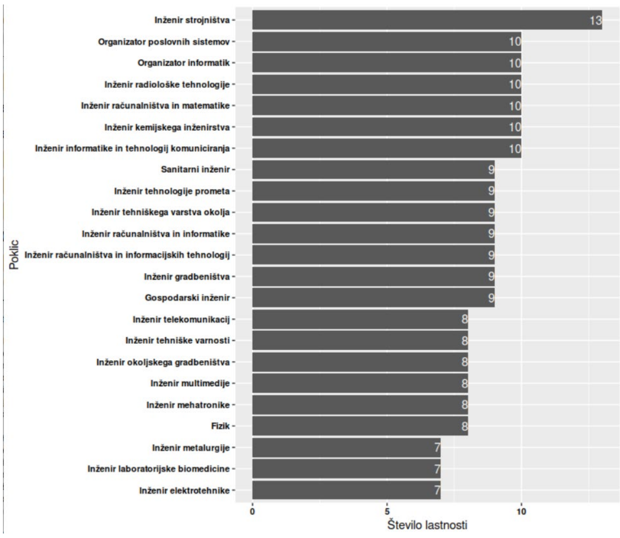


Slika 11. Cronbach alfa po področjih, ki jih opredeljujejo vprašanja Likertovega tipa.

Preverjanje konsistentnosti vprašalnika je za skupino vprašanj s področja kompetenc pokazalo, da je konsistentnost dobra za 3 področja (*sprejemanje odločitev, čustvena inteligenca in vodenje*), sprejemljiva za 3 področja (*odnos do okolja, delo v zaprtem prostoru, razgiban delovnik*) vprašljiva za 5 področij (*medsebojne spretnosti, delo z ljudmi, razvoj novih izdelkov, upravljanje s stresom, uporaba orodij*) ter šibka za 2 področji (*komunikacijske spretnosti, načrtovanje in organizacija*). Vprašanja s področja narave dela so binarnega tipa, zato so izračunani koeficienti (Crombach alfa) primerljivi le med seboj, ne pa s skupino vprašanj Likertova tipa. Najvišjo konsistentnost dosegajo področja *ciljna usmerjenost*, *uporaba tehnologije*, *zanesljivost* in *samostojno delo* vendar z referenčno oceno *vprašljivo*, sledi *delo v timu* (referenčna ocena *šibko*) in nato *analitične sposobnosti, timsko delo, delo na terenu, inovativnost, reševanje problemov, natančnost, prodaja in odnos do stranke* z referenčno oceno *nesprejemljiv*. Pri vseh izračunih je bil upoštevan 95 % interval zaupanja.

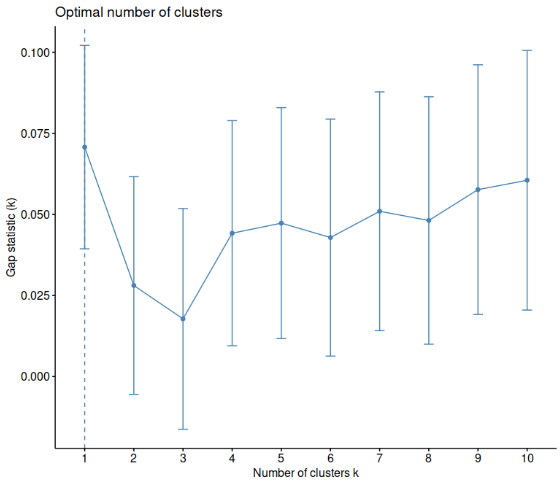
4.3 Gruče poklicev glede na zahtevane lastnosti visokošolskih inštitucij

Določitev zahtevanih lastnosti v veliki meri vpliva na priporočilo o najustreznejšem poklicu. Vsaka visokošolska inštitucija je določila tiste lastnosti, ki jih pričakuje od svojih diplomantov. Skupno je bilo na voljo 26 lastnosti, od katerih se je polovica nanašala na naravo delo, polovica pa na kompetence. V bazi so bile pripravljene lastnosti za 23 poklicev. Na sliki 12 je prikazano število lastnosti, ki so jih visokošolske inštitucije zahtevale od »svojih« poklicev.



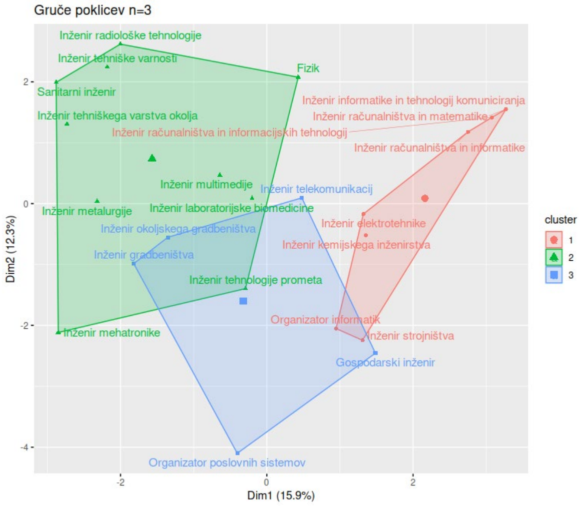
Slika 12. Število zahtevanih lastnosti za poklic.

Z metodo, ki se imenuje statistika vrzeli (gap statistics), smo ugotovili, da je optimalno število gruč 3. Na sliki 13 je prikazan graf za število gruč med 1 do 10. Optimalno število gruč je določeno z najnižjo vrednostjo statistike vrzeli, ki smo jo izvedli s 1000 simulacijskimi teki.



Slika 13. Funkcija statistike vrzeli za optimalno število gruč.

Skupine poklicev pri optimalnem številu gruč ($n = 3$) prikazuje slika 14, slika 15 pa povzetek pripadnosti poklicev pri številu gruč od 1 do 7.



Slika 14. Skupine poklicev pri optimalnem številu gruč (n=3)

Z vidika inštitucij, ki izobražujejo za več poklicev, je morda pomembna diferenciacija. Tak primer je UM FOV, ki je predstavila dva poklica: *organizator informatik* in *organizator poslovnih sistemov*. Analiza gruč je pokazala dobro diferenciacijo, saj se razlikujeta že pri klasificiranju v dve gruči. Kot primer poklicev, ki neodvisno od števila gruč vedno nastopajo skupaj najdemo: *inženir informatike in tehnologij komuniciranja, inženir računalništva in matematike, inženir računalništva in informacijskih tehnologij ter inženir računalništva in informatike*. Zanimiv je tudi poklic inženir *mehatronike*, pri katerem bi pričakovali, da bo pogosto nastopal v gručah *inženirjem strojništva* in *inženirjem elektrotehnike*. Vendar je v gruči z omenjenima le, kadar klasificiramo v pet gruč, sicer pa mu članstvo zelo spreminja. Pri treh gručah nastopa v skupini s še devetimi poklici, med katerimi ni pričakovanih. Lastnosti, ki so jih izobraževalne ustanove zahtevale za posamezne poklice, zelo vplivajo na gruče in priporočila anketirancem za najprimernejši poklic.

	1	2	3	4	5	6	7
Gospodarski inženir	1	2	3	2	1	4	5
Inženir elektrotehnike	1	2	1	3	3	6	7
Fizik	1	1	2	1	2	2	1
Inženir gradbeništva	1	1	3	2	4	4	5
Inženir kemijskega inženirstva	1	2	1	4	3	5	4
Inženir laboratorijske biomedicine	1	1	2	1	5	2	3
Inženir mehatronike	1	1	2	4	3	3	2
Inženir metalurgije	1	1	2	1	5	2	6
Inženir multimedije	1	1	2	4	5	5	4
Inženir okoljskega gradbeništva	1	1	3	2	4	4	5
Inženir računalništva in informacijskih tehnol…	1	2	1	3	2	1	1
Inženir informatike in tehnologij komuniciranja	1	2	1	3	2	1	1
Inženir računalništva in informatike	1	2	1	3	2	1	1
Inženir računalništva in matematike	1	2	1	3	2	1	1
Inženir radiološke tehnologije	1	1	2	4	4	3	2
Inženir strojništva	1	2	1	3	3	6	7
Inženir tehniške varnosti	1	1	2	1	5	3	2
Inženir tehniškega varstva okolja	1	1	2	1	5	2	6
Inženir telekomunikacij	1	1	3	2	1	4	5
Inženir tehnologije prometa	1	1	2	1	5	2	3
Organizator informatik	1	2	1	4	3	5	4
Sanitarni inženir	1	1	2	1	4	2	6
Organizator poslovnih sistemov	1	1	3	2	1	4	3

Slika 15. Pripadnosti poklicev pri številu gruč (n od 1 do 7).

5. DISKUSIJA

Samoocena anketirancev (odgovori na 78 vprašanj), določitev osebnih lastnosti, ki jih skupine vprašanj (26) opredeljujejo in določitev zahtevanih lastnosti poklicev (23) vplivajo na priporočila o primernosti posameznega poklica za posameznega anketiranca. Tako poleg anketirancev v procesu izdelave priporočila nastopajo razvijalci ankete ter sodelujoče visokošolske ustanove S *post festum* analizo smo rangirali poklicne preference za 1750 anketirancev. Na sliki 16 so za vse poklice prikazane frekvence rangov od 1 do 3. Seveda je za poklic (posredno za visokošolsko ustanovo) pomembno, da nastopa čim večkrat z najvišjim rangom (R1).

Posameznik ima običajno tudi lastnosti, ki jih visokošolska ustanova poklicu ni predpisala. Tudi te lastnosti so v delovnem okolju lahko odločilne za razvoj kariere. Podobno kot smo rangirali poklice po specificiranih lastnostih smo to storili tudi za nespecificirane oziroma presežne lastnosti. Pri teh sta bila najvišje rangirana (R1) poklica *inženir okoljskega gradbeništva* (226) in *inženir elektrotehnike* (224). Presežne lastnosti v poročilu za anketiranca v spletni anketi niso dosegljiva, morda pa bi jih v prihodnosti lahko vključili, saj utegnejo posamezniku tudi pomagati pri izbiri poklicne poti.

	rn	R1	R2	R3
1	Fizik	72	94	99
2	Inženir računalništva in informatike	98	103	78
3	Inženir tehnologije prometa	37	47	54
4	Sanitarni inženir	53	102	136
5	Inženir elektrotehnike	38	25	33
6	Inženir laboratorijske biomedicine	94	91	111
7	Inženir mehatronike	167	111	104
8	Inženir metalurgije	48	45	60
9	Inženir računalništva in matematike	9	28	33
10	Inženir strojništva	344	213	156
11	Organizator poslovnih sistemov	13	25	30
12	Inženir radiološke tehnologije	0	3	13
13	Inženir tehniške varnosti	6	28	24
14	Inženir telekomunikacij	5	10	13
15	Gospodarski inženir	45	60	70
16	Inženir okoljskega gradbeništva	6	13	44
17	Inženir računalništva in informacijskih tehnologij	57	82	67
18	Inženir tehniškega varstva okolja	29	46	56
19	Inženir gradbeništva	71	72	97
20	Inženir kemijskega inženirstva	56	60	67
21	Inženir multimedije	215	200	146
22	Inženir informatike in tehnologij komuniciranja	46	49	60
23	Organizator informatik	241	243	199

Slika 16. Frekvence rangov poklicev za prvo, drugo in tretje priporočilo anketirancu.

6. ZAKLJUČEK

Analiza podatkov orodja za pomoč pri izbiri poklica »KamBi« je obsegala tri vsebinske sklope, ki so v domeni anketiranca, pripravljavca ankete ter visokošolskih ustanov, ki izobražujejo za »svoje« poklice. Kompleksno analizo smo izvedli v jeziku R [8] in z vmesnikom RStudio [9], kar je v kombinaciji z Latex-om pripomoglo k sprotnemu dokumentiranju in vizualizaciji rezultatov obdelave.

Priložnosti za izboljšavo v smislu boljših in natančnejših priporočil anketirancem so predvsem: 1. večstransko ocenjevanje posameznikovih lastnosti. Poleg samoocene je možno vključiti tudi osebe, ki anketiranca dobro poznajo in ga bolj nepristransko ocenijo. 2. razmislek o vprašalniku, posebej za področja, kjer je preverjanje interne konsistentnosti pokazalo nižje referenčne ocene in 3. razmislek o lastnostih, ki so posameznim poklicem določene. Fakultete bi lahko vsaki od 26 lastnosti določile relativno težo (pomen) za »svoj« poklic. posamezne lastnosti.

Orodje KamBi ni le »še ena anketa« temveč je skupaj s podatki, ki morajo biti pripravljeni pred lansiranjem ankete ter podatki, ki nastanejo v času izvajanja, lahko koristno sredstvo za izbiro posameznikove karierne poti, pripravljavcem orodij za izbiro poklicev in visokošolskim ustanovam pa lahko nudi empirično podporo pri izvajanju glavnih aktivnosti – poklicnega usmerjanja in izobraževanja.

ZAHVALA

Avtorja se zahvaljujeva vsem institucijam, ki so sodelovale pri razvoju orodja KamBi [1].

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Priprava in uporaba kvizov v različnih programih za preverjanje usvojenega znanja pri predmetu fizika na gimnaziji

Preparation and use of quizzes in various IT tools for checking pupil's knowledge in the subject of physics in high school

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POVZETEK

Pouk, kjer učitelj predava, dijak pa posluša, ni dovolj učinkovit in je v nasprotju s smernicami, ki veljajo za sodoben pouk. Pri poučevanju na daljavo pa se je še posebej izkazalo, da dijaki potrebujejo več motivacijskih nalog, izzivov in zanimivosti, ki pritegnejo k poslušanju in usvajanju nove snovi. Za sprotno preverjanje znanja se v šoli najpogosteje uporabi kar metoda ustnega spraševanja na samem začetku ure ali pa po končani razlagi. Učitelj tako sproti oceni, kako je z usvojenim znanjem. Pri poučevanju na daljavo sem poiskala pripomočke, ki so se izkazali za najuporabnejše pri preverjanju usvojenega znanja in so nadomestili sprotno preverjanje, ki ga izvajam v šoli. V prispevku predstavim preverjanje usvojenega znanja s pomočjo orodja Kahoot!, Ankete, ki jo omogoča komunikacijski program Zoom in orodje Kviz v programu Moodle. Vsa našteta orodja oziroma aplikacije sem predstavila tudi ostalim zaposlenim na kratkih delavnicah, ki smo jih interno organizirali v šolskem letu 2020/2021 na našem zavodu. V članku pa predstavim tudi rezultate kratkega vprašalnika za zaposlene, ki sem ga izvedla po končanih delavnicah.

KLJUČNE BESEDE

Preverjanje usvojenega znanja, kviz, Kahoot!, Moodle, Zoom

ABSTRACT

Teaching where the teacher is lecturing, and the pupil is listening is not effective enough in fact it is contrary to the guidelines that apply to modern teaching. When teaching remotely, however, it has been especially shown that pupils need more motivational tasks, challenges and points of interest that attract them to listen and master new material. For purpose of current assessment of knowledge, the method of oral questioning in the school is most often used at the very beginning of the class or after the end of the explanation. The teacher thus assesses the knowledge acquired. I searched for tools that proved to be most useful in assessing the acquired knowledge when teaching remotely. In this article, I present an assessing of acquired knowledge with the help of the learning platform Kahoot!, surveys with video communication platform Microsoft Zoom and tool Kviz that is part of learning management system Moodle. All the listed tools were presented to other employees of our institution at short workshops, which we organized internally in the school year 2020/2021. In this article the results of a short questionnaire for employees after those workshops are also presented.

KEYWORDS

Checking the acquired knowledge, Quiz, Kahoot!, Moodle, Zoom

1 UVOD

Sodobna šola v primerjavi s šolo preteklih desetletij zahteva prožnost, s tem pa ne samo miselni, temveč tudi strokovni preskok pri delu z mladimi. Mladi si želijo motiviranega odprtega učitelja, dovzetnega za novosti in sodoben način dela v razredu. Pouk, kjer učitelj predava, dijak pa posluša, ni dovolj učinkovit in je v nasprotju v smernicami, ki veljajo za sodoben pouk [1]. Učitelj poučuje dijake, ki so računalniško pismeni, poznajo komunikacijska sredstva in temu primerno mora prilagoditi pouk [2].

Pri pouku, ki poteka na daljavo, pa postanejo kompetence sodobnega učitelja še pomembnejše. Pri pouku na daljavo se pojavijo naslednje težave: dijaki niso notranje dovolj motivirani, primanjkuje jim zunanje motivacije, so preobremenjeni z velikim številom ur, ki jih presedijo za računalnikom … [3]. Če učitelj želi pripraviti uro, ki bo dijake pritegnila, jih obdržala pred ekrani, poleg tega pa naj bi še usvojili želene cilje ure, je potrebno upoštevati pravilno zgradbo ure. Ura mora biti zgrajena tako, da pripomore k boljši motivaciji dijakov.

Izkazalo se je, da motivacija na začetku šolske ure v obliki kviza, kjer vsi dijaki sodelujejo, pritegne k poslušanju, kratka vprašanja za vse dijake tekom šolske ure držijo dijake zbrane tudi med uro in da s sprotnim preverjanjem na koncu ure učitelj lažje organizira razlago v prihodnjih urah. Hkrati pa je potrebno poudariti, da preveliko število aplikacij, orodij, načinov podajanja snovi za dijake povzroča dodatne kognitivne obremenitve in pripelje do velikega miselnega napora. Ugotovitve kažejo, da sočasna vključitev velikega števila novih spletnih platform in orodij niža učenčev občutek

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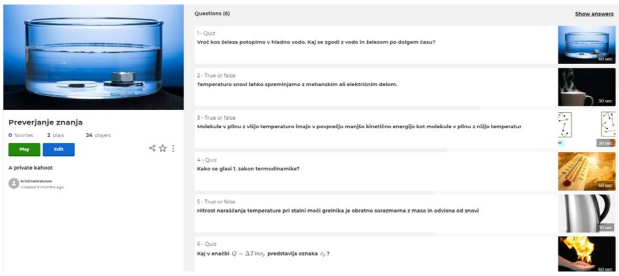
samoučinkovitosti [4]. Zmernost vseh spodaj opisanih orodij je ključna.

2 PRIPRAVA KVIZA S PROGRAMOM KAHOOT!

Prvo predstavljeno orodje je program Kahoot!, s katerim sem ustvarila kvize za preverjanje usvojenega znanja. Kahoot! je učna platforma, ki je zasnovana na igrah in se uporablja kot izobraževalna tehnologija v šolah in drugih izobraževalnih ustanovah. Igre, ki so zasnovane kot kvizi z več izbirami, so dostopne prek spletnega brskalnika ali aplikacije Kahoot! [5].

Sama sem uporabila kvize na začetku učne ure in so služili kot motivacija. S kvizom sem preverila, koliko dijaki že poznajo temo, ki sem jo med poukom predstavila. Orodje Kahhot! namreč takoj pokaže statistiko pravilnih in nepravilnih rešitev, kar omogoča takojšen vpogled v nivo znanja, ki ga imajo dijaki pri določeni temi. Orodje Kahoot! pa se je dobro izkazalo tudi za analizo usvojenega znanja po uri (slika 1). Učitelj dobi takojšnjo povratno informacijo o razumevanju določene snovi.



Slika 1: Preverjanje znanja v programu Kahoot!

Možnosti, ki jih ponuja progam, je več. Učitelj lahko sestavi različne tipe nalog: Drži/Ne drži, več možnih izbir, Da/Ne … Bralca vabim, da vse možnosti uporabe razišče sam.

2.1 Prednosti in slabosti uporabe

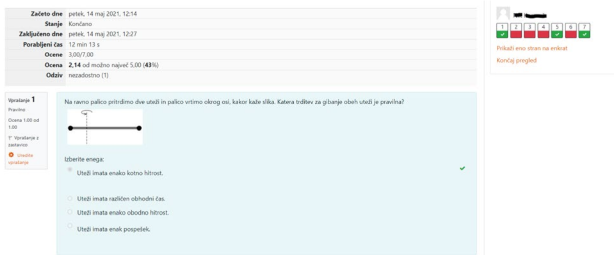
Glavna prednost programa Kahoot! je v preprosti uporabi. Ko je kviz pripravljen, lahko z deljenjem kode dijaki kviz »odigrajo« takoj, možno ga je tudi večkrat ponoviti. Pozitivna lastnost orodja je hitra analiza rezultatov, kar da hiter vpogled v trenutno stanje znanja, ki ga imajo dijaki. Orodje pokaže dijake, ki so najuspešnejši, dijake, ki potrebujejo dodatno pomoč. Prednost je tudi, da za reševanje kviza dijaki potrebujejo zgolj mobilni telefon in ne potrebujejo nameščene aplikacije ali dodatnega programa. V kviz je možno vključiti slikovno gradivo. Kviz je na ta način tudi vizualno zelo privlačen. Ob samem reševanju kviza igra tudi izbrana glasba, ki še stopnjuje in poudarja napetost med samim reševanjem.

Dijaki so obliko kviza v platformi Kahoot! dobro sprejeli. Vedno so z veseljem »odigrali« igro. Pri povratnih informacijah, ki sem jih dobila na koncu šolskega leta, so poudarili, da je kviz popestril ure, jih naredil bolj dinamične. Kvizov v tej obliki si želijo tudi v naslednjem šolskem letu, ne glede na način izobraževanja, ki nas čaka v letu 2021/2022; doma ali v šoli.

Slabost, ki morda to tudi ni, je, da je program plačljiv in v svoji brezplačni različici ponuja zgolj nekaj možnosti. V kolikor se učitelj odloči za nakup licence, se namreč možnosti, ki jih ima učitelj pri sestavi kviza, povečajo. Omogočene so dodatne funkcije in analize. Slednjih ne morem komentirati, saj sem uporabnica brezplačne verzije programa.

3 PRIPRAVA KVIZA V PROGRAMU MOODLE

Usvojeno znanje sem preverjala še s programom Kvizi v spletnih učilnicah Moodle. Za pripravo kviza so na voljo različni tipi vprašanj: Drži/Ne drži, Esej, Kratek odgovor, Izberi manjkajoče besede, Povleci in spusti, Ujemanje, Ugnezdeni odgovori, Izračunano, Več izbir. Sama sem se najpogosteje poslužila možnosti Drži/Ne drži in možnost Več izbir (slika 2).



Slika 2: Vprašanje tipa Več izbir v enem od pripravljenih kvizov

Kviz sem uporabila na več načinov. Uporabila sem ga kot orodje za preverjanje znanja na začetku ure. Na žalost se v tej situaciji v mojem primeru ni izkazal kot najboljši pripomoček, saj analiza ni tako hitra in pregledna kot na primer v orodju Kahoot! Rezultatov torej nisem mogla uporabiti kot temelj, na katerem naj gradim razlago nove snovi. Kviz pa sem uporabila tudi kot preverjanje znanja celotne predelane snovi. V tej situaciji pa je po mojem mnenju orodje zelo uporabno. Orodje Kviz omogoča, da se ga odpre za dijake na točno določen datum in uro. Dijaki lahko kviz rešujejo sočasno. Kviz je lahko časovno omejen in po končanem reševanju orodje samo določi oceno uspešnosti reševanja. Ker se v nastavitvah kviza da omogočiti tudi pomešana vprašanja, to omogoči verodostojnejše rezultate in ocene. Analiza rezultatov je tista, ki je v nadaljevanju uporabna za oceno izvedene ure. S pomočjo orodja sem ocenila, koliko so dijaki razumeli predstavljeno snov. Podrobnejša analiza natančno pokaže tudi, pri katerem vprašanju so imeli dijaki težave. Učitelj vidi, katerega dela snovi dijaki niso razumeli, usvojili ter lahko uro prilagodi na ta način, da ponovi razlago.

Kviz v orodju Moodle se da uporabiti tudi pri maturantih, saj je pri maturi iz fizike ena od maturitetnih pol sestavljena iz vprašanj izbirnega tipa. Baza vprašanj je dosegljiva v banki nalog [6]. V kombinaciji z že pripravljenimi vprašanji je kviz pripravljen hitro in je dobra priprava na maturo.

3.1 Prednosti in slabosti uporabe

Kviz v Moodlu se je izkazal kot zelo uporabno orodje. Ima kar nekaj prednosti. Prva od njih je, da ima več tipov vprašanj, kar omogoča pestro postavitev kviza. Prednost je tudi, da je kviz lahko časovno omejen in da ponudi pomešana vprašanja. Kviz ponuja dobro analizo rezultatov in pregleden vpogled v analize.

Pomanjkljivosti, ki bi izstopale, orodje Kviz nima. Bi pa bil v kombinaciji z zaklenjenim zaslonom uporaben pripomoček tudi za samo ocenjevanje znanja, ne le preverjanje.

4 PRIPRAVA PREVERJANJ V APLIKACIJI ZOOM

Orodje Zoom omogoča izvedbo anketnega vprašalnika med kreirano sejo. Anketni vprašalnik se lahko pripravi že pred pričetkom seje ali med sejo samo. Možnost anketnega vprašalnika sem uporabila kot kviz za preverjanje usvojenega znanja oziroma razumevanje novih pojmov. Vprašalnik lahko dijaki rešujejo le med uro, rezultati so vidni takoj. Po zaključeni seji anketnega vprašalnika ni več možno reševati. Ker so rezultati vprašalnika vidni takoj, je možno takojšnje ukrepanje pri razlagi. Anketni vprašalnik sem uporabila tudi kot orodje za reševanje nalog, kjer so bili ponujeni odgovori na daljše računske naloge. Na ta način sem videla, koliko dijakov je nalogo rešilo, koliko je bilo pravilno rešenih nalog itn.

4.1 Prednosti in slabosti uporabe

Prednost anketnega vprašalnika, ki ga ponuja orodje Zoom, je ta, da dijaki ne potrebujejo telefonov, s katerim rešujejo naloge/vprašanja. Vprašalnik se pojavi v sami seji, kjer spremljajo predavanje. Na ta način ni preklapljanja med orodji in aplikacijami. Dijaki ostanejo zbrani.

Glavna pomanjkljivost orodja pa je, da orodje postane nepregledno, če so vprašanja daljša in jih je več. Najprimernejše je za kratka vprašanja tipa Drži/Ne drži ali kratke odgovore na krajše naloge.

5 PREDSTAVITEV ORODIJ ZAPOSLENIM

V obliki kratkega predavanja so bila orodja predstavljena tudi ostalim zaposlenim v našem zavodu. Med učenjem na daljavo smo se namreč zavedali dejstva, da dijaki težko ostanejo motivirani ves čas pouka in da mora učitelj na različne načine poskrbeti, da je ura dinamična in zanimiva. Ena od možnosti so tudi zgoraj omenjeni kvizi.

Pri predstavitvi orodji sem bila pozorna na to, da so bila orodja predstavljena kratko in jedrnato. Poudarila sem glavne prednosti in slabosti. Pokazala sem po en primer za vsako orodje.

Po končani predstavitvi sem izvedla še kratek vprašalnik, kjer me je zanimalo, če jim je bila predstavitev všeč, ali bodo uporabljali orodja pri pouku in katero orodje se jim zdi najuporabnejše. Zaposleni so odgovorili, da so bili s predstavitvijo zadovoljni. 80 % zaposlenih še ni uporabljalo orodja Kahoot! Nihče od zaposlenih ni uporabljal orodja Kviz v Moodlovih učilnicah. Le 10 % zaposlenih pa je vsaj enkrat uporabilo anketni vprašalnik v programu Zoom. Kar 95 % zaposlenih je zapisalo, da bodo v nadaljnjih urah preizkusili vsaj eno omenjeno orodje. Največ zaposlenih je po zapisanem poskusilo orodje Kahoot!, na drugem mestu je anketni vprašalnik v Zoom-u. Samo dva zaposlena pa sta poskusila uporabiti tudi Kviz v Moodlovi učilnici.

6 ZAKLJUČEK

Uporaba zgoraj predstavljenih orodij je ena od možnosti, kako sproti preverjati usvojeno znanje ne samo pri fiziki, ampak tudi pri ostalih predmetih tako na osnovni kot tudi na srednji šoli, če pouk poteka na daljavo. Predstavljena orodja pa so zelo uporabna tudi pri pouku, ki poteka v učilnici. S pomočjo orodij je pouk dinamičen, zanimiv in sodobnejši. S predstavitvijo orodij zaposlenim pa se je hitreje razširilo tudi znanje in njihova uporaba pri ostalih predmetih. S predstavitvijo so bili zaposleni zadovoljni, kar so dokazali s tem, da so orodja tudi začeli uporabljati pri pouku.

ZAHVALA

Zahvaljujem se vodstvu Gimnazije Franceta Prešerna, ki je v času šolanja na daljavo podprlo vse ideje ter mi stalo ob strani pri izvajanju novosti.

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Spletni jezikovni priročniki pri pouku slovenščine

Online linguistic manuals for teaching Slovene

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POVZETEK

Pri jezikovnih dilemah so nam v pomoč jezikovni priročniki. V sodobnem digitaliziranem svetu jih najdemo vedno več na spletu, po njih pa lahko brskamo s pomočjo elektronskih naprav. Pojavila so se spletna mesta, kjer lahko na enem mestu najdemo povezave do različnih jezikovnih virov in servisov. Učni načrt za slovenščino v osnovni šoli narekuje uporabo jezikovnih priročnikov v knjižni in elektronski obliki. V prispevku je opisana učna ura v računalniški učilnici, kjer učenci spoznajo portal Fran, tj. spletišče, na katerem so uporabnikom na voljo vsi temeljni jezikovni priročniki za slovenščino. Z reševanjem praktičnih nalog se urijo v uporabi le-teh. Taka izvedba učne ure je večini učencev všeč, poleg tega pa temelji na izkustvenem učenju in navaja na uporabo spletnih jezikovnih priročnikov. V bodoče bo za namen pouka možno uporabiti novo nastali portal Franček, ki pa je namenjen posebej učencem in dijakom.

KLJUČNE BESEDE

Jezikovni priročniki, splet, portal Fran

ABSTRACT

Linguistic manuals help us with language dilemmas. In today's digital world, we can find an increasing number of them online, and we can browse through them with the help of electronic devices. Websites have appeared which allow us to find links to various language sources and services in one place. The curriculum for Slovene in primary school dictates the use of linguistic manuals in book and electronic form. The paper describes a lesson in a computer classroom, where pupils get to know the Fran portal - a website with all basic language manuals for Slovene available to users. By solving practical tasks, they are trained in the use of these manuals. Most of the pupils like that kind of lesson which in addition is based on experiential learning and builds a habit of using online linguistic manuals. In the future, it will be possible to use the newly created Franček portal for the purpose of lessons with stated portal being intended especially for pupils and students.

KEYWORDS

Linguistic manuals, web, Fran portal

1 UVOD

V življenju se marsikdaj srečamo z vprašanji, kako se beseda prav napiše, prav izgovori, kaj pomeni, od kod izvira … Včasih se želimo prepričati o njenih oblikoslovnih lastnostih. Vse te podatke najdemo v različnih pravopisnih, slovarskih in drugih priročnikih. Nekdaj smo po njih brskali predvsem v knjižnici na polici z referenčno zbirko ali na domači knjižni polici. To je dajalo vsej stvari poseben čar. V današnjem digitaliziranem svetu pa imamo vse to na spletnih straneh, kjer besed več ne iščemo po abecednem vrstnem redu, ampak jih samo še vtipkamo v iskalnik in že imamo rezultat.

2 JEZIKOVNI PRIROČNIKI

Pri razreševanju jezikovnih dilem so nam v pomoč jezikovni priročniki. To so knjige, ki nam pomagajo, da naš jezik čim bolj ustreza okoliščinam, v katerih ga uporabljamo, in namenu, ki ga imamo z njim [1]. Lahko so **vsebinski** – v njih so opisane lastnosti posameznih jezikovnih ravnin (slovnica, pravila v prvem delu Slovenskega pravopisa), **abecedni** – predstavljene besede po abecednem vrstnem redu (slovarji, Slovenski pravopis) ali **zbirke besedil v e-obliki** oz. t. i. **korpusi** – to so obsežne zbirke besedil, ki jih zbirajo iz množičnih medijev, knjig, spletnih strani …, s katerimi lahko preverimo zapis in rabo iskane besede, besedne zveze ali dela besedila [1]. Najpomembnejši jezikovni priročniki so:

- **Slovenska slovnica**, kjer so opisane in predstavljene značilnosti jezika po posameznih enotah (glasoslovje, besedoslovje, besedotvorje, oblikoslovje, skladnja, sporočanje).
- **Slovar slovenskega knjižnega jezika**, ki obsega oblikovne in vsebinske podatke o besedah slovenskega besedišča.
- **Slovenski pravopis**, ki vsebuje pravila o pravilnem zapisovanju besed in slovarski del.
- **Slovenski etimološki slovar**, ki obravnava izvor besed in pojasnjuje, iz katerih jezikov so prišle v slovenščino.
- **Veliki slovar tujk**, ki pojasnjuje besede, prevzete iz tujih jezikov.

2.1 ezikovni priročniki na spletu

S širjenjem digitaliziranega sveta najdemo vedno več jezikovnih priročnikov na spletu, ki lahko na tak način preko računalnikov, pametnih telefonov ali tablic dosežejo širši krog uporabnikov, tudi mladih, ki so še posebej vešči uporabe digitalnih naprav.

Ministrstvo za kulturo RS je v letu 2014 finančno podprlo projekt »Izdelava spletne strani z opisi jezikovnih virov in orodij za slovenščino ter osnovnimi (video) navodili za njihovo uporabo«, ki je nastal pod okriljem zavoda za uporabno slovenistiko Trojina in se je v naslednjih letih še nadgrajeval. [2] Tako lahko na enem mestu najdemo povezave do različnih virov – jezikovnotehnoloških, korpusnih, pravopisnih, slovarskih, slovničnih, terminoloških in zgodovinskih (Slika 1). Vsak vir je predstavljen s kratkim videoposnetkom, ki nam prikazuje osnovne značilnosti in načine iskanja.

Ditko (Moj jezik v digitalnem svetu) je podoben projekt, ki je nastal na Inštitutu za medijske komunikacije na Fakulteti za elektrotehniko, računalništvo in informatiko Univerze v Mariboru. Njegov namen je bil v digitalnem obdobju ponuditi digitalne vsebine slovenščine, tj. spletne jezikovne priročnike, in jih čim bolj učinkovito približati uporabnikom. V sklopu projekta Ditko, ki je trajal od začetka leta 2018 do konca oktobra 2019, so vzpostavili spletno stran www.ditko.si s predstavitvijo vseh spletnih jezikovnih priročnikov, ki so na voljo za slovenščino [3].

Jezikovne vire in servise najdemo tudi na spletni strani Slovenskega društva za jezikovne tehnologije (SDJT), seznam slovenskih spletnih slovarjev pa na www.Slovarji.si.

Slika 1: Portal jezikovnih virov

3 JEZIKOVNI PRIROČNIKI PRI POUKU

O tem, kje in kako iskati, se učijo učenci že v osnovni šoli. Učni načrt za slovenščino [4] v drugem in tretjem vzgojno-izobraževalnem obdobju narekuje razvijanje učenčeve pravopisne zmožnosti z uporabo pravopisnih priročnikov v knjižni in elektronski obliki, v tretjem vzgojno-izobraževalnem obdobju pa še razvijanje poimenovalne zmožnosti z uporabo slovarskih priročnikov v knjižni in elektronski obliki, kot so SSKJ, Veliki slovar tujk ipd. Učenec ob koncu devetletke pokaže poimenovalno zmožnost tako, da zna uporabljati slovarske priročnike v knjižni in elektronski obliki, pravopisno zmožnost pa pokaže tako, da zna uporabljati pravopisne priročnike v knjižni in elektronski obliki.

Uporaba jezikovnih priročnikov pri pouku slovenščine je pomembna, saj učenci s tem širijo in bogatijo svoje besedišče ter se navajajo na njihovo samostojno rabo. Uporaba slovarjev namreč pozitivno vpliva na uspešno učenje novih besed ter pripomore k poglabljanju znanja o besedah tako na ravni pomena kot rabe, bogat besedni zaklad pa je izjemno pomemben element sporazumevalne zmožnosti posameznikov – med drugim igra veliko vlogo pri šolskem uspehu, saj omogoča lažje razumevanje novih šolskih vsebin ter ima pozitiven vpliv na bralno pismenost [5]. Slovar v šolski praksi ni le priročnik, ki daje informativno-normativne podatke o jeziku, ampak je tudi pomembno didaktično sredstvo [5].

3.1 Portal Fran

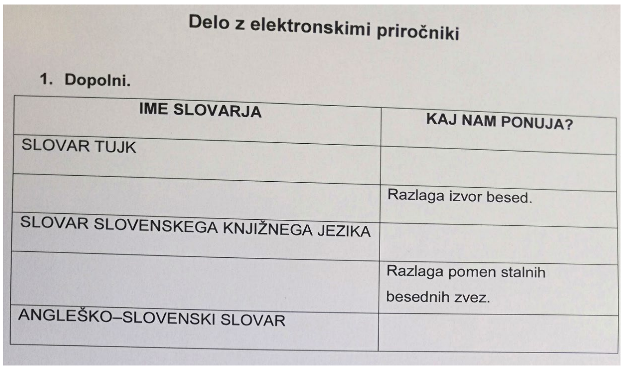
Fran, jezikovni portal Inštituta za slovenski jezik Frana Ramovša ZRC SAZU, je spletišče, na katerem so uporabnikom na voljo vsi temeljni jezikovni priročniki za slovenščino. Namenjen je najširšemu krogu uporabnikov – temu sta prilagojena iskanje in prikaz podatkov. Uporaben je pri pouku, saj učencem omogoča, da aktivno spoznavajo pomene in rabo znanih in neznanih besed ter da preverijo pravopisne, oblikoslovne in skladenjske lastnosti določene besede. Učenci tako spoznavajo različne jezikovne lastnosti besedja in hkrati pridobivajo védenje o uporabi jezikovnih priročnikov. Iskalnik na www.fran.si omogoča zelo enostavno iskanje razlag slovenskih besed, njihovega pregibanja, pravopisnih lastnosti, frazeologije, etimologije, zgodovinske in narečne rabe (Slika 2). Izhodiščna stran omogoča dober vizualni pregled temeljnih slovenskih slovarjev po tematskih skupinah. Fran trenutno vključuje 29 slovarjev, narečni atlas, nekatere jezikovne podatkovne zbirke in povezave na druge pomembnejše jezikovne vire za slovenščino ter dve jezikovni svetovalnici, znotraj katerih lahko uporabniki strokovnjakom zastavljajo vprašanja v zvezi s svojimi jezikovnimi zadregami [6].

Slika 2: Portal Fran

3.2 Uporaba spletnih jezikovnih priročnikov pri pouku

V sedmem razredu osnovne šole z učenci obravnavamo Slovar slovenskega knjižnega jezika in ob tem pregledamo še ostale jezikovne priročnike. Najprej se učenci v razredu spoznajo s teorijo – naštevajo vrste priročnikov, si ogledajo fizične izvode najpomembnejših priročnikov, ugotavljajo, kaj nam posamezni izvod prinaša in kako in kdaj ga uporabljamo. Pokažem jim, kje najdejo elektronske priročnike, še posebej predstavim portal Fran, ki ga bodo sami preizkusili v nadaljevanju. Sledi praktični del v računalniški učilnici, kjer učenci rešujejo konkretne naloge, saj je cilj, da znajo priročnike uporabljati v vsakdanjem življenju.

Za začetek učenci ponovijo, katere slovarje poznajo in kaj jim le-ti prinašajo (Slika 3).

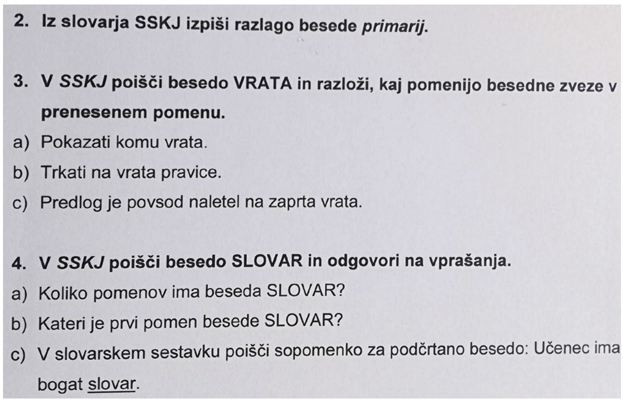

Delo z elektronskimi priročniki

1. Dopolni.

IME SLOVARJA	KAJ NAM PONUJA?
SLOVAR TUJK	
	Razlaga izvor besed.
SLOVAR SLOVENSKEGA KNJIŽNEGA JEZIKA	
	Razlaga pomen stalnih besednih zvez.
ANGLEŠKO–SLOVENSKI SLOVAR	

Slika 3: Učni list, naloga 1

V nadaljevanju odprejo Slovar slovenskega knjižnega jezika. Spoznavajo posamezne geselske članke, iščejo razlago besed, spoznavajo frazeološko gnezdo kot sestavni del geselskega članka in iščejo pomene stalnih besednih zvez (Slika 4).


2. Iz slovarja SSKJ izpiši razlago besede *primarij*.

3. V *SSKJ* poišči besedo VRATA in razloži, kaj pomenijo besedne zveze v prenesenem pomenu.

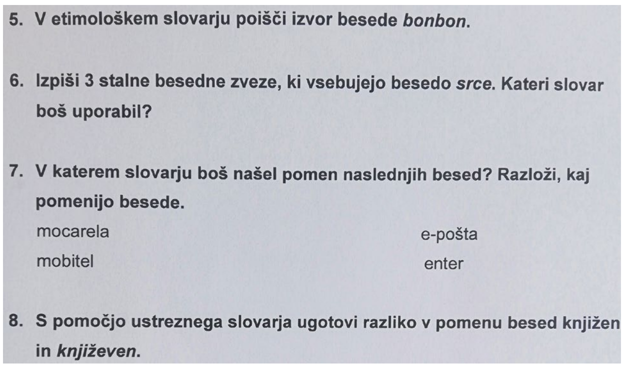
a) Pokazati komu vrata.
b) Trkati na vrata pravice.
c) Predlog je povsod naletel na zaprta vrata.

4. V *SSKJ* poišči besedo SLOVAR in odgovori na vprašanja.

a) Koliko pomenov ima beseda SLOVAR?
b) Kateri je prvi pomen besede SLOVAR?
c) V slovarskem sestavku poišči sopomenko za podčrtano besedo: Učenec ima bogat slovar.

Slika 4: Učni list, naloge 2–4

Sledi spoznavanje Etimološkega slovarja, Slovarja slovenskih frazemov in Slovarja novejšega slovenskega jezika. Učenci iščejo izvor besed, ki jih uporabljamo v slovenskem jeziku, pomene stalnih besednih zvez in pomene besed, ki so v slovenskem jeziku dokaj nove. Učence navajam k temu, da sami vedo, kateri slovar bodo uporabili (Slika 5).


5. V etimološkem slovarju poišči izvor besede *bonbon*.

6. Izpiši 3 stalne besedne zveze, ki vsebujejo besedo *srce*. Kateri slovar boš uporabil?

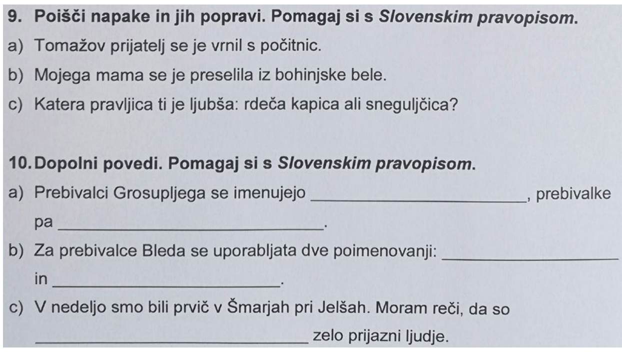
7. V katerem slovarju boš našel pomen naslednjih besed? Razloži, kaj pomenijo besede.

mocarela e-pošta
mobitel enter

8. S pomočjo ustreznega slovarja ugotovi razliko v pomenu besed *knjižen* in *književen*.

Slika 5: Učni list, naloge 5–8

Sledijo naloge, povezane s Slovenskim pravopisom, s katerim si učenci lahko pomagajo pri odpravljanju pravopisnih napak in ugotavljanju pravilnega zapisa težjih besed (Slika 6).


9. Poišči napake in jih popravi. Pomagaj si s *Slovenskim pravopisom*.

a) Tomažov prijatelj se je vrnil s počitnic.
b) Mojega mama se je preselila iz bohinjske bele.
c) Katera pravljica ti je ljubša: rdeča kapica ali sneguljčica?

10. Dopolni povedi. Pomagaj si s *Slovenskim pravopisom*.

a) Prebivalci Grosupljega se imenujejo ______________________, prebivalke pa __________________________.
b) Za prebivalce Bleda se uporabljata dve poimenovanji: _________________ in ______________________.
c) V nedeljo smo bili prvič v Šmarjah pri Jelšah. Moram reči, da so ___________________________ zelo prijazni ljudje.

Slika 6: Učni list, naloge 9–10

Za konec učencem predstavim spletno stran http://besana.amebis.si (Slika 7), kjer lahko s pomočjo avtomatske lektorice preverijo pravilnost zapisa ali si pomagajo pri pregibanju različnih besednih vrst (Slika 8).

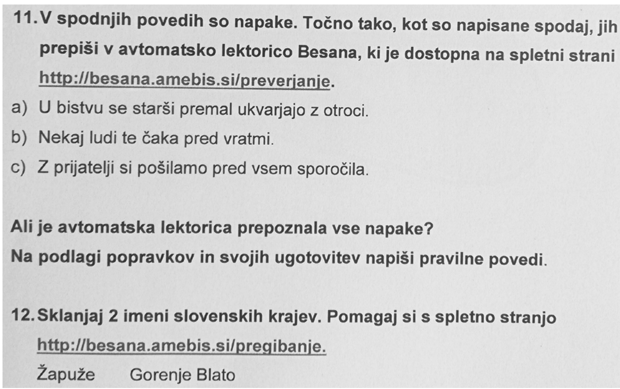

vrt

samostalnik
občno ime

moški spol

	ednina	dvojina	množina
imenovalnik	vrt	vrta vrtova	vrti vrtovi
rodilnik	vrta	vrtov	vrtov
dajalnik	vrtu	vrtoma vrtovoma	vrtom vrtovom
tožilnik	vrt	vrta vrtova	vrte vrtove
mestnik	vrtu	vrteh vrtovih	vrteh vrtovih
orodnik	vrtom	vrtoma vrtovoma	vrtmi vrtovi

Slika 7: Amebis Besana, pregibanje


11. V spodnjih povedih so napake. Točno tako, kot so napisane spodaj, jih prepiši v avtomatsko lektorico Besana, ki je dostopna na spletni strani http://besana.amebis.si/preverjanje.

a) U bistvu se starši premal ukvarjajo z otroci.
b) Nekaj ludi te čaka pred vratmi.
c) Z prijatelji si pošilamo pred vsem sporočila.

Ali je avtomatska lektorica prepoznala vse napake?
Na podlagi popravkov in svojih ugotovitev napiši pravilne povedi.

12. Sklanjaj 2 imeni slovenskih krajev. Pomagaj si s spletno stranjo http://besana.amebis.si/pregibanje.

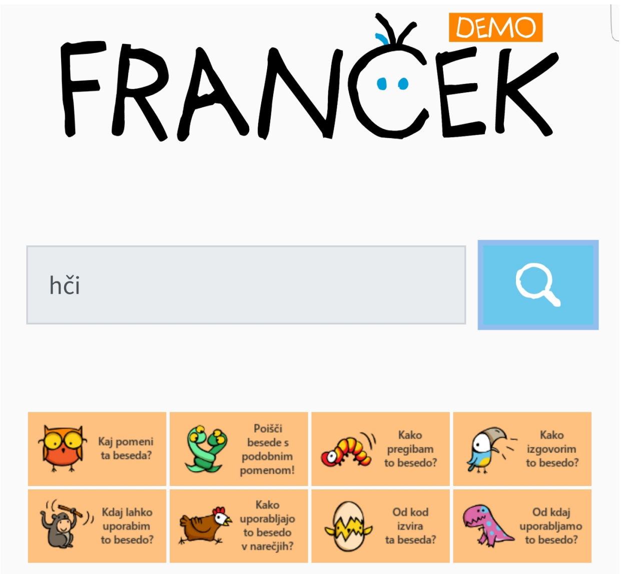
Žapuže Gorenje Blato

Slika 8: Učni list, naloge 11–12

3.3 Portal Franček

Na Inštitutu za slovenski jezik Frana Ramovša so šli še korak dlje. Ob 30. obletnici samostojnosti Republike Slovenije so objavili nov portal Franček (Slika 9), ki bo v končni obliki na voljo konec avgusta 2021. E-orodje bo prinašalo vsebine, posebej prilagojene vsaki od treh starostnih skupin učencev (prva in druga triada, tretje triada, srednja šola). Kot tako bo prvo celovito slovarsko-slovnično orodje te vrste na Slovenskem, ki bo neposredno uporabno pri izpolnjevanju osnovnih ciljev učnega narta za slovenščino v osnovni in srednji šoli. Učence in dijake bo uvajalo v delo s spletnimi slovarji in spletnimi slovničnimi priročniki.

Portal Franček bo obsegal odgovore na vprašanja o pomenu, rabi, pomenski povezanosti, (ne)zaznamovanosti, zvrstnosti, stilnih značilnostih, izgovoru, pregibanju, izvoru, narečni rabi in zgodovinski umeščenosti besedja slovenskega jezika. Poleg tega pa bo vseboval še orodje, ki bo povezalo slovarske vsebine s slovničnimi, jezikovno svetovalnico za učitelje slovenščine in nabor gradiv z opisom učnih metod, ki bodo pripomogle k obsežnejši uporabi predstavljenega e-orodja pri pripravi in izvajanju pedagoških procesov in k boljši usposobljenosti učiteljev za delo na področju prožnih oblik učenja. Na voljo bo tudi nov Šolski slovar slovenskega jezika [7].



Slika 9: Portal Franček

4 ZAKLJUČEK

Če primerjam učno uro o jezikovnih priročnikih v računalniški učilnici s tisto v razredu, ko lahko učitelj samo frontalno prikazuje vsebine na platnu, učenci pa doma sami brskajo po spletnem ali klasičnem slovarju, potem bi se vedno odločila za prvo. Učencem je taka izvedba všeč, radi imajo pouk, ki je drugačen in popestri, na tak način se urijo v uporabi elektronskih priročnikov, učitelj pa jih medtem lahko usmerja in jim pomaga. Najbolj štejejo prav praktične izkušnje in s tem lahko pripomoremo k uporabi jezikovnih priročnikov tudi v učenčevem kasnejšem obdobju. V prihodnje bo vredno preizkusiti nov portal Franček, ki je namenjen posebej učencem, in prinaša številna koristna orodja.

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Delo na daljavo in preverjanje znanja pri matematiki

Distance learning and checking progress at mathematics

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POVZETEK

Pri pouku na daljavo so zelo pomembni vidiki sprotno in končno preverjanje učenčevega znanja ter ustrezno podajanje povratne informacije. V šolskem letu 2019/20 se je šolanje na daljavo preselilo na splet praktično preko noči, v šolskem letu 2020/21 pa smo učitelji uspeli izpopolniti svoje znanje tudi na tem področju. V prispevku prikazujem nekaj možnosti preverjanja znanja preko spletnih aplikacij, ki so na voljo brezplačno, ter možnost uporabe le-teh pri matematiki. Vsi načini preverjanja znanja se ne morejo uporabljati v vseh situacijah. Pomembna je tudi povratna informacija, ki jo ob preverjanju znanja pridobi učenec s strani učitelja. Podajam tudi slabosti in prednosti, ki sem jih zaznala pri posameznih načinih preverjanja znanja, ter nakazujem možnosti, kje lahko svoje delo še izboljšam.

KLJUČNE BESEDE

Delo na daljavo, preverjanje znanja, povratna informacija

ABSTRACT

A very important aspect of distance learning is the ongoing and final examination of the student’s knowledge and the appropriate provision of feedback. In the school year 2019/2020 schooling was moved online practically overnight, and in 2020/2021 teachers managed to educate ourselves in this area as well. In this paper I present some possible ways of checking students’ progress through some applications, which are available for free, and the possibilities of using them at mathematics. Not all types of progress checks can be used in all situations. What is also important is the feedback the student receives from the teacher. I also talk about the advantages and disadvantages that I came across during my work, as well as the possibilities of further improving it.

KEY WORDS

Distance learning, progress check, feedback

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1 UVOD

Prav vsi učitelji smo se v preteklih dveh šolskih letih srečali z delom na daljavo, se na tem področju izobraževali in iskali najboljše rešitve pri podajanju učne snovi. Zelo pomemben vidik poučevanja predstavlja prejemanje povratne informacije s strani učencev, kar mi predstavlja dodaten vidik pri organizaciji nadaljnjega dela. Preverjanja znanja in pridobivanje informacij o doseženih ciljih je bilo potrebno vpeljati premišljeno, da le-ta niso bila prepogosta in da sem iz njih dobila dovolj ključnih informacij, ki so me vodile v proces načrtovanja. Sama sem skozi večmesečno delo uporabila različne načine za pridobivanje povratne informacije, nekateri načini so se mi zdeli še posebej zanimivi in jih bom vključila v sam proces izobraževanja tudi pri delu v šoli (ne le na daljavo).

2 OBRAVNAVA UČNE SNOVI PRI DELU NA DALJAVO

Pri samo obravnavi učne snovi na daljavo sem morala upoštevati več vidikov – od tehničnih možnosti, ki so jo imeli na voljo učenci doma, do same motiviranosti za delo. Pouk sem izvajala z vnaprej pripravljenimi posnetki, ki sem jih večinoma posnela sama ali pa smo si jih s kolegicami izmenjale, srečevanjem na Zoomih in samostojnim delom. Na posnetkih sem največkrat razlagala novo snov, na videosrečanjih, ki so potekala enkrat do dvakrat tedensko, smo v prvem delu skupaj vadili že razloženo snov, v drugem delu pa sem razložila krajše pravilo oziroma dodala težje primere. Tako sem zagotovila, da so učenci imeli možnost postaviti vprašanja ob nejasnostih razložene snovi. Pri samostojnem delu so učenci dobili navodila in novo snov obravnavali s pomočjo i-učbenika [6]. Sam potek dela in organizacijo pa sem usklajevala s pomočjo Arnesove spletne učilnice [7].

3 PREVERJANJE ZNANJA IN POVRATNA INFORMACIJA

3.1 Preverjanje znanja

Med procesom obravnave učne snovi je potrebno razumevano snov večkrat preveriti, pri delu na daljavo pa je bil ta vidik še toliko bolj pomemben, saj nisem imela možnosti opazovati učencev pri samem delu in razlagi snovi.

Učitelj preveri doseganje učnih ciljev pred obravnavo novih učnih vsebin, med samo obravnavo ter ob koncu obravnave učne snovi. Pomembno je, da se učencem nudi povratne informacije o uspešnosti učenja ter da se skupaj z njim išče razloge za morebitno slabše razumevanje ter načine za premagovanje vrzeli. Učenčevo predznanje lahko preverimo s pogovorom, kvizi, reševanjem nalog … Učitelj pa mora ob tem upoštevati, katere učne cilje, ki jih predvideva učni načrt, so oz. bodo lahko dosegli v času izobraževanja na daljavo [4].

3.2 Odziv učencev in učiteljev na povratne informacije

V svojem članku Eržen V. [1] povzema raziskavo Centra za raziskave in inovacije na področju izobraževanja, v kateri ugotavljajo, da učiteljeva povratna informacija na učence pomembno vpliva in je spodbudna, kadar:

- je pravočasna oz. izražena ob pravem času,
- izhaja iz jasnih ciljev in kriterijev uspešnosti,
- je konkretna in specifična ter
- vsebuje učiteljeve predloge, kako nadaljevati učenje ali izboljšati dosežek.

V raziskavi, ki jo je izvedla Žitko U. [2] so rezultati pokazali, da je učencem povratna informacija o opravljeni domači nalogi zelo koristna za analiziranje lastnih napak, saj so z analiziranjem lastnih napak lahko svoje znanje izboljšali. Večina učencev je povratno informacijo sprejela pozitivno. Učencem je bolj ustrezalo, če so povratno informacijo dobili zapisano, kot pa če jim je bila podana ustno. Pomembno pa je tudi, da učencu znamo napisati povratno informacijo tako, da jo razume in mu omogoči, da svoje napake lahko odpravi.

Na drugi strani pa učitelji menijo, da s pomočjo preverjanja znanja s povratno informacijo lahko pridobijo kakovostne informacije, ki so jim v pomoč pri načrtovanju nadaljnjega dela. Mnenje učiteljev v raziskavi je bilo, da preverjanja pozitivno vplivajo na boljše dosežke pri ocenjevanju znanja ter da s spodbudnimi besedami lahko učitelj motivira učence k boljšimi dosežkom [3].

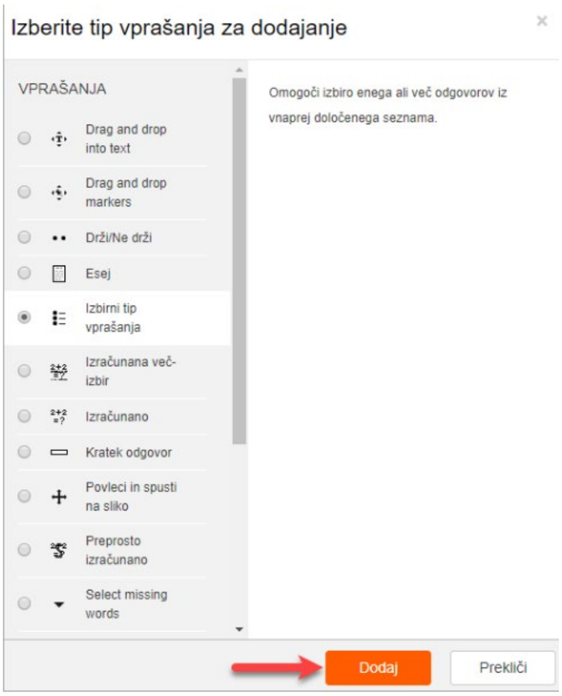
4 DELO NA DALJAVO IN POVRATNA INFORMACIJA

Pri delu na daljavo imamo kar nekaj možnosti za preverjanje znanja. V nadaljevanju predstavljam nekatere aplikacije, ki so nam na voljo, in kako sem jih sama uporabila pri delu. Podam tudi slabosti in prednosti, ki sem jih zaznala pri delu.

4.1 Kviz v spletnem učnem okolju Moodle

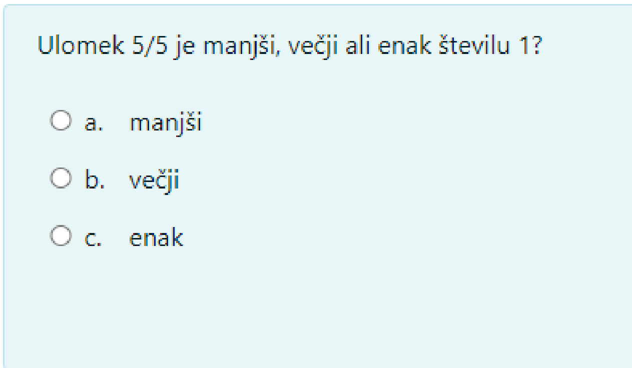
Ena izmed možnosti, ki se nam ponuja pri uporabi spletnih učilnic je prav gotovo oblikovanje Kviza v spletni učilnici Moodle [5]. Takega načina preverjanja znanja so se učitelji posluževali zelo pogosto. Tudi sama sem preizkusila ta način preverjanja.

Pri oblikovanju kviza imamo več možnosti nastavitev. Prvi sklop omogoča: kdaj je kviz učencem na voljo za reševanje, lahko nastavimo čas, ki ga ima učenec za reševanje kviza, oceno za uspešno opravljanje, dovoljeno število poskusov, način ocenjevanja. Lahko nastavljamo še druge parametre, ki določajo potek reševanja. Dodajanje vprašanj kviza zopet lahko poteka na več načinov, tudi pri vprašanjih imamo več možnosti izbir tipa vprašanj (Slika 1): povleci in spusti na sliko, povleci in spusti na besedilo, drži/ne drži, esejski tip, povezovalni tip vprašanj, izbirni tip vprašanja (omogoča izbiro enega ali več odgovorov iz vnaprej določenega seznama) …

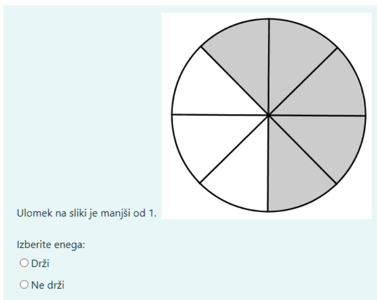


Slika 1: Izbira tipa vprašanja v Kvizu. Vir: https://sio.si/vodici/moodle/#_kviz

Naloge se učencem prikazujejo posamično (Slika 2, Slika 3).



Slika 2: Primer naloge – ulomki



Slika 3: Primer naloge – ulomki

Učenci po končanem preizkusu dobijo glede na nastavitve ustrezno povratno informacijo, ki jo je določil učitelj. Pogledajo lahko pravilnost rešenih nalog ter pravilne odgovore.

Učitelj pa lahko po reševanju pregleda seznam rešenih kvizov, kdaj in koliko časa je učenec reševal kviz ter uspešnost reševanja po nalogah (Slika 4).

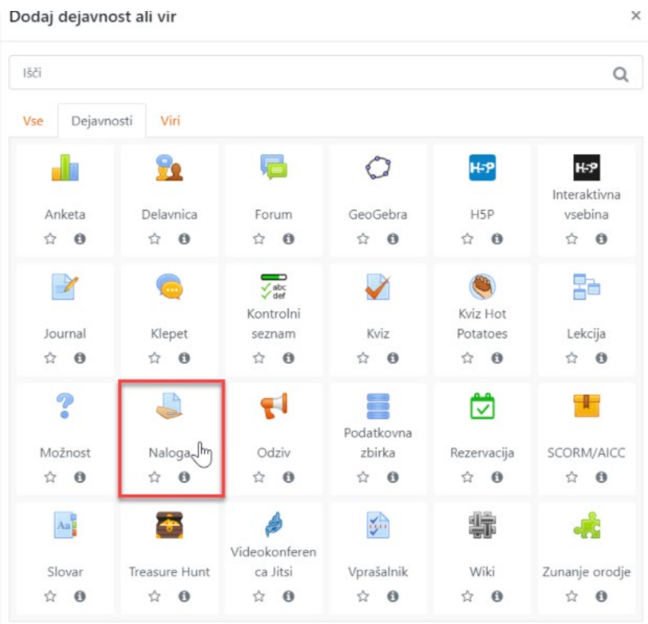
Slika 4: Poročilo o dosežku učenca

Tak način preverjanja znanja je zelo primeren za kratke odgovore, ki ne zahtevajo vmesnih postopkov, saj samo iz rezultatov ne vidimo postopkov reševanja in predhodnega razmišljanja učencev.

Dobra stran takega načina preverjanja je prav gotovo prihranek časa pri pregledovanju pravilno rešenih nalog. Učitelj se lahko osredotoči na tiste, ki so napačno rešene in poskuša ugotoviti, kaj mora učenec v dani nalogi izboljšati. Nekoliko bolj zamudno je samo sestavljanje kviza, saj je potrebno vsako vprašanje posebej ustavljati v kviz. Učencem lahko povratno informacijo posredujemo tudi preko sporočil. Kot pomanjkljivost pri takem načinu preverjanja se je pokazalo, da so nekateri učenci kviz rešili na hitro, saj sem ob pregledu ugotovila, da so ga nekateri rešili prej kot v minuti, kar pomeni, da so ga reševali, zgolj da je bil rešen.

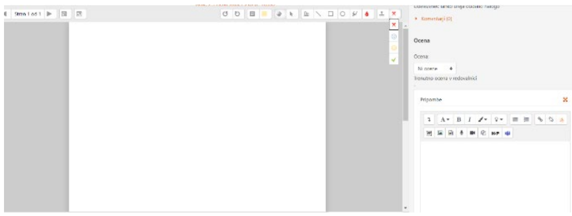
4.2 Možnost Naloga v spletni učilnici Moodle

Kot drugi način preverjanja znanja, ki sem se ga posluževala pri delu na daljavo, je bil oddaja naloge v spletni učilnici (Slika 5). Pri nastavitvi oddaje nalog imamo zopet na voljo več parametrov. Oddajo lahko časovno omejimo, omejimo število oddaj in nastavimo vrsto oddanih datotek.



Slika 5: Aktivnost za oddajo naloge v Moodlu
Vir: https://ucilnice.arnes.si/

Učitelj ima na voljo tudi nastavitve povratne informacije: zapisati komentarje v nalogo oziroma komentirati oddano nalogo kot celoto (Slika 6). Imamo tudi možnost uporabe popravnih znakov v nalogi. Tak način podajanja povratne informacije je s strani učitelja zelo zamuden, s strani učenca pa najbolj uporaben. Učitelj lahko učencu poda napotke za nadaljnje delo, ob morebitni napaki učenca usmeri v odpravljanje pomanjkljivosti, in to lahko stori ob vsaki posamezni nalogi posebej.



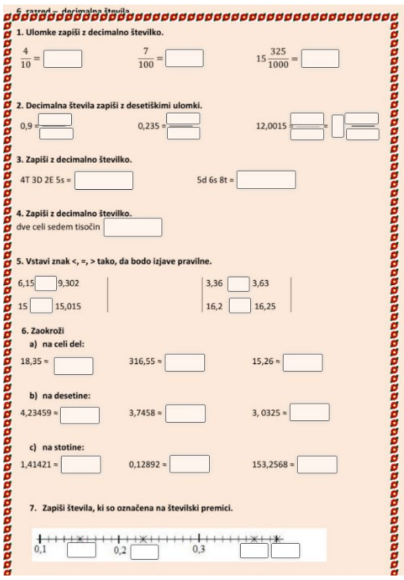
Slika 6: Podajanje povratne informacije

Pozitivna stran takega načina oddajanja preverjanja je prav gotovo kakovostna povratna informacija. Ker so morali na povratno informacijo počakati tudi kakšen dan, saj je bila količina oddanih nalog precejšnja in zame kar velik zalogaj za popravljanje in komentiranje, se je na koncu izkazalo, da večina učencev povratne informacije ni niti pogledala.

4.3 Liveworksheets

Tretja možnost preverjanja znanja, ki sem jo uporabljala pri delu na daljavo, je bila spletna aplikacija Liveworksheets [8]. Učitelji imamo pripravljenih precej učnih listov, ki jih pri delu v šoli s pridom uporabljamo. Že prej sem opisala, kako lahko uporabimo obstoječe naloge za preverjanja znanja, a mi je ta način bil zelo blizu. Uporabila sem lahko učne liste, ki sem jih že imela pripravljene za delo v šoli. Aplikacija Liveworksheets ponuja različne načine preverjanja znanja (izberi pravilno izbiro, poveži, dopolni …). Učni list v obliki pdf formata uvozimo v saplikacijo, dodamo elemente aktivnosti (kaj mora učenec narediti/izpolniti), aplikacija ponuja tudi druge možnosti nastavitve glede časa reševanja, objave učnega lista … Učni list lahko ohranimo zaseben ali pa ga javno podelimo z ostalimi učitelji. V tej aplikaciji lahko najdemo kar nekaj idej za preverjanje, ki so deljena v skupno rabo.

Učenci po reševanju učnega lista (Slika 7) pošljejo svoje odgovore s pomočjo aplikacije v učiteljev predal, kjer se zbirajo njihovi izdelki.



Slika 7: Preverjanje decimalnih števil

Vsekakor je prednost takega načina dela skrajšan čas priprave, saj lahko uporabimo že pripravljene učne liste, aplikacija pa tudi avtomatsko preveri pravilnost rezultatov, poda povratno informacijo v točkah, učenec pa lahko s pomikom na napačno rešeno polje (rdeče) vidi pravilen rezultat (Slika 8).

Slika 8: Povratna informacija učencu

Po končani oddaji sem vedno pregledala izdelke učencev. Ker so bili izdelki že pregledni s strani aplikacije, sem dokaj hitro zaznala napake, ki so jih učenci delali na preverjanju (ali je bila napaka lapsus ali pa je šlo za nepoznavanje obravnavane snovi). Trudila sem se, da sem ob vsakem takem preverjanju učencem tudi zapisala povratno informacijo v pisni obliki in jih spodbujala k nadaljnjem delu. Tudi pri tem preverjanju sem imela nekaj učencev, ki so oddali preverjanje prazno ali pa so vpisovali nelogične rešitve.

5 ZAKLJUČEK

Kljub delu na daljavo smo poskušala z učenci maksimalno usvojit učne cilje, ki smo si jih zadali pri načrtovanju dela. Povratna informacija je bila učencem in meni ključnega pomena. Zgoraj sem navedla nekaj primerov, ki sem jih sama uporabljala pri delu na daljavo. Vsak način je imel prednosti in slabosti, pri vsakem primeru sem se nekaj novega naučila.

Bistvo pri preverjanju je bilo, da dobim tako jaz kot tudi učenci čim boljši vpogled v obravnavo učne snovi in njihovo znanje ter da pri tem ne porabimo preveč časa, da lahko to počnemo kontinuirano tudi na dolgi rok. Sem se pa srečevala z učenci, ki so preverjanje reševali neresno ali pa ga sploh niso oddali.

Preverjanje znanja mi je bilo vodilo za nadaljnje delo na daljavo, sem pa s tem dobila tudi dovolj dober vpogled v učenčevo znanje in sem lahko na podlagi tega učence povabila na dodatno uro razlage oziroma na dopolnili pouk. V nadaljnje bom del preverjanj, ki sem jih izvajala na daljavo, prav gotovo uporabila tudi pri delu v šoli, saj so se izkazala za učinkovita tako za učence kot tudi za učitelja.

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[6] Iučbeniki. Spletno mesto interaktivnih učbenikov. Dostopno na naslovu https://eucbeniki.sio.si/ (1. 4. 2021)

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[8] Liveworksheets Dostopno na naslovu https://www.liveworksheets.com/ (1. 4. 2021)

Matematični učbenik Franca Močnika

Franc Močnik's mathematics textbook

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POVZETEK

V prispevku je predstavljen sklop učnih ur, ki so bile izvedene v času pouka na daljavo med epidemijo. V okviru medpredmetnega poučevanja pri matematiki in slovenščini z zgodovinskim ozadjem je bil aktualiziran učbenik avtorja dr. Franca Močnika z naslovom Aritmetika za učiteljišča, ki je bil izdan leta 1885. Močnik je pisal večinoma v nemškem jeziku, saj se je v takratnem času na našem ozemlju govorilo in pisalo pretežno v nemščini. Okrog 150 njegovih izvirnih del je bilo prevedenih v slovenski jezik in še v 12 drugih jezikov. S profesorico slovenščine Matejo Ceket Odar smo poučevale timsko v prvem letniku gimnazijskega programa. Dijakom je bil predstavljen jezik, v katerem je bil učbenik napisan. Obenem so spoznali, da se matematika skozi stoletja v bistvu ni spreminjala. Še več, ugotovili smo, da so Močnikove definicije in izreki popolnoma enakovredni tistim, ki so zapisani v sodobnih učbenikih.

KLJUČNE BESEDE

Dr. Franc Močnik, kriteriji deljivosti, matematični učbeniki, medpredmetna povezava

ABSTRACT

The article presents a set of lessons that were conducted during distance learning during the epidemic. As part of interdisciplinary teaching in mathematics and Slovene with a historical background, the textbook by dr. Franc Močnik with the title Arithmetic for Teachers (Aritmetika za učiteljišča), published back in 1885. At that time the majority of writings produced on the Slovenian territory were written in German language and so were a lot of Močnik's works. By now approximately 150 pieces of his original writings were translated into Slovenian and 12 other languages. With Slovene language teacher Mateja Ceket Odar, we decided for interdisciplinary course for students in the first year of the high school program. Students were introduced to the language in which the textbook was written. They realized also that mathematics has not changed a bit over the centuries and, even more, that Močnik's definitions and theorems are exact equivalents of the ones in contemporary textbooks.

KEYWORDS

Dr. Franc Močnik, criterion for divisibility, mathematics textbooks, interdisciplinary course

1 UVOD

Medpredmetno in timsko poučevanje učiteljem predstavlja velik izziv. Poleg iskanja idej za predstavitev snovi na drugačen, avtentičen način, je tovrsten pristop vsakič inovativen. Povezati se s predmeti, ki se zdijo sprva nezdružljivi in kjer se zdi, da je nemogoče poiskati skupni imenovalec zato zahteva podrobnejšo organizacijsko in dobro snovno pripravo.

Tokrat smo medpredmetno sodelovale učiteljice matematike, slovenščine ter zgodovine. V prvem letniku gimnazijskega programa je bila obravnavana tema kriteriji deljivosti s pomočjo matematičnega učbenika, ki je bil izdan leta 1885 avtorja dr. Franca Močnika. Z dijaki smo prevedli del razlage v sodelovanju s slavistko Matejo Ceket Odar v sodobno slovenščino. Ob tem smo se pogovorili o izrazih, ki so se pojavili v zapisu ter matematične pojme dokazali s pomočjo definicij in izrekov, ki smo jih spoznali pri pouku. Za razumevanje zgodovinskega ozadja časa, v katerem je živel in delal dr. Franc Močnik, je pri urah zgodovine poskrbela profesorica Metka Kolenc.

Dijaki so na ta način pridobili 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.

2 MEDPREDMETNO POUČEVANJE[1]

Med načeli in cilji posodabljanja učnih načrtov (Smernice, 2007) sta tudi povezovanje predmetov in disciplin ter holističnih pristop učenja in poučevanja. Martin-Kneip, Fiege in Soodak (1955) opredeljujejo medpredmetno povezovanje kot primer holističnega učenja in poučevanja, ki kaže realen interaktiven svet, njegovo kompleksnost, odpravlja meje med posameznimi disciplinami in podpira načelo, da je vse znanje povezano. Medpredmetno povezovanje ne pomeni le razvijanja konceptualnega povezovanja (povezovanje sorodnih pojmov pri različnih predmetih), ampak razvija pri učencih tudi generične veščine, ki so neodvisne od vsebine in so uporabne v različnih okoliščinah (npr. kritično mišljenje, obdelava podatkov, uporaba IKT…).

Dejavnosti, povezane z medpredmetnim povezovanjem, vodijo k doseganju kompleksnih znanj in h kompleksnim pričakovanim rezultatom. Medpredmetne povezave uresničujemo in izvajamo na različnih ravneh in z različnimi cilji:

a) Na ravni vsebin: obravnava oz. reševanje interdisciplinarnih problemov. Pri teh dejavnostih uporabljamo

[1]Povzeto po: Posodobitve pouka v gimnazijski praksi, 2010, Zavod Republike Slovenije za šolstvo.

specifična znanja posameznih disciplin in tudi generične veščine in spretnosti, ki predstavljajo aplikacijo specifičnega znanja na avtentične probleme.

b) Na ravni procesnih znanj: učenje in uporaba procesnih znanj (npr. iskanje virov, oblikovanje poročila ali miselnega vzorca, govorni nastop, delo v skupini,…).

c) Na konceptualni ravni: obravnava pojmov iz različnih predmetnih perspektiv z namenom poglabljanja in razumevanja (npr. naravna rast pri biologiji v povezavi z eksponentno funkcijo pri matematiki, eksponentno pojemanje v povezavi z upadanjem vrednosti dobrin na trgu idr.). Primeri naj bodo kot pomembni zgledi, ki so namenjeni razumevanje matematike in osmišljanju matematičnih vsebin.

Pri tovrstnih dejavnostih dijaki pridobivajo izkušnje in se učijo matematike ter tudi generičnih znanj, ki naj bi se v končni fazi kazala kot kompleksni pričakovani rezultati, kot npr., da dijaki:

- prepoznajo vlogo in pomen matematike in drugih disciplin v realnih situacijah in se učijo matematiziranja;
- uporabljajo matematiko v matematičnih kontekstih in v realnih situacijah,
- modelirajo, primerjajo modele ter rezultate različnih modelov in interpretirajo njihove rešitve z vidika matematike in realnih situacij idr.

Didaktični vidiki medpredmetnega povezovanja iz perspektive matematike:

- obravnavati matematične pojme iz različnih predmetnih perspektiv;
- prepoznati matematični kontekst v realnih situacijah in modelirati;
- reševati interdisciplinarne probleme in matematizirati;
- razvijati uporabo IKT kot možnosti za razvoj matematičnega znanja ter kot podporo pri učenju in poučevanju;
- razvijati generične veščine in spretnosti.

Z medpredmetnim sodelovanjem omogočimo, da zadane cilje dosežemo lažje, saj jih posamezen profesor v okviru svojega predmeta ne more doseči tako dobro in poglobljeno, kot kadar sodeluje s profesorjem drugega predmetnega področja. Tovrsten način dela poveča motivacijo, izboljša komunikacijo ter omogoča rast na profesionalnem področju, saj s tem sodelujoči razširi in poglobi lastno znanje. Dijakom je timsko poučevanje blizu, saj jim prisotnost dveh učiteljev omogoča sočasno podporo iz dveh predmetov ter bolj individualiziran pouk. Tudi navzoči pri taki uri so bolj dovzetni do sodelovalnega učenja ter dela po skupinah. Pri tem ima posameznik določeno nalogo in je hkrati za svoje delo odgovoren v svoji skupini. Bolje kot člani skupine sodelujejo, bolje, lažje in prej je delo opravljeno.

Pri izvedbi učnih ur smo del ur namenile skupinskemu delu 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. [2]

Delo v skupini je aktivno in živahno, ker vključuje postavljanje vprašanj, razlaganje, podajanje predlogov, kritiziranje, poslušanje, strinjanje, nestrinjanje, iskanje rešitev, usklajevanje in skupne odločitve. [3]

Pri poučevanju na daljavo je bila informacijsko komunikacijska tehnologija nenehno prisotna. In prav zaradi nenehnih impulzov sodobne tehnologije, ki je poleg prisotnosti na video srečanju, dijake begala in jih odvračala od poslušanja razlage, moramo profesorji dijakom omogočati, da so zato 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.

3 DEJAVNOST

3.1 Ideja in oblikovanje dejavnosti

Leta 2015 smo obeležili 200-letnico rojstva matematika, pedagoga in pisca matematičnih učbenikov dr. Franca Močnika. Takrat sva z zgodovinarko Metko Kolenc izvedli sklop medpredmetnih povezav med matematiko in zgodovino, pri čemer so pri zgodovini dijaki spoznali zgodovinsko ozadje časa v katerem je živel in deloval dr. Franc Močnik, pri matematiki pa smo skupaj pregledali eno od poglavij, ki ga obravnavamo v prvem letniku gimnazijskega programa. V letošnjem šolskem letu, ko je pouk pretežno potekal na daljavo, pa sem želela takratno izvedbo nadgraditi ter se povezati še s slovenščino. Tako je bilo izvedenih nekaj šolskih ur v sodelovanju s slavistko Matejo Ceket Odar. Skupaj sva načrtovali učne ure, določili vzgojno-izobraževalne cilje in metode dela. Pri tem sva se ravnali v skladu z učnim načrtom (Učni načrt. Matematika/slovenščina. Splošna, klasična in strokovna gimnazija, 2008). Priprave na učne ure je oblikovala vsaka sama, skupaj pa sva preučili ustrezno literaturo, vire in gradiva.

V Katalogu znanja za gimnazije je priporočena uporaba različnih oblik in metod dela ter je poudarjeno samostojno delo učencev [5, 6]. Dijaki naj bi pri samostojnem delu uporabljali različne vire in sodobno tehnologijo. Zato sva izvedbo zasnovali tako, da so dijaki pri urah bili samostojni in podajali svoje ideje ter kot posamezniki bili vključeni v skupinsko delo.

3.2 Cilji

Vključeni (pod)gradniki matematične pismenosti, s katerimi dijak:

- razume sporočila z matematično vsebino,
- pozna in uporablja strokovno terminologijo in simboliko,
- predstavi, utemelji in vrednoti lastne miselne procese,
- uporablja različne strategije pri reševanju matematičnih problemov.

Operativni cilji dejavnosti (vsebinski, procesni), pri katerih dijaki:

- utemeljijo in uporabljajo osnovne kriterije za deljivost,
- razberejo, primerjajo in uporabijo različne reprezentacije kriterijev za deljivost ter različne matematične simbolne zapise,
- komunicirajo v matematičnem jeziku,
- pri delu spretno uporabijo vire.

3.3 Načrtovanje dejavnosti

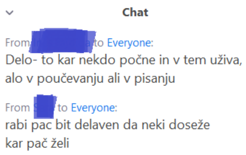
Načrtovanje dejavnosti se je začelo z uskladitvijo učnih ciljev in pripravo poteka učnih ur. Za izvedbo ur sva pripravili ustrezno gradivo v skupnem dokumentu. Pri posnetkih gradiv je sodeloval upokojeni učitelj slovenščine in pisec ljudskega izročila na ajdovskem Franc Černigoj. Preizkusili sva razdelitev udeležencev po skupinah preko videokonferenčne aplikacije Zoom, ki sva jo pri vseh urah uporabljali.

3.4 Izvedba dejavnosti

Izvedba ur je potekala na daljavo preko videokonferenčne aplikacije Zoom. Ker je poučevanje potekalo timsko, sva bili obe prijavljeni kot gostiteljici, da je bilo omogočeno preklapljanje med zaslonom, ki sva ga delili.

V uvodnem delu ure je dijakom na kratko predstavljeno življenje in delo dr. Franca Močnik. Povedano jim je bilo, da bo o tem več pojasnjenega pri uri zgodovine, kjer jim je profesorica Metka Kolenc pojasnila pomen njegovih del za nadaljnji razvoj slovenskega jezika ter delovanje posameznikov v takratni družbi.

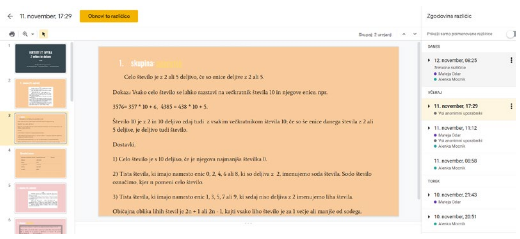
V začetku videokonferenčnega srečanja sva dijake prosili, da v klepet na Zoomu zapišejo pomen Močnikovega reka Virtute et opera = Z vrlino in delom (Slika 1). Posamezni dijaki so se pri tem oglasili ter pojasnili zapisano.



Slika 1: Zapisi v klepetu.

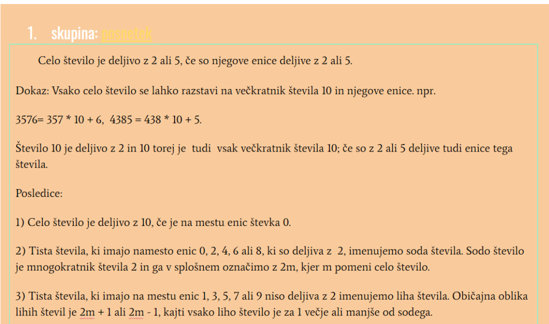
V nadaljevanju smo poslušali posnetek iz Močnikovega matematičnega učbenika. Posnetek je nastal v sodelovanju s Francem Černigojem. Pri tem je bil uporabljen programček diktafon, ki je prosto dostopen na prenosnem računalniku. Program omogoča preproste operacije za obdelavo zvoka.

Nato so bili dijaki razdeljeni po skupinah (delo po sobah v Zoom videokonferenci), kjer so prevajali posamezno poglavje v sodoben knjižni jezik. Zapisano besedilo je bilo deljeno v skupnem dokumentu (Slika 2), ki so ga lahko vsi sodelujoči sproti popravljali in dopolnjevali.



Slika 2: Besedilo pred popravki.

Skupaj smo pregledali prevedena poglavja ter se pogovorili o matematičnih pojmih ter po potrebi razložili, česar dijakom ni bilo razumljivo. Dijaki so bili opozorjeni na neustrezno uporabo strokovne terminologije.



1. skupina:

Celo število je deljivo z 2 ali 5, če so njegove enice deljive z 2 ali 5.

Dokaz: Vsako celo število se lahko razstavi na večkratnik števila 10 in njegove enice. npr.

3576= 357 * 10 + 6, 4385 = 438 * 10 + 5.

Število 10 je deljivo z 2 in 10 torej je tudi vsak večkratnik števila 10; če so z 2 ali 5 deljive tudi enice tega števila.

Posledice:

1) Celo število je deljivo z 10, če je na mestu enic števka 0.

2) Tista števila, ki imajo namesto enic 0, 2, 4, 6 ali 8, ki so deljiva z 2, imenujemo soda števila. Sodo število je mnogokratnik števila 2 in ga v splošnem označimo z 2m, kjer m pomeni celo število.

3) Tista števila, ki imajo na mestu enic 1, 3, 5, 7 ali 9 niso deljiva z 2 imenujemo liha števila. Običajna oblika lihih števil je 2m + 1 ali 2m - 1, kajti vsako liho število je za 1 večje ali manjše od sodega.

Slika 3: Ustrezno popravljeno besedilo.

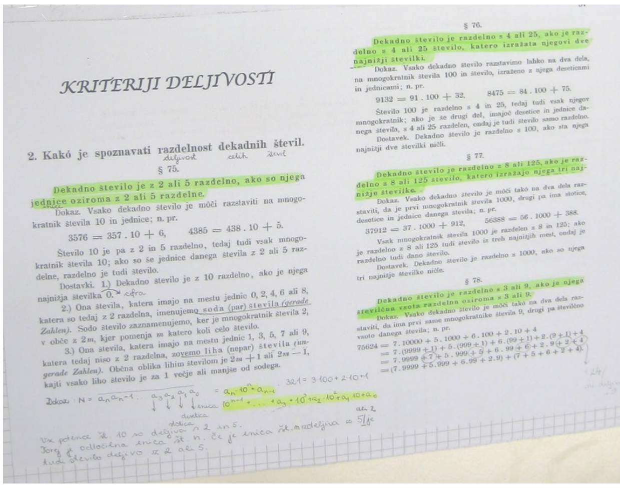
Vzporedno s prevodi je nastajal slovarček starinsko zaznamovanih izrazov (Slika 4).

Slovarček izrazov:

Starinsko zaznamovane besede	Sodobna ustreznica	Opomba
dekadno število	celo število	
jednice	enice	
ako	če	
razdelno	deljivo	
ondaj	takrat	
moči	mogoče	
tri najmanjše števke	je njegov trimestni konec deljiv	

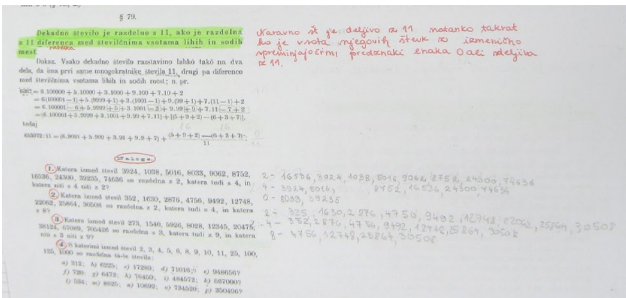
Slika 4: Slovarček izrazov.

Pri dokazih nekaterih izrekov, ki so se pojavili v posameznih odsekih besedila, je bil deljen zaslon tabličnega računalnika. Sproti so si dijaki zapisali snov na učni list (Slika 5), ki jim je bil predhodno posredovan, da so si ga lahko natisnili doma pred izvedbo učne ure.



Slika 5: Zapisi v zvezku.

Dijaki so reševali naloge na učnem listu ali samostojno ali v skupinah (Slika 6). Rešitve nalog smo preverili ali ustno ali pa so dijaki narekovali postopek reševanja. Profesor je pri tem spremlja samostojno delo dijakov. Po potrebi jim je bila snov dodatno razložena s pomočjo deljenja zaslona na tabličnem računalniku.



Slika 6: Reševanje nalog v zvezku.

Ure medpredmetnega poučevanja so bile zaključene z zgodovino slovenskega knjižnega jezika v 2. polovici 19. stoletja.

4 EVALVACIJA UDELEŽENCEV

Po zaključku dela sva z dijaki opravili evalvacijo v aplikaciji Padlet (Slika 7). Odgovorili so na sledeča vprašanja:

1. Kaj si se pri uri novega naučil-a?
2. Kaj ti je povzročalo največ težav? Kaj bi naredil-a drugače?
3. Kaj ti je bilo všeč?
4. Želiš še kaj dodati?

Dijaki so izrazili pozitivno mnenje o obravnavani snovi in načinu dela. Zapomnili so si, kako pomembno je bilo 19. stoletje za oblikovanje slovenskega naroda ter pomen izobrazbe za razvoj in krepitev narodne zavesti. Drugačen potek učnih ur jim je bil všeč in zanimiv tudi zaradi jezika, ki je bil v učbeniku uporabljen.

Največ težav jim je povzročalo razumevanje besedila iz Močnikovega učbenika, saj niso poznali vseh izrazov.

Pogrešajo več takih ur in tem, saj jim tak način dela omogoča večjo aktivnost med poukom ter prisotnost dveh profesorjev, ki se medsebojno dopolnjujeta, torej je vseskozi prisotno tudi timsko poučevanje. Zelo pomembna je aktualizacija teme, saj jo tako dijakom približamo. Dijaki se na ta način lažje vživijo v takratni način življenja in ga primerjajo s sodobnim ter razumejo vpliv nekega zgodovinskega pojava na nadaljnji razvoj. Obenem so spoznali, da se matematika skozi stoletja ni spreminjala. Še več, ugotovili smo, da so Močnikove definicije in izreki popolnoma enakovredni tistim, ki so zapisani v sodobnih učbenikih.

Slika 7: Evalvacija.

5 ZAKLJUČEK

Snov je bila obdelana medpredmetno, in sicer pri slovenščini, kjer so dijaki prevedli izbrane odlomke v sodoben knjižni jezik, pri uri zgodovine, kjer so dijaki spoznali zgodovinsko ozadje časa v katerem je živel dr. Franc Močnik ter pri uri matematike, kjer smo del snovi obdelali po njegovem učbeniku , ki je bil zapisan pred več kot 200 leti. Medpredmetne povezave so aktivna oblika pouka, ki dijakom omogoča pridobivanje vseživljenjskih znanj. Priprava na pouk in sama izvedba je potekala na vsebinsko – metodični in organizacijski ravni. Metodična raven je zajemala ustrezen izbor vsebin, ciljev in metod, organizacijska pa ustrezno časovno usklajevanje in skupno načrtovanje profesoric.

Dijaki so spoznali, da se obravnavana snov pri slovenščini ter zgodovinske vsebine lahko uporabijo tudi pri matematiki, in obratno. Značilnost medpredmetnega poučevanja je tudi ta, da je znanje dijakov trajnejše in jih usmerja h kritičnemu reševanju problemov.

Zavedava se, da bi bilo v šolskem letu potrebno opraviti več takih medpredmetnih povezav, vendar smo profesorji omejeni s številom ur in vsebinami pri posameznih predmetih, kjer snovi niso časovno usklajene in se ne obravnavajo v istem obdobju ali celo v istem letniku.

Obravnava učne snovi s pomočjo didaktičnega pristopa timskega in medpredmetnega poučevanja se je izkazala kot dobra, ker so dijaki s tem razširili svoje znanje in uvideli uporabnost znanja zgodovine z uporabo avtentičnega pisnega gradiva v vsakdanjem življenju.

Tako zasnovan pouk je odlična izbira za poglabljanje učnih tem. Dijaki nas velikokrat sprašujejo, kje bodo to znanje potrebovali. Spoznali so, da lahko pridobljena znanja uporabijo, v kolikor se srečajo s starejšim gradivom, kjer je medpredmetno poznavanje vsebin še kako potrebno.

Načrtovanje medpredmetnega in timskega poučevanja je sicer za profesorje zahtevnejše in časovno daljše, saj je potrebne več priprave kot pri običajnem pouku, so pa zato rezultati toliko boljši in znanje trajnejše.

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Uporaba aplikacije Genially v 2. razredu osnovne šole

The use of application Genially in 2nd grade of elementary school.

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POVZETEK

V času šolanja na daljavo smo učitelji ves čas iskali drugačne načine poučevanja v veliki želji, da bi se čim bolj približali učencem in jih hkrati uspešno pripeljali do usvojenih znanj na koncu šolskega leta. Pri tem smo se močno oprli tudi na sodobno tehnologijo. Informacijsko-komunikacijska tehnologija je danes dostopna skoraj vsakomur in je postala (sploh v času šolanja na daljavo) nepogrešljiv pripomoček v vzgojnem-izobraževalnem procesu.

V prispevku je predstavljeno interaktivno orodje Genially, saj se je izkazalo kot eden najbolj uporabnih pripomočkov, ki nam ponuja kar nekaj možnosti za ustvarjanje. Lahko uporabimo »klasično« predstavitev, infografiko, igrifikacijo, interaktivno sliko, videoposnetke itd. Predstavljenih je nekaj primerov, ki so bili uporabljeni v času šolanja na daljavo v drugem razredu osnovne šole. Primeri so razporejeni glede na to, v katerem delu učne ure jih lahko izvedemo: uvodnem, osrednjem ali zaključnem delu. Dodan je še primer interaktivne slike, ki je bila izdelana za popestritev učne ure.

Pri redni uporabi aplikacije Geniallya vedno znova ugotavljamo, da je aplikacija odlično motivacijsko orodje, saj se učenci pri njeni uporabi zabavajo in hkrati naučijo veliko novega.

KLJUČNE BESEDE

Aplikacija Genially, IKT, interaktivno, orodje, učenci, šola na daljavo

ABSTRACT

During distance learning, teachers are constantly looking for different ways of teaching in a great desire to get as close as possible to students and at the same time successfully bring them to the acquired knowledge at the end of the school year. They also relied heavily on modern technology. Today, information and communication technology is accessible to almost everyone and has become (especially during distance learning) an indispensable tool in the educational process.

The article presents the interactive tool Genially, as it has been selected as one of the most useful accessory, offering us some options for creating. You can use a »classic« presentation, infographic, gamification, interactive images, videos, etc. Some examples that were used during distance learning in second grade of primary school are presented. Examples are arranged according to which part of the lesson they can carried out: introductory, main or final part. An example of interactive images has been added, which was designed to diversify the lesson.

With regular use of Genially, we always find that the app is a graet motivational tool, as students have fun using it and learn a lot of new things at the same time.

KEYWORDS

Application Genially, ICT, interactive, tools, pupils, distance learning

1 UVOD

Informacijsko-komunikacijska tehnologija (IKT) se je v šolstvo postopoma uvajala že kar nekaj let. V trenutnih razmerah koronavirusa pa marsikomu dano znanje ni več zadoščalo, saj so se v procesu izobraževanja pojavile zahteve po hitrih spremembah oz. prilagoditvah za lažjo izvedbo učenja na daljavo. Pri tem smo si učitelji pomagali z različnimi programi, ki so omogočili poučevanje z različnimi interaktivnimi učnimi vsebinami.

Z uporabo IKT-ja je pouk bolj dinamičen, zanimiv, raznolik … Učitelje spodbuja k izboljšanju poučevanja v razredu, saj s sliko, videom, zvokom in z različnimi animacijami bolj pritegnejo pozornost učencev pri šolskem delu.

Med IKT-tehnologijo sodi tudi aplikacija Genially, ki je za učence lahko dober motivacijski element pri učenju različnih vsebin, učitelju pa program omogoča drugačen način podajanja teoretičnih snovi, preverjanja ter utrjevanja znanja. Z njo smo si v času šolanja na daljavo močno olajšali delo.

2 INFORMACIJSKO-KOMUNIKACIJSKA TEHNOLOGIJA (IKT)

Živimo v obdobju, ko družbene, gospodarske, izobraževalne in vzgojne potrebe zahtevajo prisotnost tehnologije. Danes se računalniki in druga informacijska tehnologija uporabljajo v vseh delovnih okoljih in na vseh področjih [1].

Informacijsko-komunikacijska tehnologija (v nadaljevanju IKT) je skupen izraz različnih računalniških, informacijskih in komunikacijskih naprav, ki so postale naš vsakdanji spremljevalec [2]. Najbolj nepogrešljiv pripomoček pa je zagotovo postala v času šolanja na daljavo.

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Uporaba IKT ima v procesu učenja kar nekaj prednosti:

- izboljšanje informacijske pismenosti,
- povečanje storilnosti učiteljev,
- izboljšanje dostopa do informacij,
- motiviranje učencev,
- podpora sodobnim pedagoškim pristopom [3].

Zelo je pomembno, da nas pri izbiri IKT-ja vodi učni cilj, ki ga želimo doseči, predznanje učencev, njihovi interesi ter starost otroka. Osredotočeni moramo biti tudi na to, da je program pri pedagoški uri uporaben, kakovosten in za učence čim bolj zanimiv.

Učitelj si mora pred uporabo novega orodja zastaviti naslednja vprašanja:

- kako bo orodje pripomoglo k uresničevanju učnih ciljev,
- kakšne funkcije ponuja orodje,
- kako ob njegovi uporabi spremljati sodelovanje in napredek učencev,
- kako poiskati ustrezne in prilagojene naloge,
- kakšni so interesi učencev in prednosti uporabe [4].

Predstavljeno interaktivno orodje Genially je zagotovo eno izmed tistih, ki tem ciljem in postavljenim vprašanjem zelo dobro sledi.

2 KAJ JE GENIALLY?

Na spletni strani Genially je navedeno, da je Genially interaktivno izobraževalno orodje za učenje in poučevanje [5].

Aplikacija nam ponuja različne možnosti pri ustvarjanju:

- Predstavitev. Nanizanih je ogromno predlogov, ki vsebujejo različne teme. Izbrani predlog lahko potem po svoje dopolnjujemo oz. oblikujemo.
- Infografika. Vizualno predstavitev podatkov in informacij prikazuje na način, da si jih hitreje zapomnimo in tudi lažje razumemo.
- Igrifikacija. Genially lahko uporabimo tudi za ustvarjanje interaktivnih iger od kvizov do sob pobega. Igre so popestrene z različnimi animacijskimi vložki.
- Interaktivna slika. Slika nam služi za ozadje. Z interaktivnimi gumbi lahko dodamo besedilo, glasbo, video itd.
- Videopredstavitve. Z aplikacijo Genially lahko ustvarimo videoposnetek z različnimi animacijskimi vložki.
- Interaktivni digitalni vodnik. Ustvarjamo zanimive interaktivne in animirane vodnike.
- Ostala interaktivna gradiva za ustvarjanje [6].

Genially je preprosto in zanimivo motivacijsko orodje za učence. Učitelji ga uporabljamo za uvodno motivacijo, samostojno delo, usvajanje nove snovi, ponavljanje in utrjevanje ali pa le za popestritev pouka.

3 KAKO ZAČETI?

Najprej obiščemo spletno stran https://genial.ly, kjer se prijavimo in ustvarimo svoj račun. Nato kliknemo na “create genially”. Na tej strani se odprejo različne možnosti, ki jih Genially ponuja (predstavitve, infografika, igrifikacija …). Vsaka izbrana možnost nam ob kliku ponuja veliko idej, med katerimi lahko izbiramo. Naša naloge je le še, da se odločimo za eno, ki nas najbolj zanima, in začnemo ustvarjati.

Ne glede na to, kaj izberemo, pa lahko pri vsaki izbrani predstavitvi z lastno vneseno vsebino po želji menjamo barve, spreminjamo sličice, po svoje oblikujemo zapise, dodajamo interaktivne gumbe, glasbo ali videoposnetke.

4 UPORABA APLIKACIJE GENIALLY PRI POUKU

Pred pričetkom dela je smiselno preveriti znanje učenca (v drugem razredu OŠ tudi staršev) o uporabi aplikacije. Šele ko dobimo vpogled, kakšna je situacija pri posameznem učencu, lahko načrtujemo izvedbo pouka. Pri samostojnem delu je pomembno, da podamo jasna, konkretna navodila in da učence vodimo pri njihovem delu na način, da sprotno preverjamo njihovo delo in jim dajemo redne povratne informacije, ki bodo učencu omogočale napredovanje po njihovih zmožnostih [7].

Predstavljeni so raznoliki primeri v drugem razredu OŠ, ki jih lahko uporabimo pri uvodnem, glavnem in zaključnem delu pedagoške ure. Dodan je tudi primer za popestritev ure kar tako.

4.1 Uvodni del ure

Učna tema: Vrste koledarjev
Učni cilj:

- učenec spozna različne vrste koledarjev.

Slika 1: Vrste koledarjev

Aplikacija Genially je bila uporabljena kot videoposnetek pri uvodni motivaciji**.** V predstavitev je vključenih veliko fotografij različnih koledarjev. Ob ogledu videoposnetka učence na zanimiv način popelje v novo snov o koledarjih.

Povezava:
https://view.genial.ly/610677986fd52b0ddcd8856e/video-presentation-genial-videopresentation

4.2 Osrednji del ure

4.2.1 Primer 1

Učna tema: Učenje nove pesmi
Učna cilja:

- učenec samostojno in doživeto poje ljudsko pesem,
- poje doživeto, upošteva glasno, tiho in počasnejše, hitrejše izvajanje.

Slika 2: Marko skače

V predstavitvi so poleg besedila dodane atraktivne slike, videoposnetek pesmi ter spletni program Song Maker, s pomočjo katerega so učenci lahko sledili melodiji in hitrosti tempa.

Učenci so se po predstavitvi z interaktivnimi puščicami sami premikali naprej. Na zadnji strani so se s puščico lahko vrnili na začetek in pesem po potrebi ponovili.

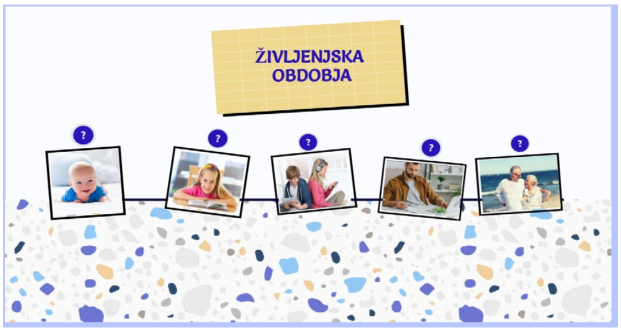
Povezava: https://view.genial.ly/5ffc258c1ac90d0d0daf6fd7/presentation-marko-skace

4.2.2 Primer 2

Učna tema: Življenjska obdobja

Učna cilja:

- učenec se seznani z različnim življenjskim obdobjem ter usvoji nove pojme: dojenček, otroštvo, mladost …,
- časovno opredeljuje in pojasnjuje dogodke in spremembe v različnih življenjskih obdobjih.



Slika 3: Življenjska obdobja

Časovnica je bila uporabljena za temo življenjska obdobja kot osrednji del ure. Vsako sličico so učenci poimenovali, odgovor pa preverili s klikom na interaktivni gumb, ki je pripet nad vsako fotografijo.

Ta primer bi lahko uporabili tudi kot motivacijski uvodni del ure ali kot ponovitev teme pri zaključnem delu.

Povezava: https://view.genial.ly/610bfb502ac9b70dad1ea97b/interactive-content-terrazzo-timeline

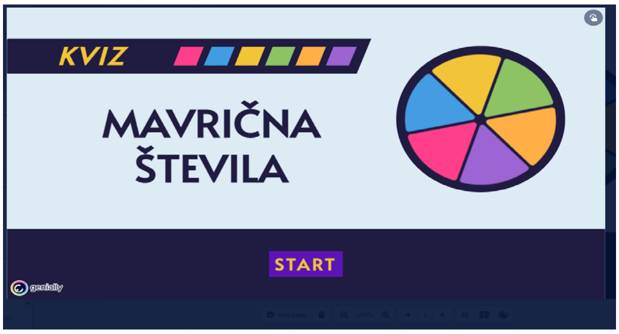
4.3 Zaključni del ure

Primer 1

Učna tema: Naravna števila do 100

Učni cilji:

- učenec šteje in bere števila do 100,
- razlikuje desetiške enote in razume odnose med njimi (enice, desetice in stotice),
- določi predhodnik in naslednik danega števila,
- oblikuje in nadaljuje zaporedja števil.



Slika 4: Mavrična števila

Kviz lahko uporabimo za ponavljanje in utrjevanje snovi.

Učenec mora med tremi odgovori izbrati pravega. Če izbere pravilno, ga kviz za večjo motivacijo nagradi z zanimivo interaktivno sliko (nekaj predlogov program ponudi že sam). Vsako vprašanje ima tudi svojo barvo (na levi strani utripa kvadratek z določeno bravo). Kviz je končan, ko se zamenjajo vse barve, temu primerno je izbran tudi naslov kviza Mavrična števila.

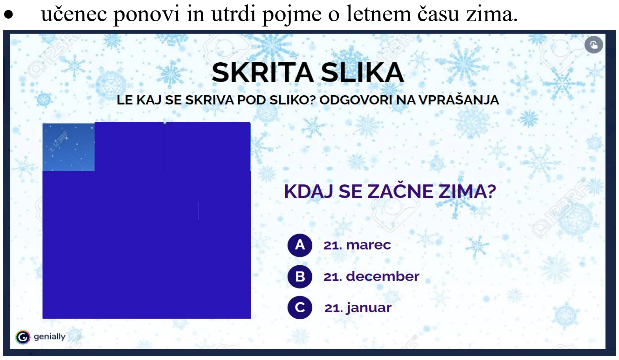
Povezava: https://view.genial.ly/606d7b3158a44c0d6370fc5f/interactive-content-stevila-do-100

Primer 2

Učna tema: Letni čas zima

Učni cilj:

- učenec ponovi in utrdi pojme o letnem času zima.



Slika 5: Skrita slika

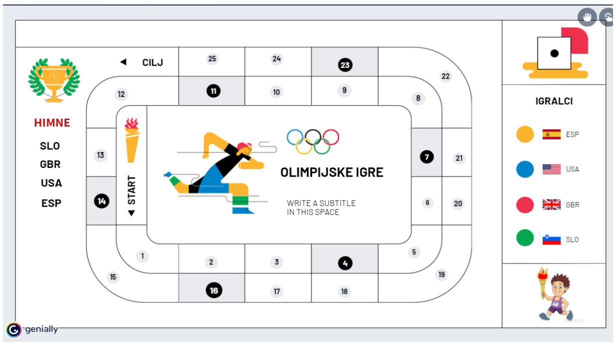
Tudi pri tem kvizu učenci med tremi odgovori izberejo pravega. Z vsakim pravilnim odgovorom se na levi strani odkrije del slike. Na koncu kviza so nagrajeni z zanimivo sliko o izbrani tematiki.

S kvizom so temeljito obnovili znanje o letnem času zima.

Povezava: https://view.genial.ly/5fdcb49c60e6a00cfc74c12c/learning-experience-challenges-zima

Primer 3
Učna tema: Usvajanje različnih naravnih oblik gibanja, iger in športnih znanj.
Učni cilji:

- učenec sproščeno izvaja naravne oblike gibanja;
- izboljšuje gibalne in funkcionalne sposobnosti: skladnost (koordinacijo) gibanja, moč, hitrost, gibljivost, natančnost, ravnotežje, splošno vzdržljivost;
- oblikuje pozitivne vedenjske vzorce (strpno in prijateljsko vedenje v skupini, upoštevanje pravil v igrah in športnega obnašanja, odgovorno ravnanje s športno opremo, odgovoren odnos do narave in okolja).



Slika 6: Olimpijske igre

V aplikaciji je že bila dana predloga tekmovalne steze, kjer se odvijajo olimpijske igre. Dodana je bila država Slovenija in himne držav, ki tekmujejo. V desnem zgornjem kotu je bila tudi že postavljena interaktivna kocka, ki se ob kliku sama zavrti. Tekmovalci izberejo državo, ki jo želijo zastopati, in se z izbrano barvo razporedijo pred startom. Če tekmovalec pride na črno (interaktivno) število, dobi ob kliku športno nalogo, ki jo mora opraviti pred nadaljevanjem igre. Zmaga tisti igralec, ki prvi pride do cilja. Na cilju je njegova zmaga nagrajena s himno države, ki jo je zastopal.

Povezava: https://view.genial.ly/6106f22f1a3eec0dd59f5966/interactive-content-untitled-genially

4.4 Del ure za popestritev

Primer 1
Učna tema: Voščimo
Učna cilja:

- učenec ve, da imajo nekateri dnevi v letu (prazniki) poseben pomen, in pozna poseben pomen različnih praznovanj,
- ob praznikih ustrezno vošči.

Interaktivna slika je bila uporabljena za novoletne želje. Najprej izberemo sliko za ozadje, nato pa poljubno nanizamo interaktivne gumbe. Učenci so se ob klikih zabavali z nenavadnimi, smešnimi fotografijami učiteljice, ki jim na različne načine vošči ob prazniku. Fotografije so bile posnete s pametnim telefonom s programom YouCamFun.

Povezava: https://view.genial.ly/5fe33ae56157fe0d6919263d/interactive-image-praznicne-zelje

Slika 7: Praznične želje

5 ZAKLJUČEK

V prispevku sem nanizala le nekaj idej, ki jih lahko uporabimo z aplikacijo Genially. Želela sem prikazati različne načine uporabe pri pouku v drugem razredu osnovne šole. Vsi predstavljeni programi so bili s strani tako učencev kot staršev zelo dobro sprejeti.

V času šolanja na daljavo pa to ni bil edini način posredovanja znanja – za poučevanje sem uporabila tudi drugačne pristope. Je pa aplikacija Genially zagotovo ena izmed boljših za motiviranje učencev. Pomembno je poudariti, da s takim načinom poučevanja tudi rezultati niso izostali, preverjanja znanja na koncu šolskega leta so bila precej uspešna.

ZAHVALA

Posebna zahvala gre hčerki Gaji, saj mi je bila v času šolanja na daljavo v veliko pomoč pri usvajanju osnovnih znanj pri uporabi IKT-ja.

Zahvalila bi se tudi aktivu učiteljic drugega razreda na OŠ n. h. Maksa Pečarja. Med seboj smo ves čas sodelovale, se bodrile in si močno pomagale v času, ki je bil za vse nas precej nov in nenavaden.

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Varna raba spleta za učence z učnimi težavami

Safe use of the internet for students with learning difficulties

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POVZETEK

Uporaba svetovnega spleta je med uporabniki v zadnjih letih močno narasla, še posebej med mladimi. Ti so med najbolj dovzetnimi za novosti na tehničnem in družbenem področju. S pametnimi mobilnimi napravi, ki so v zadnjih letih postale tudi dokaj cenovno dostopne, se je uporaba svetovnega spleta močno povečala. Velik delež tega predstavljajo družabna omrežja, igranje videoiger, objavljanje lastnih fotografij, posnetkov in drugih informacij. Mladi pogosto s premalo znanja in veščinami (ne)kritično uporabljajo različne aplikacije, komunikacijo preko družabnih omrežij, izmenjavanje in objavljanje posnetkov, fotografij in drugih podatkov. Pogosto ne znajo ločevati med resničnimi ali lažnimi identitetami sogovornikov, ki jih skušajo na različne načine izkoriščati za negativna dejanja. Učenci s slabšimi kognitivnimi sposobnostmi in učnimi težavami imajo tudi slabšo splošno poučenost in vedenje o uporabi pametnih mobilnih naprav in predvsem spleta. S tem postajajo dokaj lahka skupina za spletne prevarante, saj ne poznajo njihovih oblik in načinov dela. Za varno rabo spleta je zato ključno, da se otroke z učnimi težavami pravočasno izobražuje o tej tematiki. S pomočjo učiteljev, staršev in strokovnjakov se bodo tako uspešno zaščitili pri svojem delu s spletom in postali pozorni na elemente varne rabe spleta.

KLJUČNE BESEDE

Informacijska tehnologija, učenci z učnimi težavami, varna uporaba spleta

ABSTRACT

The use of the Internet has risen sharply among users in recent years, especially among young people. These are the most susceptible to technical and social innovations. With smart mobile devices having become quite affordable in recent years, the use of the World Wide Web has increased dramatically. A large part of this are social networks, playing video games, posting photos, videos and other information. Young people with insufficient knowledge and skills often (un) critically use various applications, communicate via social networks, share and publish recordings, photos and other data. They often do not know how to distinguish between true or false identities of their interlocutors, who try to exploit them in various ways for negative actions. Pupils with lower cognitive abilities and learning difficulties also have poorer general education and knowledge about the use of smart mobile devices and especially the Web. This makes them a fairly susceptible group for online scammers as they do not know their forms and ways of working. Educating children with learning disabilities about the safe use of the web in a timely manner is therefore crucial. With the help of teachers, parents and professionals, they will be able to successfully protect themselves in their work with the Internet and become aware of the elements of safe use of the Internet.

KEYWORDS

Information technology, students with learning difficulties, safe use of the Internet

1 UVOD

Pridobivanje informacij je z razširitvijo svetovnega spleta postalo vsakdanje in dokaj preprosto. Pri tem ljudje uporabljajo različne pametne naprave – računalnike, tablice, igralne konzole in pametne mobilne telefone. Vsaka naprava od njih zahteva določeno stopnjo znanja za njeno varno uporabo. Mnoga podjetja najdejo tržno nišo ravno med mladimi, ki pogosto spremljajo nove tehnične izdelke in jih nato kupujejo. Množičen porast pametnih mobilnih naprav je prispeval tudi k množični uporabi spleta, pri tem se porajajo različni vidiki pravilne in varne uporabe. Mladi običajno dokaj hitro osvajajo nove aplikacije in spletne novosti, a se pogosto premalo zavedajo celovitosti (prekomerne) uporabe omenjenih tehnologij. Ena izmed teh je tudi varnost in varna uporaba osebnih podatkov pri delovanju na spletu s pametnimi mobilnimi napravami. Učenci z učnimi težavami so še posebej ranljiva skupina, saj imajo premalo znanja o celovitem delovanju in varnosti pri uporabi spleta in pametnih mobilnih naprav, kar jih lahko nehote sooča z negativnimi posledicami.

2 INFORMACIJSKA TEHNOLOGIJA V VZGOJI IN IZOBRAŽEVANJU

Informacijska tehnologija je v nekaj desetletjih močno zaznamovala naše življenje na vseh ravneh, saj je v procesih vzgoje in izobraževanja zelo pomembna z vidika omogočanja kvalitetne in učinkovite podpore pri pouku. Tovrstna tehnologija je postala finančno dostopna za široko uporabo, njeno uvajanje v izobraževalne vsebine in učne načrte kot del načrtov v šolah pri različnih evropskih državah [1]. Z omenjeno tehnologijo učenci, pedagoški delavci in ostali strokovnjaki uporabljajo gradivo na

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spletu, ga urejajo, objavljajo in delijo s širšo družbo. Veliko informacij zahteva tudi, da se nauči tovrstne informacije ločevati, ovrednotiti in jim zaupati. Pri tem je potrebno pokazati dovolj znanja in veščin, da se nauči postati informacijsko opismenjen, saj lahko v nasprotnem primeru pride do informacij, ki so nezanesljive, napačne ali težko preverljive [10].

Pri pouku je tovrsten način še posebej pomemben, saj morajo mladi v procesu pridobivanja znanja pridobiti veščine za pravilno uporabo informacijske tehnologije. V zadnjih letih so v šolah učitelji začeli uporabljati za dopolnjevanje učnih vsebin gradiva z interaktivnimi viri. Pri tem mladi pridobivajo večjo motivacijo in izkušnje pri učenju. Svetovni splet, interaktivni viri in aplikacije z izobraževalnimi gradivi omogočajo učiteljem, da ponudijo možnosti za učinkovito učenje in večje vključevanje samih učencev v izobraževalni proces. Učitelji spodbujajo rabo tehnologije pri učencih ter jih tako učijo pravilnih pristopov pri iskanju informacij, analiz, oblikovanju rešitev ter učinkoviti komunikaciji. Prednosti uporabe učnih gradiv v izobraževalne namene omogočajo učencem pri prejemanju informacij, saj pri tem uporabljajo multisenzorne načine učenja, prilagajanje individualnim potrebam učencev; raznovrstno predstavljanje učne snovi; uporabo mobilnih naprav pri učenju, saj so zelo vpete v vsakdanje življenje. Samo učenje s pomočjo pametnih mobilnih naprav in spleta se nanaša na načine, ko se uporablja omenjena tehnologija hkrati s spodbujanjem učenja [6]. Rezultati raziskav so pokazali, da uporaba informacijsko-komunikacijske tehnologije v podporo učnemu okolju pozitivno vpliva na učenje [1]. Med mladimi je prvi vir informacij ter najpogosteje uporabljena tehnologija v učne namene računalniška in informacijska tehnologija [8]. Pri pouku se uporaba informacijske tehnologije razlikuje med oblikami in metodami dela. Zaradi različnih učenčevih sposobnosti se po potrebi izvede diferenciacijo z dodatno razlago ali dodatnimi nalogami [2].

Uporaba elektronskih gradiv je za učenje smiselna, ko z njeno uporabo dosežemo časovno racionalizacijo, boljše rezultate pri učenju in preverjanju doseženega znanja. Tovrstni način se razlikuje od pouka v živo, zato je bilo potrebno predhodno določiti cilje in načine podajanja učne snovi, načrtovati izvedbo, pripraviti ustrezna e-orodja v učnem okolju ter samovrednotiti dosežke in pridobljeno znanje [9]. Učenci, ki imajo nižje sposobnosti, potrebujejo smiselno sestavljene naloge, prilagojene težavnostnim stopnjam, da vsebujejo dovolj podpornega konkretnega slikovnega gradiva ter animacij (še posebej so poučne pri možnostih ponovitve in korigiranju hitrosti). Spletne strani z učno vsebino, ki omogočajo spletne povezave z navezovanjem na sorodne vsebine, učencem spodbudijo željo po spoznavanju novih informacij, hkrati pa jih učijo pravilne uporabe informacijsko-komunikacijske tehnologije [9].

Učenci z učnimi težavami pri uporabi spletnih didaktičnih orodij in strani prejmejo sebi prilagojene informacije, tako da bodo učno snov bolje memorirali ter usvojili. Na spletu obstajajo različna spletna orodja za utrjevanje, ponavljanje in podajanje učnih vsebin. S temi orodji pridobijo znanje na zanimiv in razgiban način ter omogočajo pot k samostojnemu pridobivanju iskanja informacij ter nadgraditve obstoječega znanja. Z uporabo spletnih orodij so bolje motivirani, aktivni, zavzeto rešujejo naloge, abstraktne vsebine bolje konkretizirajo ter si jih zapomnijo. S tem je proces memoriranja podatkov, ki učencem povzroča težave in nemotiviranost, učinkovitejši in trajnejši.

3 UČENCI Z UČNIMI TEŽAVAMI IN UPORABA INFORMACIJSKE TEHNOLOGIJE

S specializacijo znanj in diferenciacijo poklicev se je v šolstvu uspelo učence, ki imajo učne težave, ustrezno diagnosticirati in strokovno določiti njihove primanjkljaje, da bi lažje in s strokovno pomočjo uspešneje premostili učne težave. Omenjeni učenci imajo različne vrste primanjkljajev in so posledično učno manj uspešni, saj glede na vrstnike počasneje usvajajo znanja in spretnosti pri učnih predmetih. Posledično sta njihov učni uspeh in rezultat slabša. Učne težave se lahko pri učencih kažejo kot posledica prepleta dejavnikov, ki vplivajo na učenčevo šolsko delo – podpovprečne in mejne intelektualne sposobnosti, slabše razvite samoregulacijske sposobnosti, težave v socialno-emocionalni akomodaciji, primarni socialno-kulturno-jezikovni drugačnosti, socialni in kulturni deprivaciji oz. izoliranosti, pomanjkanju motiviranosti za delo. Učne težave vplivajo na nekatere ali mnoge vidike posameznikovega življenja (izobraževanje, delo, interakcije v družini, socialnem okolju) ter se kažejo v različnih pogledih. Primanjkljaji se med seboj prepletajo ali so ločeni ter vplivajo na učno delo in na samo življenje. Dražljajev in informacij iz okolice ne sprejemajo, analizirajo in nanje ne reagirajo enako kot sovrstniki, zato so nekatere poti učenja ovirane. Učinkovitosti sprejemanja in izražanja informacij so zaradi kognitivnih primanjkljajev na nekaterih področjih zmanjšane. Na teh področjih se zato težko učijo na tradicionalen način in s hitrostjo, ki je sprejemljiva za njihove vrstnike [5, 7].

Nekateri med njimi z različnimi oblikami pomoči (dopolnilni pouk, individualna in skupinska pomoč, dodatna strokovna pomoč) pridobijo možnost za premostitev svojih primanjkljajev. V zadnjih letih se je s pomočjo procesov integracije in inkluzije tem učencem pomagalo, da so kljub težavam uspešnejši in pozitivno sprejeti med vrstniki in v samo šolsko okolje. S tem se pozitivno vpliva na njihovo samopodobo in učne rezultate. Z uporabo pametnih mobilnih naprav in računalnikov so tudi otroci s posebnimi potrebami bolje motivirani za učenje, usvajanje ter pomnjenje znanja. Spletne vsebine, orodja in spletne aplikacije omogočajo dinamično, nazorno, dostopnejše, multisenzorno podajanje informacij, ki so za učence zanimive in privlačne. S tem bolje procesirajo, obdelajo vsebino in njihovo pomnjenje [7].

Učitelji učencem z učnimi težavami in premajhno vključenostjo v razred nudijo oporo pri vključevanju v razredno okolje, aktivnosti, pouk ter upoštevajo njihove primanjkljaje. Med šolami prihaja do različnih spodbujanj motiviranosti učiteljev za poučevanje in motiviranosti otrok za učenje [4].

4 NEGATIVNI VIDIKI UPORABE INFORMACIJSKE TEHNOLOGIJE MED MLADIMI

V vzgoji in izobraževanju so se tekom zadnjih desetletij zgodile pomembne spremembe pri uporabi novih oblik gradiv, materiala in pripomočkov. S pametnimi mobilnimi napravami so se nekatere učne vsebine učencem približale, konkretizirale ter se je olajšal dostop do informacij. Prekomerna uporaba spleta in informacijske tehnologije škoduje fizičnemu, psihološkemu in emocionalnemu stanju, pojavljajo se odvisnosti in odklonski vedenjski vzorci. Ena izmed posledic prekomerne uporabe je tudi pomanjkanje socialnega stika ter odnosov, ki so del človeške družabne narave. Pri tem se vzpostavlja navidezne socialne odnose preko elektronskih medijev in družabnih omrežij, ki pa pogosto prikrivajo realno stanje in odnose med ljudmi. .Mladi in tudi odrasli so lahko izpostavljeni raznim prevarantom, ki od njih zaradi pomanjkanja tovrstnega znanja pridobijo njihove osebne podatke, možnosti zlorab fotografij in podatkov, ki jih delijo na spletu. Ena izmed spletnih strani, ki se ukvarja z varno rabo spleta, je tudi www.safe.si. Po njenih podatkih se je v zadnjih 10 letih uporaba mobilnih naprav zelo povečala, tako da je bilo v svetu v uporabi že več kot 10 milijard mobilnih naprav (pametni mobilni telefon, prenosni računalnik, tablica). Obširna raziskava Mladi na netu 2010 je pokazala, da ima svoj mobilni telefon 93 % otrok in mladostnikov med 8 in 18 letom; delež uporabnikov mobilnih naprav za dostop do interneta je bil največji med osebami, starimi od 16 do 24 let, in sicer je obsegal 74 %, in osebami, starimi od 10 do15 let (54 %). Mladi zelo sprejemajo napredek pri tehničnih novostih, saj se z naraščanjem zmogljivosti pametnih telefonov spreminjajo tudi njihove navade. Tako je raziskava Mladi na netu 2010 pokazala, da 63 % mladih med 8 in 19 letom v Sloveniji kot glavni vir iskanja podatkov na svetovnem spletu uporablja mobilni telefon. Negativne posledice uporabe omenjene tehnologije se kažejo tudi pri nepoznavanju skritih pasti, saj se je 29 % slovenskih otrok in mladih, starih od 11 do 19 let, že slikala brez oblek in sliko posredovala po družabnih omrežjih. Pri tem so fantje bolj izpostavljeni tveganjem kot dekleta (43 % fantov je prek mobilnega telefona že poslalo svojo sliko brez obleke, to pa je storilo 14 % deklet) [12].

5 VARNA RABA SPLETA PRI UČENCIH

Evropske institucije, ki skrbijo za varstvo osebnih podatkov, v svojem poročilu (Mnenje 2/2009 Delovne skupine iz člena 29) izpostavljajo, da mladoletne osebe in tudi nekateri odrasli, ki še niso dosegli fizične in psihološke zrelosti, potrebuje več zaščite kot ostali. To je še posebej pomembno pri uporabi spleta in pametnih mobilnih naprav, saj je treba posredovati znanje o zasebnosti pri uporabi novih tehnologij v vsaki fazi otrokovega izobraževanja. Z odraščanjem, izobraževanjem in pridobivanjem socialnih stikov se pri mladih povečajo interkacije z različnimi institucijami, ki obdelujejejo njihove osebne podatke. Pri tem je potrebno imeti v obziru zaščito otrok. Pristop k varovanju zasebnosti otrok mora temeljiti na izobraževanju (s pomočjo družine, šole, organov za varstvo osebnih podatkov, skupnosti otrok in drugih) o pomembnosti varstva osebnih podatkov in zasebnosti ter o posledicah razkrivanja osebnih podatkov, kadar to ni potrebno [3].

Za varno rabo mobilnih naprav, aplikacij, spleta in družabnih omrežij je pomembno, da se učence na primeren način izobražuje in predstavi njihovo uporabo. Strokovnjaki s tega področja izpostavljajo, da je to dolgotrajen proces, ki temelji na odgovornem ravnanju, izobraževanju in graditvi zaupanja med učenci, starši in pedagoškimi delavci. V primeru težav je pomembno, da se o tem spregovori in poišče ustrezno rešitev. Objava podatkov na spletu pomeni tudi, da so dostopne širšemu krogu ljudi, tako da je učence potrebno seznaniti in poučiti, da informacije na spletu ostanejo in se hitro širijo. S praktičnimi prikazi učence poučijo, kako informacije posredujejo oz. jih zavarujejo, še posebno pred nepoznanimi osebami. Za odrasle je pomembno, da vršijo nadzor nad otroki, da sproti preverjajo, katere spletne strani in aplikacije na mobilnih napravah uporabljajo, ter jim sprotno razlagajo elemente varnosti pri uporabi spleta [12].

Izobraževanje učencev za pravilno ter varno uporabo spleta sovpada tudi z izobraževanjem staršev in pedagoških delavcev, saj so oboji povezani z učenci. S svojim znanjem in veščinami pomagajo pri vzgoji in izobraževanju mladih, kako primerno svetovati mladim pri uporabi spleta. Prav tako je za mlade pomembno, da v primeru težav zaupajo odraslim in tako najdejo ustrezne rešitve. Mlajši otroci potrebujejo nadzor pri uporabi spleta. Odrasli jim prikažejo lastnosti varnih spletnih strani, varne načine komuniciranja, uporabe strojne in programske opreme, varovanja osebnih podatkov in splošnih informacij [11].

Mnoge izobraževalne spletne strani nudijo izobraževalne vsebine, pri tem vključujejo animacije, videoposnetke, didaktične igre, možnosti praktičnih predavanj, izvedbo seminarjev in izobraževalne teme za odrasle. Vse to je zelo pomembne za otroke z učnimi težavami, saj je njihovo splošno razumevanje in dojemanje nevarnosti pri uporabi spleta premalo zaznavno. Ne zavedajo se spletnih pasti in negativnih posledic pri uporabi spleta pri svojem delu, saj imajo poenostavljene poglede na tovrstno problematiko in ne poznajo elementov za prepoznavo (ne)varnih spletnih strani. Za varno rabo spleta je pri njih potrebno več časa, da lahko dojamejo obsežnost uporabe spleta in pametnih mobilnih naprav, saj imajo tudi slabšo splošno poučenost in premalo informacij o morebitnih spletnih nevarnostih. Tako lahko pri iskanju informacij preko spleta nevede zaidejo na lažne spletne strani, ki zahtevajo določene osebne podatke pri nadaljnjem pridobivanju informacij. Ne poznajo določenih certifikatov ali spletnih digitalnih identitet, ki zagotavljajo določeno stopnjo varnosti. V družabnih omrežjih večkrat naivno nasedejo sogovorcem pri izmenjavi osebnih podatkov ali celo pri pošiljanju fotografij ali finančnih sredstev, kjer spletni goljufi s pridom izkoristijo njihovo zaupljivost in nevednost. Učenci in tudi nekateri odrasli pri brskanju po spletu najdejo reklame, oglase, ki ponujajo senzacionalne ali enostavne rešitve, vendar je v resnici v ozadju zgolj nepošteno pridobivanje finančnih sredstev in opeharjenje naivnih uporabnikov. Omenjeni mladi s svojim pomanjkljivim znanjem hitreje postanejo žrtve spletnih izsiljevalcev preko družabnih omrežij, saj so slednji bolje podkovani v uporabi spletne komunikacije. Učenci z učnimi težavami so prav tako bolj dovzetni za možnost manipulacije preko uporabe spleta, pri prebiranju informacij, pri igranju videoiger, gledanju videoposnetkov, saj imajo pomanjkljivo znanje in nekritično distanco do omenjenih vsebin. Pri tem se kasneje pokažejo negativne posledice na različnih ravneh, kar negativno vpliva na njihovo samopodobo in psihosocialno stanje.

6 ZAKLJUČEK

Uporaba mobilnih naprav in spleta prinaša mnogo pozitivnih in tudi žal negativnih posledic. Mladi, med njimi še posebej vrstniki z učnimi težavami, veliko časa preživljajo na spletu, kjer igrajo videoigre, komunicirajo preko družabnih omrežij, objavljajo svoje posnetke in fotografije. Nemalokrat se pri tem premalo posvečajo tudi vprašanjem o varni uporabi, samemu poznavanju ozadja delovanja spleta, varnega objavljanja informacij in njegove uporabe. Odrasli, učitelji in starši učence skozi njihovo obdobje odraščanja izobražujejo in informirajo o varni uporabi spleta, jim predstavljajo skrite pasti ter vzpostavitve kritičnega in zdravega odnosa do pametnih naprav in spleta. Učenci z učnimi težavami, ki so še posebej izpostavljeni zaradi svojega šibkejšega razumevanja in vedenja uporabe spleta, potrebujejo dodatno varnost, čas za izobraževanje in spoznavanje za varno delo na spletu, da bodo ohranili določeno stopnjo varovanja osebnih podatkov. Pri tem jim pomagajo učitelji, starši in tudi sovrstniki, da bodo s tem bolje opolnomočeni uporabljali to tehnologijo.

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Storitve šolske knjižnice v času učenja na daljavo

School library services during distance learning

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POVZETEK

V prispevku je predstavljeno delo šolske knjižnice na Osnovni šoli Vide Pregarc v Ljubljani v času učenja na daljavo. Šolska knjižnica je v skladu z navodili in priporočili prilagodila svoje storitve in jih v čim večji meri skušala prenesti v spletno okolje. Da bi omogočila čim širši nabor knjižničnih storitev na daljavo, odprt in varen prostor za vse uporabnike, je šolska knjižnica skrbela za dostop do besedil, izvedbo bralnih dejavnosti, podporo pouku, informiranje učiteljev, opravljanje bralnih značk, izvajanje projekta Medgeneracijsko branje in se vključevala v razširjen program šole. Šolska knjižnica je z uporabo različnih orodij skrbela za motivacijo bralcev in za razvijanje informacijske pismenosti, ki je potekala v okviru medpredmetnih učnih ur.

KLJUČNE BESEDE

Šolska knjižnica, knjižnične storitve, učenje na daljavo, bralne dejavnosti, informacijsko opismenjevanje, medpredmetne učne ure

ABSTRACT

The paper presents the work of the school library at the Vida Pregarc Primary School in Ljubljana during distance learning. The school library adapted its services in accordance with the instructions and recommendations and tried to transfer them to the online environment as much as possible. In order to provide the widest possible range of library services remotely, open and safe space for all users, the school library took care of access to texts, reading activities, teaching support, informing teachers, reading badges, implementing the Intergenerational Reading project and participating in extended school program. Using various tools, the school library took care of motivating readers and developing information literacy, which took place as part of interdisciplinary lessons.

KEYWORDS

School library, library services, distance learning, reading activities, information literacy, interdisciplinary lessons

1 ŠOLSKA KNJIŽNICA IN UČENJE NA DALJAVO

V šolskem letu 2020/21 se je poučevanje na daljavo za osnovne šole izvajalo od meseca oktobra 2020 do februarja 2021. V tem času se je za učence osnovnih šol pouk preselil v spletno okolje, izvajalo se je poučevanje na daljavo. Šolske knjižnice so se znašle pred novimi izzivi in iskale načine, kako prilagoditi storitve za svoje uporabnike. Kot pravi Novljanova [1], je ključ do upeha knjižnice pri razvijanju informacijske pismenosti prilagajanje spremembam in vplivanje na spremembe.

Mednarodna zveza bibliotekarskih društev in ustanov ali IFLA v Smernicah za šolske knjižnice [2] predstavi definicijo, vlogo, vizijo, poslanstvo in storitve šolske knjižnice. Šolsko knjižnico opredeljuje kot odprt in varen prostor, izobraževalno in informacijsko okolje, informacijski, tehnološki in družbeni prostor ter center pismenosti.
Mednarodne smernice prav tako predlagajo, da storitve šolske knjižnice vključujejo:

- strokovni razvoj za tiste, ki poučujejo,
- živahne programe na področju literature/branja za znanstvene dosežke ter osebno zadovoljstvo in bogatenje,
- raziskovalno učenje in razvoj informacijske pismenosti,
- sodelovanje z drugimi knjižnicami.

Poleg naštetih storitev pa vsaka šolska knjižnica kot učno in informacijsko središče šole nudi svojim uporabnikom možnosti za razvijanje različnih vrst pismenosti z zagotavljanjem primerne in urejene knjižnične zbirke [3].

Upoštevajoč smernice in vizijo šole, iz katere izhaja tudi vizija šolske knjižnice, ki je v prvi vrsti usmerjena v podporo oz. integracijo v vzgojno-izobraževalni proces, smo se na Osnovni šoli Vide Pregarc v Ljubljani soočili na eni strani s prenosom storitev v spletno okolje in na drugi strani z omejitvami, s katerimi smo se srečevali z vstopom na splet.

Če smo šolski knjižničarji izhajali iz potreb uporabnikov, je bilo potrebno razviti pristope, ki bodo čim bolj enostavni za uporabo, sploh za najmlajše učence, ki so se prvič soočali z digitalnim okoljem. Druga omejitev je bila izbira besedil. Šolski knjižničarji smo izbirali prosto dostopna elektronska besedila, besedila primerna razvojni starosti mladih bralcev, preprosta besedila v tujih jezikih, besedila z ekološkimi vsebinami upoštevajoč avtorske pravice. Tretja omejitev, s katero smo se srečevali v času izvajanja pouka na daljavo, so bile tehnične težave, kot na primer nezadostna internetna povezava, preobremenitev spletnih okolij, zmogljivost in zastarelost IKT šolske opreme.

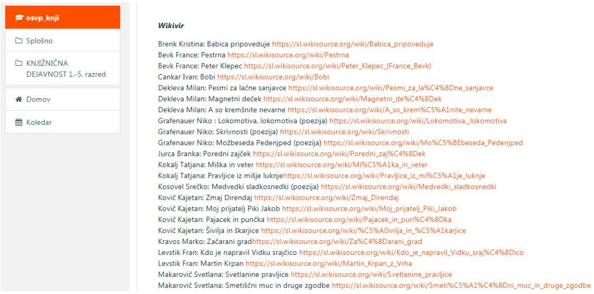
Prenos knjižničnih storitev v spletno okolje pa sam po sebi ni dovolj, kadar je v ospredju vzgojno-izobraževalni proces, zato se je bilo potrebno povezovati z drugimi strokovnimi delavci. Večina dejavnosti se pri klasičnem pouku izvaja medpredmetno, saj je informacijsko opismenjevanje daljši proces, ki je vtkan v cilje različnih šolskih predmetov. S tega vidika so šolski knjižničarji upoštevali priporočila Zavoda Republike Slovenije za šolstvo [4], kjer je izpostavljeno, da poenotenje znotraj zavoda, po predmetnih področjih in aktivih, omogoča lažji proces poučevanja na daljavo. Priporočila med drugim osvetljujejo tudi razlike med učenci, na katere so šolski knjižničarji še posebej pozorni, če želijo zagotoviti varno in vključujoče okolje.

Na tem mestu je vredno omeniti, da so v proces razvijanja informacijske pismenosti zajeti tudi strokovni delavci šole. Avtorji raziskave Računalniška in internetna pismenost učiteljev osnovnih šol [5] ugotavljajo, da učitelji osnovnih šol dosegajo različne stopnje računalniške in internetne pismenosti in da ravnatelj nima tolikšnega vpliva na razvoj pismenosti. Zaradi velikih razlik v stopnji računalniške in internetne pismenosti med učitelji, ki so se kazale tudi na Osnovni šoli Vide Pregarc, je bilo potrebno oblikovati tudi podporni sistem, ki je omogočal razvijanje pismenosti tistih odraslih uporabnikov, ki so se sami prepoznali kot slabše računalniško in internetno pismeni. S prenosom vzgojno-izobraževalnega procesa na splet so se odprla številna nova vprašanja in izzivi, ki smo jih šolski knjižničarji reševali postopoma. Pri delu z uporabniki je tudi s prehodom v spletno okolje bilo potrebno razmisliti o pestri ponudbi, tehnični podpori, varnem spletnem okolju in aplikacijah, ki so preproste za uporabo.

2 STORITVE ŠOLSKE KNJIŽNICE V SPLETNEM OKOLJU

Šolska knjižnica Osnovne šole Vide Pregarc je v okviru vzpostavitve dogovorjenih kanalov in platform najprej oblikovala Arnesovo spletno učilnico, do katere so lahko dostopali vsi učenci z AAI računom. Ker so izkušnje s prejšnjega šolskega leta pokazale, da je spletna učilnica Knjižnica ena redkih, ki ne potrebuje gesel in da jo uporabniki včasih res potrebujejo na hitro, smo se odločili, da bo odprta.

Izposoja gradiva v šolski knjižnici je ena najpomembnejših storitev, smo se lotili urejanja nabora besedil, ki so bili urejeni po abecednem seznamu avtorjev, ki so jim sledile povezave do prosto dostopnih besedil (Slika 1).



Slika 1: Nabor do prosto dostopnih besedil

Sčasoma so se pojavile potrebe po raznolikosti gradiv, zato se je glede na želje strokovnih delavcev nabor besedil dopolnjeval z ekološkimi vsebinami, kvizi, interaktivnimi vajami, strokovnimi članki in besedili v tujih jezikih.

2.1 Skrb za podporo strokovnih delavcev

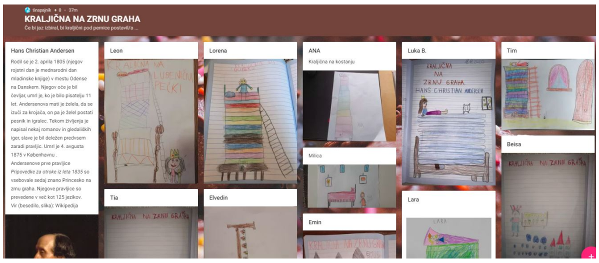
Strokovni delavci so pri izvedbi poučevanja na daljavo potrebovali celostni pristop. Učitelj pri svojem delu je potreboval učbeniško gradivo, kar mu je bilo zagotovljeno s strani založb. Mnoge založbe so digitalizirale berila, omogočala prost dostop do svojih portalov, organizirale webinarje in objavljale novosti na spletnih straneh. Šolski knjižničarji so skrbeli za dostope, pridobitve kod, iskanje informacij, prepošiljanje obvestil o webinarjih in drugih izobraževanjih na daljavo, ki so pripomogli k učinkoviti izvedbi pouka na daljavo. Zaradi raznolikih potreb z več predmetnih področij in različnih razvojnih značilnostih učencev je bil oblikovan elektronski zbirnik v Padletu, ki je vsem strokovnim delavcem omogočal, da so poiskali tiste informacije, ki so jih zanimale (Slika 2).

Slika 2: Elektronski zbirnik za učitelje v Padletu

Poizvedovanja učiteljev so bila zelo raznolika, zato je bilo potrebno dvakrat tedensko posodabljati elektronski zbirnik s povezavami. Na voljo so bili tudi video vodiči in navodila za tiste učitelje, ki so se šele učili uporabljati spletna orodja. Zbirnik v Padletu je zajel oba vidika, tako podporo za učenje kot tudi možnost za strokovni razvoj učiteljev, saj so lahko pregledali strokovno literaturo, raziskave, spletne priročnike, digitalne zbirke in slovarje. Pri izvajanju poučevanja na daljavo se ne izvaja zgolj pouk, ampak tudi podporne dejavnosti oziroma razširjen program, kar smo pri vzpostavljanju virtualne oglasne deske imeli ves čas v mislih.

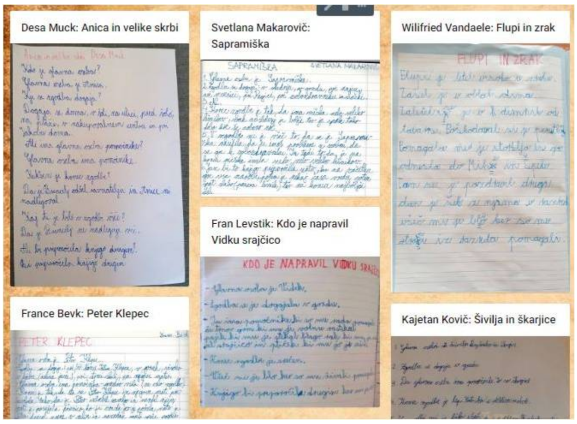
2.2 Bralne dejavnosti na daljavo

Šolski knjižničarji so se vključevali v pouk na daljavo z različnimi bralnimi dejavnostmi. V mesecu novembru smo za učence drugega razreda izvedli delavnico v spletnem okolju Zoom v okviru projekta Medgeneracijsko branje. Učenci so prebrali slikanico Kraljična na zrnu graha, ki je prosto dostopna na spletu. Nato so sodelovali v debatnici na Zoomu, kjer so se z učiteljico in knjižničarko pogovarjali o prebranem besedilu. Spoznali so spletno orodje Padlet in ga za nalogo uporabili tako, da so svoj likovni izdelek pripeli na virtualno oglasno desko z naslovom Kraljična na … , pri čemer so izbirali predmet, na katerem je kraljična spala (Slika 3).



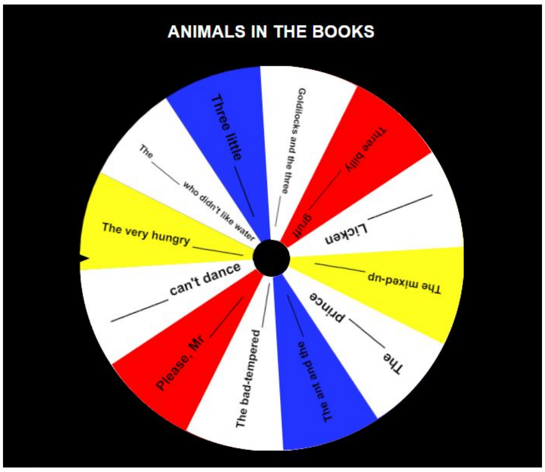
Slika 3: Uporaba Padleta v drugem razredu

Bralna značka in eko bralna značka sta se izvajali na daljavo na različne načine. Eko bralna značka se je izvedla v sodelovanju z razredniki tako, da so učenci prebrali tri članke iz nabora objavljenih besedil in si ogledali kratki animirani film, ki je prosto dostopen na spletu. Nato so izbirali med petimi različnimi termini na Zoomu, kjer je potekal pogovor s knjižničarko. Bralna značka se je izvajala v obliki pogovorov preko Zooma in Skypa ali pisno preko elektronske pošte ali preko Padleta, ki je bil dostopen v spletni učilnici (Slika 4).



Slika 4: Primer opravljanja bralne značke

V tretjem razredu je bila izvedena medpredmetna učna ura pri pouku angleščine preko Zooma, kjer so učenci prebirali krajša besedila v tujem jeziku, nato pa s kolesom sreče ponovili besedišče na temo živali. Aplikacija Wheel Decide omogoča izdelavo kolesa sreče, s katerim so učenci poiskali žival, ki nastopa v znani angleški pravljici (Slika 5).



Slika 5: Wheel Decide pri angleščini v tretjem razredu

Meseca decembra je bila izvedena bralna delavnica za učitelje, ki so se prijavili k sodelovanju v projektu Medgeneracijsko branje. Po prebrani knjigi Jane Frey z naslovom Jaz, drugačna so se učitelji udeležili delavnice preko Zooma, kjer so se pogovarjali o vsebini knjige, o kulturni raznolikosti, stereotipih in bralnih užitkih.

Za pravljično vzdušje naših najmlajših šolarjev, ki so se šele začeli opismenjevati, smo pripravili virtualni adventni koledar Advent my friend, ki je prosto dostopen na spletu. Pravljični koledar je omogočal, da so učenci prvih razredov vsak dan v mesecu decembru kliknili na okence, v katerem so se skrivali prosto dostopni zvočni posnetki znanih pravljic (Slika 6).

Slika 6: Primer adventnega pravljičnega koledarja

Tudi po vrnitvi v šolske klopi so se bralne dejavnosti izvajale na daljavo. Zaradi priporočil, da se pouk izvaja v mehurčkih, kjer se ohranjajo čisti oddelki, so se dodatne dejavnosti še vedno izvajale na daljavo. Tretji razredi so se v spomladanskih mesecih pripravljali na Cankarjevo tekmovanje, zato jim je bil ponujen dodatni pouk s knjižničarko. Preko Zooma so učenci diskutirali o prebranem besedilu, ga analizirali in spoznavali različne zorne kote za ravnanje književnih oseb. Uvodna dejavnost je potekala s pomočjo aplikacije Wheel of names, kjer so učenci zavrteli kolo, dopolnili naslov znanega besedila in v treh povedih povzeli bistvo (Slika 7).

Slika 7: Wheel of Names pri dodatnem pouku

2.3. Razvijanje informacijske pismenosti

Razvijanje informacijske pismenosti je potekalo v okviru medpredmetnih ur. Ko so se učenci udeležili učnih ur na daljavo, se je šolski knjižničar vključeval kot strokovna in tehnična podpora. Učence je bilo vedno potrebno seznaniti z novimi orodji in s pravili vedenja na spletu ter jih osveščati o varni rabi interneta. Mlajši učenci so se učili orientirati v spletni učilnici, oddajati naloge in pripenjati priponke. Spoznavali so spletno okolje Arnes, Zoom, Padlet, Kahoot, Liveworksheet ter druga spletna orodja, ki so jih učitelji uporabljali pri pouku. Starejši učenci so se učili navajati vire, uporabljati Cobiss ter poiskati informacije na spletu.

Šolska knjižnica je prav tako sodelovala pri razrednih likovnih natečajih in virtualnih razstavah ob posebnih dnevih, kot na primer Dan Zemlje in Eko dan. Vključevala se je v razredne ure s tematiko trajnostnega razvoja in globalnega učenja. Izvajala je učne ure slovenščine za učence priseljence, ki so potrebovali pomoč pri vzpostavljanju rutine, orientaciji v spletnem okolju in pri razvijanju strategij učenja za premostitev jezikovnih ovir s spletnim slovarjem Franček (Slika 8).

Slika 8: Primer uporabe spletnega slovarja Franček

2.4 Sodelovanje z drugimi zavodi

Za šolsko knjižnico je poleg izposoje in dela z uporabniki pomembna tudi obdelava gradiva in posodabljanje informacij ter dokumentov, spremljanje trendov in iskanje povratnih informacij s strani uporabnikov šolske knjižnice. Da bi si šolski knjižničarji izmenjali informacije in primere dobre prakse, so se vzpostavile različne mreže in individualni komunikacijski kanali. Pri iskanju novih informacij se je za koristno izkazala spletna učilnica Knjižnična dejavnost Zavoda Republike Slovenije za šolstvo, kjer so se objavljali primeri dobrih praks in so se izvajala srečanja s svetovalko s spletnem okolju MS Teams. Odličen vir informacij je v času učenja na daljavo bilo tudi družabno omrežje Facebook, kjer so v zaprti skupini Sekcija šolskih knjižnic knjižničarji delili celo vrsto uporabnih idej.

Šolska knjižnica OŠ Vide Pregarc se je povezovala tudi z drugimi slovenskimi šolami, tako pri timskem poučevanju na daljavo kot z deljenjem spletnih gradiv. V mesecu decembru, ko so se zvrstile statistike ob zaključku koledarskega leta, je šolska knjižnica sodelovala z NUK-om in IZUM-om, ki sta pomagala pri svetovanju in pri tehničnih dilemah pri delu s COBISS-om.

Povezovanje z drugimi zavodi je bilo nujno, saj je število knjižničarjev na šolah bistveno manjše kot število učiteljev, ki so se lahko vsakodnevno povezovali in sodelovali znotraj svojih strokovnih področij. Z vidika strokovnosti je šolski knjižničar v številnih primerih sam na šoli, zato je zanj toliko bolj pomembno, da poišče pomoč in podporo pri svojih strokovnih kolegih in pri zavodih, ki nudijo strokovno in tehnično podporo.

3 TEŽAVE IN POMANJKLJIVOSTI

Prenos knjižničnih storitev v spletno okolje je zahtevalo veliko časa in truda. Ker se je sam vzgojno-izobraževalni proces na daljavo ves čas spreminjal in ker se je motivacija za delo na daljavo med uporabniki zelo razlikovala, je bilo za šolsko knjižnico ključnega pomena, da je šolska knjižničarka ves čas spremljala novosti, posodabljala spletno učilnico in elektronske zbirnike ter zbirala povratne informacije svojih uporabnikov, tako učencev kot učiteljev.

Seveda vseh knjižničnih storitev ni bilo mogoče prenesti v spletno okolje, so se pa vse storitve lahko prilagodile do te mere, da se jih je lahko izvajalo tudi na daljavo. Največji izziv je bilo vzdrževanje in ohranjanje motivacije za branje, zato je bilo pomembno, da se dejavnosti niso ponavljale in da so bile zasnovane v krajši obliki in z dodatnimi aplikacijami, ki so popestrile sedenje za ekrani.

Ker so tudi uporabniki imeli tehnične težave, je bilo potrebno razmišljati tudi o rezervnem načrtu, zato se je vedno po srečanjih na Zoomu za vse odsotne pripravil opis dejavnosti s povezavami, ki je bil objavljen v spletni učilnici.

Najbolj so bile obiskane bralne dejavnosti, ki so vnašale zabavo in gibanje v učni proces, kar je zviševalo motivacijo za delo in za opravljanje bralne značke.

Tudi pri učenju na daljavo je šolska knjižnica uspela ohranjati odprt dostop. Delovala je vključujoče in je nudila varno spletno okolje, pri čemer je uporabnike seznanjala s pravili vedenja in z varnostjo na spletu.

Vsekakor je prednost učenja na daljavo bila uporaba spletnih okolij, ki jim uporabniki drugače nikoli ne bi bili izpostavljeni. S tega vidika je šolska knjižnica lahko zelo veliko prispevala k postopnemu informacijskemu opismenjevanju, a le, če se je šolski knjižničar znal povezovati in sodelovati z drugimi strokovnimi delavci, saj je večina ur knjižnično-informacijskih znanj potekala v povezavi z drugimi predmetnimi področji.

Največja pomanjkljivost pri izvajanju knjižnične dejavnosti na daljavo pa je vsekakor bila odsotnost stika v živo, ki je za mlajše učence ključnega pomena, sploh pri obravnavi književnih besedil. Tehnične težave, socialno-ekonomski status uporabnikov, učne in vedenjske težave pa so vse tiste prepreke, s katerimi so se soočali vsi strokovni delavci v vzgoji in izobraževanju in ne samo šolski knjižničarji.

4 ZAKLJUČEK

Šolska knjižnica Osnovne šole Vide Pregarc je v času učenja na daljavo prilagodila dejavnosti in omogočila svojim uporabnikom spletne storitve. Nudila je varno spletno okolje in omogočila podporo vzgojno-izobraževalnemu procesu, ki je potekal na daljavo. Prednosti in slabosti dela na daljavo so v novem šolskem letu postala izhodišče za nadaljnje delo. Vsekakor pa šolske knjižnice ostajajo prostor za promocijo bralne kulture ter za razvoj informacijske pismenosti – tako v šolskih prostorih kot na daljavo.

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Preliminarna anketa kot didaktični pripomoček

Preliminary survey as a didactic tool

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POVZETEK

V prispevku na praktičnem primeru pokažem uporabo preliminarne ankete kot didaktičnega pripomočka in pristopa za obravnavo trajnostnega razvoja pri pouku. Namen je bil aktivirati učence za razmišljanje o tej temi ter obenem preveriti in izenačiti predznanje. Učenci so pri pouku zato že poznali in razumeli osnovni koncept trajnostnega razvoja in so bili bolj aktivni v pedagoškem pogovoru. Uporabil sem okolje MS Forms, ki je zelo praktično.

KLJUČNE BESEDE

Anketa, didaktika, trajnostni razvoj

ABSTRACT

In this article, I show a practical example of a preliminary survey used as a didactic tool and teaching approach about sustainable development in the classroom. The purpose was to activate students' thinking about this topic, and at the same time to check and equalize their prior knowledge. Therefore, the students already knew and understood the basic concept of sustainable development in class and were more active in the pedagogical conversation. I used the MS Forms environment, which is very practical.

KEYWORDS

Survey, didactics, sustainable development

1 UVOD

Pri obravnavi nove snovi lahko naredimo različne oblike uvoda, da učence pripravimo na neko novo poglavje in jih miselno aktiviramo. To lahko naredimo na začetku učne ure, na koncu prejšnje ure ali pa kot domačo nalogo. Pri pouku na daljavo, pa tudi pri običajni obliki pouka v šoli, lahko izkoristimo elektronska orodja, s katerimi ne samo povečamo raznolikost, ampak dobimo neke nove koristi. Anketni vprašalnik je zelo zanimiv za uporabo pri pouku tako v šoli kot na daljavo. V tem prispevku bomo pogledali izvedbo preliminarne ankete v okolju MS Forms.

2 (PRELIMINARNA) ANKETA

Anketa oz. anketni vprašalnik je zelo uporabno orodje, s katerim si lahko pomagamo pri pouku tako v šoli kot na daljavo.

Izvedba ankete pred obravnavo nove snovi (preliminarna anketa) aktivira učence, da začnejo razmišljati o snovi malo prej, bolj dejavno so vključeni vsi učenci, prav tako nanje ne vplivajo sošolci, ki dvigujejo roke in že dajejo neke ideje, misli, ki bi vplivale na njihovo razmišljanje. To je pomembno z vidika počutja učencev pri sami uri, ker zaradi seznanjenosti z obravnavano snovjo lažje bolj tvorno sodelujejo in nimajo občutka podrejenega položaja. [3] Prav tako pa tudi poveča vključenost učencev, ki imajo morda slabše predznanje in ki morda pridejo manjkrat na vrsto v pogovoru v razredu, kar je pomemben vidik inkluzije. [2]

2.1 Microsoft (MS) FORMS

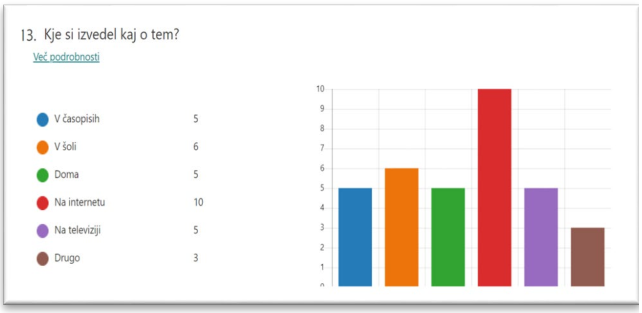
Pri izvajanju pouka na daljavo smo na naši šoli uporabljali okolje MS Teams in aplikacije, ki so vključene v Microsoft Oblak 365. Ena od njih je tudi MS Forms, s katero lahko izdelujemo različne oblike elektronskih obrazcev, s katerimi pridobimo informacije od uporabnikov. Lahko je narejena z namenom preverjanja znanja in točkovanjem – kot kviz, lahko pa je brez točkovanja – kot klasični anketni vprašalnik. Omogoča tudi t. i. razvejane ankete, pri katerih je vprašanje lahko pogojeno s tem, kako smo odgovorili na prejšnje. Zelo dobra je tudi povezava med MS Teams in MS Forms, saj lahko vprašalnik učenci izpolnjujejo kar v okolju Teams in s tem pridobimo ločenost po razredih ter tudi avtomatično imensko beleženje učencev, ki so izpolnili vprašalnik.

MS Forms je preprost za uporabo in ima zelo intuitiven način dela. Seveda pa je na voljo še kar nekaj podobnih aplikacij oz. spletnih strani, kot so Google Forms, 1ka.si, Survey Monkey, za kvize pa še Quizzizz, Kahoot in podobne.

Slika 1: Logo MS Forms

2.2 Kviz ali anketa?

Kaj je razlika? Pri kvizu samo preverjamo znanje, ki ga imajo učenci, in od njih ne pridobimo novih informacij. Pri anketi pa nas zanimajo razmišljanje, ideje … učencev. Rezultate ankete lahko tudi statistično analiziramo in si z njimi pomagamo pri izvedbi naslednjih ur. V okolju MS Forms lahko naredimo tako vprašalnik v obliki kviza, kot tudi anketni vprašalnik. Rezultate program sam že osnovno statistično obdela in tudi grafično predstavi, kar je zelo praktično.



Slika 2: Samodejna grafična predstavitev odgovorov

2.3 Zakaj preliminarna anketa

Anketa, ki je izvedena še pred obravnavo snovi (preliminarna anketa), aktivira učence, da začnejo razmišljati o snovi malo prej. Anketo običajno jo izvedemo enosmerno – da dobimo informacije od vprašanih. S preliminarno anketo lahko preverimo, koliko učenci znajo že od prej, lahko preverimo in spoznamo, kakšno je njihovo razmišljanje, nivo znanja, ne da bi nanje vplivali sošolci. Lahko pa je narejena malo drugače in poleg pridobivanja informacij lahko nekaj teh tudi posredujemo. V anketi lahko nekaj informacij zapišemo in tako jih učenci dobijo še pred obravnavo snovi, s tem pa lahko izenačimo predznanje, povemo kakšen del tega, kar bomo spoznali, razložimo osnovne pojme in tako aktiviramo razmišljanje o neki temi, zaradi česar bo sama obravnava lažje stekla, pogovor pa bo bolj poglobljen, saj se z nekaterimi osnovnimi pojmi ne bo več treba ukvarjati.

Učenci se bodo počutili bolj suvereni in kompetentni za sodelovanje, lažje bodo sodelovali kot subjekti v vzgojno-učnem procesu in bodo s tem imeli od njega največje koristi. [3]

Ravno obravnava trajnostnega razvoja se mi zdi za takšen način zelo primerna v 9. razredu, saj učenci v prejšnjih letih večkrat govorijo o varovanju okolja, o okolijski problematiki, onesnaževanju, vendar še morda nikoli niso slišali za koncept trajnostnega razvoja oz. trajnostnega razmišljanja, ki je bolj kompleksen. Tako lahko s posredovanjem definicij osnovnih pojmov vnaprej pospešimo ali celo preskočimo razlago in pri pouku hitreje preidemo na glavni del – pedagoški pogovor in iskanje rešitev.

Poleg posredovanja informacij pa seveda nekaj informacij tudi zberemo. Ker to izvedemo prej, lahko zbrane informacije uporabimo pri sami učni uri in tako vključimo razmišljanja in ugotovitve učencev, zato se bodo učenci počutili bolj vključeni in bolj zadovoljni.

3 PRIMER UPORABE MS Forms ANKETE

Pri opisanem primeru sem uporabil MS Forms razvejano anketo. Želel sem pridobiti nekaj informacij o njihovem poznavanju problematike, o njihovem predznanju, želel sem zbrati njihove ideje, jim razložiti kakšen osnovni pojem, poleg tega pa vse aktivirati za razmišljanje o konceptu trajnostnega razvoja, kaj oni že delajo na tem področju ter kako bi ta koncept lahko uporabili na nekem drugem življenjskem primeru.

Ravno obravnava teme trajnostnega razvoja se mi zdi za takšen način dela zelo primerna v 9. razredu, saj učenci v prejšnjih letih večkrat govorijo o varovanju okolja, okolijski problematiki, onesnaževanju, vendar še morda nikoli niso slišali za koncept trajnostnega razvoja oz. trajnostnega razmišljanja, ki je bolj kompleksen. V 9. razredu so učenci že bolj sposobni za kompleksnejši nivo razmišljanja, anketni pristop pa to spodbuja na individualnem nivoju. S posredovanjem definicij osnovnih pojmov vnaprej lahko pospešimo ali celo preskočimo razlago in pri pouku hitreje preidemo na glavni del – pedagoški pogovor in iskanje rešitev.

Operativni cilji in vsebine učnega načrta za pouk geografije v 9. razredu na več mestih omenjajo trajnostni razvoj, lokalno območje in osnovne raziskovalne metode. Učenec naj bi ozavestil in razumel pomembnost ohranjanja okolja za trajnostni razvoj družbe v sedanjosti in prihodnosti, razlikoval med odgovornim in neodgovornim ravnanjem s prostorom, ter se po teh spoznanjih tudi ravnal [4]. Z uporabo preliminarne ankete lahko pri učencih preverimo, kakšno je njihovo razumevanje tega področja, kakšna so njihova trajnostna ravnanja ter kakšni so njihovi predlogi za ravnanje njih in širše družbe. Zbrane podatke lahko potem uporabimo za izhodišča pedagoškega pogovora v razredu.

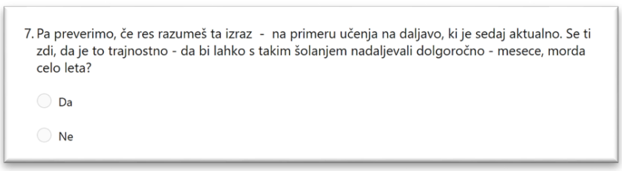
3.1 Vsebina ankete

Anketo sem razdelil v tri vsebinske sklope:

- Predstavitev, razlaga in preverjanje razumevanja definicije trajnostnega razvoja.
- Razmišljanje o uporabi koncepta trajnostnega razvoja na primeru pouka na daljavo.
- Preverjanje poznavanja in delovanja učencev na področju trajnostnega razvoja oz. trajnostnega vedenja.

V prvem delu ankete sem učence vprašal, če poznajo izraz »trajnostni razvoj«. Če so odgovorili z DA, sem jih pozval, naj s svojimi besedami napišejo, kaj je to. Če so odgovorili z NE, sem jim najprej pokazal definicijo trajnostnega razvoja Svetovne komisije za okolje in razvoj (Brundtlandina komisija) [6], ki se najbolj uporablja, nato pa so morali tudi oni sami napisati definicijo s svojimi besedami. S tem sem želel aktivirati njihovo razmišljanje in povečati aktivnost. Nato sem vsem pokazal definicijo in jih vprašal, če so po njihovem mnenju zadeli pomen. S tem sem želel preveriti njihovo samopresojo razumevanja. Nato sem jim pokazal še poenostavljeno definicijo in negirano definicijo, da bi še lažje razumeli pomen koncepta razmišljanja trajnostnega razvoja.

Sledilo je prehodno vprašanje, s katerim sem prehajal na drugi del ankete, obenem pa sem še preverjal njihovo razumevanje (glej sliko):



Slika 3: 7. vprašanje ankete

Če so učenci odgovorili z NE, sem jih dodatno vprašal, ali res mislijo, da bi šlo, in če se jim ne zdi, da bi bilo marsikomu težko delati na tak način zelo dolgo. To je bilo t. i. razvejano vprašanje, ki je bilo prikazano samo v primeru, da je učenec na prejšnje vprašanje odgovoril z NE.

Sledil je drugi del, kjer sem učence pozval, naj razmislijo, kaj pa bi morali spremeniti, da bi bil pouk na daljavo lahko trajnosten. Razložil sem, da je to kompleksno vprašanje in da bi lahko polja sprememb razdelili na tri dele – na tisto, kar lahko naredijo sami, na tisto, kar bi lahko naredili učitelji, in tisto, kar bi lahko naredila država oz. Ministrstvo za šolstvo. Nato so za vsak del posebej napisali ideje in predloge sprememb. S tem delom ankete sem želel tudi uresničevati didaktično načelo zavestne dejavnosti in kompleksnosti, ki sta dve zelo pomembni načeli poučevanja geografije. [1] S pomočjo ankete pa lahko vidimo, koliko so učenci sposobni kompleksno razmišljati, lahko opazimo kakšen »skriti talent« in vidimo, na kakšnem nivoju razmišljajo naši učenci, in temu prilagodimo pogovor v razredu.

Sledil je še tretji del, kjer smo se usmerili v trajnostni razvoj in trajnostno upravljanje z okoljem. Vprašal sem jih, če so že kdaj slišali za trajnostni razvoj ožjega okolja ali razmišljali o njem – npr. njihove občine, kje so dobili informacije ter ali se po njihovem mnenju dovolj govori in dela na tem.

Nato sem šel na bolj osebni nivo in vprašal, če sami kaj delajo na tem, če kaj delajo oz. prispevajo ter kaj jih pri tem ovira oz. zakaj je to težko.

V zadnjem delu sem jih vprašal po njihovih predlogih za trajnostno delovanje, nato so med naštetimi trajnostnimi aktivnostmi izbrali tiste, ki jih oni ali njihova družina zavestno delajo. Na koncu sem jim pokazal še cilje Agende 21 za Slovenijo iz leta 1995 [7] ter jih vprašal, v kakšni meri po njihovem mnenju danes sledimo tem ciljem. Povedal sem jim še, da se bomo o tej temi pogovarjali na naslednji uri.

Večina učencev je anketo izpolnila v manj kot 15 minutah, kar je bil tudi moj cilj.

3.2 Časovni okvir dela

Anketo sem učencem dal kot nalogo pri delu na daljavo tik preden smo spet šli v šolo. Tako so imeli dovolj časa za reševanje in so bili že z mislimi usmerjeni v novo temo, ki smo jo obravnavali potem pri pouku naslednjo uro. V vmesnem času sem pregledal odgovore, pozval učence, ki še niso oddali odgovorov, da to storijo, in začel z obdelavo rezultatov.

Pregledal sem odgovore in ugotovil, da zelo podobno razmišljajo in da so bili tudi običajno bolj tihi učenci aktivni in podajali predloge.

Zbral sem njihove odgovore po posameznih vprašanjih in naredil Power Point predstavitev z najpogostejšimi odgovori.

Te rezultate sem predstavil v uvodnem delu obravnave te teme pri pouku in razvil se je dober pogovor.

3.3 Rezultati ankete in njihova uporaba

Iz odgovorov v prvem delu sem razbral, da jih je nekaj že slišalo za trajnostni razvoj, kar precej pa je takih, ki še niso oz. tega ne razumejo ali razumejo nepravilno – veliko jih je enačilo »trajnostno« s »trajnostjo« oz. z dolžino trajanja. Ko pa so prebrali definicijo, so začenjali razumeti pravi pomen. Zelo dobro je bilo tudi, da sem lahko videl, kakšne so najpogostejše napake in to potem pri pouku korigiral in dodatno razložil. Pri običajnem pristopu v učilnici – z dvigovanjem rok – ne bi mogel dobiti tako natančnega spektra pravilnih in napačnih odgovorov. Namen iskanja in zbiranja predlogov za spremembe k bolj trajnostni obliki pouka na daljavo je bil seveda v tem, da učenci začnejo razmišljati o stanju ter možnih rešitvah, kar je osnovni način reševanja problemov, kar smo potem delali pri pouku tudi s pogovorom. Pokazal sem jim tudi, da je dobro ločiti polja sprememb in delovanja na več nivojev. Zelo sem bil presenečen nad iskrenostjo odgovorov in iskanjem rešitev, kjer se je pokazalo, da imajo podobne težave in predloge za rešitev.

V tretjem delu sem ugotavljal njihovo vključenost in aktivnost pri trajnostnem delovanju ter njihove predloge. Vesel sem bil, da so nekateri že zelo trajnostno aktivni in da imajo dobre predloge, kaj bi lahko še naredili.

4 ZAKLJUČEK

Pri poučevanju na daljavo je bilo potrebno poiskati nove načine, kako priti do tistih dodatnih informacij o učencih, ki jih v učilnici dobimo mimogrede, na daljavo pa težje dosegljive.

Po izkušnji, ki sem jo imel z izdelavo in uporabo ankete kot pripomočka za aktivacijo razmišljanja in izenačenja predznanja, sem zelo zadovoljen in bom vsekakor ta način uporabil tudi pri kakšni drugi temi. Učenci so bili zelo zadovoljni z drugačnim pristopom, veliko bolj angažirani in pripravljeni na pogovor v razredu, saj so o temi že začeli razmišljati prej, ne šele ob začetku ure.

- MS Forms se mi zdi dobro okolje za to, še posebej, ker na naši šoli uporabljamo tudi okolje MS Teams.

Herbert Spencer je nekoč zapisal: »Vsak drobec znanja, ki ga učenec pridobi sam – vsak problem, ki ga sam reši – postane mnogo bolj njegov, kot bi bil sicer. Dejavnost uma, ki je spodbudila učenčev uspeh, koncentracija misli, potrebnih zanj, in vznemirjenje, ki sledi zmagoslavju, prispevajo k temu, da se dejstva vtisnejo v spomin, kot se ne bi mogla nobena informacija, ki jo je slišal od učitelja ali prebral v učbeniku.«[5]

S pomočjo tega pristopa je zgornja misel laže uresničljiva.

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Priloga: Anketni vprašalnik

1. Si že slišal za izraz "trajnostni razvoj"?
   DA/NE

2. Se ti zdi, da veš, kaj pomeni izraz "trajnostni"?
   DA/NE

3. Ker si odgovoril, da ne veš, kaj pomeni, si preberi tale opis: "Trajnostni razvoj je takšen način razvoja, ki zadošča današnjim potrebam, ne da bi pri tem ogrožal možnosti prihodnjih generacij, da zadostijo svojim lastnim potrebam." Svetovna komisija za okolje in razvoj (WCED), 1987
   Si zdaj razumel?
   DA/NE

4. Poskusi s svojimi besedami napisati, kaj pomeni ta izraz.

5. Primerjaj to, kar si napisal, z naslednjim opisom tega izraza: "Trajnostni razvoj je takšen način razvoja, ki zadošča današnjim potrebam, ne da bi pri tem ogrožal možnosti prihodnjih generacij, da zadostijo svojim lastnim potrebam." Svetovna komisija za okolje in razvoj (WCED), 1987
Se ti zdi, da si zadel pomen?
   DA/NE

6. Lahko rečemo tudi tako: – Trajnostni razvoj pomeni, da lahko neka dejavnost traja dolgo – tako rekoč neskončno, ne da bi se zaradi posledic svojega delovanja morala končati.
   Ali pa na primer: Ne-trajnosten razvoj pomeni, da tako izkorišča vire, ljudi ali okolje, da bodisi zmanjka virov ali pa ljudje ne zmorejo več, ali da okolje ni primerno za bivanje/obdelovanje.

Je sedaj še kaj bolj razumljivo?
   DA/NE

7. Pa preverimo, če res razumeš ta izraz – na primeru učenja na daljavo, ki je sedaj aktualno. Se ti zdi, da je to trajnostno – da bi lahko s takim šolanjem nadaljevali dolgoročno – mesece, morda celo leta?
   DA/NE

8. Odgovoril si z DA. Si prepričan? No, morda lahko trdiš zase, a vendarle je marsikomu težko in ne bi zdržal takega dela dolgo, morda znanje ni dovolj kvalitetno za uspešno šolanje naprej ... Se strinjaš?
   DA/NE

9. Verjetno res ne bo šlo na tak način še dolgo. Kaj pa bi morali spremeniti? No, to je kompleksno – zapleteno vprašanje. Lahko bi razdelili polja sprememb na tri dele – na tisto, kar lahko narediš TI, na tisto, kar bi lahko naredili UČITELJI, in tisto, kar bi lahko naredila država oz. MINISTRSTVO za šolstvo.
   Napiši nekaj, kar bi moral ti spremeniti PRI SEBI, da bi lahko nadaljeval s šolanjem na daljavo še dolgo časa. Poišči vsaj tri stvari.

10. Dobro, poskusi sedaj napisati tri stvari, ki bi jih po tvojem mnenju lahko (morali) spremeniti učitelji, da bi lahko poučevali na daljavo še dolgo. Poskusi najti vsaj tri stvari.

11. Sedaj po poskusi poiskati še kakšno stvar, ki bi jo lahko naredilo drugače Ministrstvo za šolstvo oz. država, da bi tak način dela lahko izvajali dolgoročno. Poišči vsaj ENO stvar.

12. Odlično! Hvala. Sedaj že bolje razumemo, kaj pomeni trajnostnost in kaj pomeni iskanje rešitev, če želimo nekaj narediti trajnostno. O trajnostnem razvoju, trajnostni mobilnosti, trajnostnem upravljanju naravnih bogastev se veliko govori v zadnjih letih. Zanima me, če si že kdaj slišal in razmišljal o trajnostnem razvoju našega ožjega okolja – na primer Občine Škofja Loka?
   DA/NE

13. Kje si izvedel kaj o tem?
   - V časopisih.
   - V šoli.
   - Doma.
   - Na internetu.
   - Na televiziji.

14. Se ti zdi, da se o tem dovolj govori, da se na tem dovolj dela?
   DA/NE

15. Imaš občutek, da lahko tudi sam kaj prispevaš k temu, da bi bilo naše delovanje bolj trajnostno?
   DA/NE

16. Napiši, na kakšen način bi lahko ti prispeval (ali že prispevaš) k temu – na primer, kaj lahko narediš glede skrbi za okolje, kaj v vsakdanjem življenju delaš ali bi lahko delal, da bo okolje dolgoročno v dobrem stanju. Poišči vsaj tri stvari.

17. Se ti zdi, da je to lahko? Kaj te najbolj ovira pri tem, da deluješ trajnostno?

18. Imaš kakšen predlog za boljšo trajnostno skrb in ravnanje z našim okoljem? Lahko gre za majhne stvari, lahko pa napišeš tudi, kaj bi morala narediti vsa družba, država ...

19. Katera od naslednjih stvari se ti zdi, da jo TI ali tvoja družina zavestno delate:
   - Pridelava domače hrane.
   - Kupovanje lokalno pridelane hrane.
   - Uporabljanje okolju prijaznejših čistil, škropiv, gnojil.
   - Kupovanje rabljenih stvari, naprav, oblačil.
   - Popravljanje okvarjenih naprav namesto kupovanja novih.

• Dosledno ločevanje odpadkov.
• Zavestna izbira hoje/kolesa ... namesto avtomobila.
• Varčevanje z vodo.
• Varčevanje z elektriko.
• Spodbujanje drugih k odgovornejšemu ravnanju.

20. V dokumentu Agenda 21 za Slovenijo, ki ga je leta 1995 pripravila skupina nevladnih organizacij pod vodstvom Umanotere, Slovenske fundacije za trajnostni razvoj, so načela trajnostne družbe povzeta takole:

- spoštovanje občestva življenja in odgovornost zanj,
- izboljševanje kakovosti človekovega življenja,
- ohranjanje vitalnosti in pestrosti Zemlje,
- čim korenitejše zmanjševanje izčrpavanja neobnovljivih virov,
- upoštevanje nosilne sposobnosti Zemlje,
- spreminjanje osebnega odnosa in ravnanja,
- usposabljanje skupnosti za samostojno in odgovorno ravnanje z okoljem,
- oblikovanje državnega okvira za povezovanje razvoja in ohranitve,
- ustvarjanje svetovnega zavezništva.

Se ti zdi, da sledimo tem ciljem izpred 25-ih let?

• Da.
• Še kar.
• Malo.
• Nič.

Učenci s posebnimi potrebami in šolanje na daljavo

Students with special needs and distance education

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POVZETEK

Z anketnim vprašalnikom smo raziskovali, kako so učenci s primanjkljaji na posameznih področjih učenja (v nadaljevanju PPU) in imajo dodatno strokovno pomoč doživljali pouk na daljavo med epidemijo covid-19 in kakšna so njihova stališča do takšnega izobraževanja. V vzorec je bilo vključenih 25 učencev. Ugotavljali smo, kje so bile težave, na katere pogoje bomo v prihodnosti morali biti bolj pozorni in kako se je izobraževanje na daljavo obneslo pri učencih z dodatno strokovno pomočjo. Merski instrument, s katerim smo preverjali zadovoljstvo učencev, je bil vprašalnik.

Izobraževanje na daljavo nas je postavilo v popolnoma novo situacijo, spremenil se je način izobraževanja in komunikacije. Spremembe so se še bolj dotaknile ranljivejših skupin, med katere sodijo tudi učenci s primanjkljaji na posameznih področjih učenja.

KLJUČNE BESEDE

Covid-19, učenci s posebnimi potrebami, IKT, šolanje na daljavo

ABSTRACT

With the help of a survey i researched how special needs students who lack certain abilities in individual areas of learning as well as receive additional professional help couped with online school during the Covid pandemic and their views on this type of education. 25 students were included in the sample. The mesaly instrument I used to review student satisfaction was a questionnaire. The aim of this report was to research where problems may have occurred, what conditions will have to be more vigilant in the future. Online school has put us in a whole new situation and our way of communication and education has changed. Changes have had a substantial negative effect on more vulnerable groups including special needs children.

KEYWORDS

Covid-19, students with special needs, IKT, distance education

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1 UVOD

Šolanje na daljavo je institucionalno organizirana in priznana oblika izobraževanja. Pri takšnem šolanju so učitelj in učenci med poukom navadno fizično ločeni. Govorimo torej o geografski ločitvi, kar pomeni, da so učitelj in učenci med poukom na različnih krajih.

Učenje na daljavo ima lahko za učence in učitelje v primerjavi s klasičnim poukom v razredu kar nekaj prednosti. Šolarji si lahko potek dela organizirajo sami, dostop do učnih vsebin je mogoč skoraj od povsod, prav tako pa takšen način šolanja učencu omogoča hiter dostop do povratne informacije. [1] Na drugi strani lahko tehnične težave upočasnijo celoten učni proces. [2]

S pričujočo raziskavo smo želeli dodatno osvetliti vidike šolanja na daljavo med epidemijo covid-19, stališča učencev, ki potrebujejo specifično obravnavo (prilagojen pouk, prostor in čas ter posebne oblike in metode dela) tovrstnega učenja v primerjavi s klasičnim poukom.

V raziskavo je bilo vključenih 25 šolarjev. Za potrebe raziskave smo oblikovali vprašalnik za učence, s katerim smo želeli ugotoviti, kakšna stališča imajo do takšnega načina šolanja.

1.1 Učenci s posebnimi potrebami v izobraževalnih programih s prilagojenim izvajanjem in dodatno strokovno pomočjo

V Navodilih za izobraževalne programe s prilagojenim izvajanjem in dodatno strokovno pomočjo za devetletno osnovno šolo je zapisana naslednja opredelitev: »V izobraževalni program osnovne šole s prilagojenim izvajanjem in dodatno strokovno pomočjo so usmerjeni otroci, za katere komisije za usmerjanje ocenijo, da imajo takšne razvojne in učne zmožnosti, da bodo, predvidoma s prilagojenim izvajanjem in dodatno strokovno pomočjo dosegli vsaj minimalne cilje oz. standarde znanja, določene v učnih načrtih za vse predmete v predmetniku osnovne šole za razred, v katerega se vključuje otrok s posebnimi potrebami.« [5]

Izraz primanjkljaji na posameznih področjih učenja označuje zelo raznoliko skupino primanjkljajev ali motenj, ki se kažejo z zaostankom v zgodnjem razvoju pozornosti, pomnjenja, mišljenja, koordinacije, komunikacije, branja, pisanja, pravopisa, računanja, socialnih sposobnostih in čustvenem dozorevanju. [3]

Ti primanjkljaji vplivajo na posameznikovo sposobnost interpretiranja zaznanih informacij oz. povezovanja informacij ter s tem ovirajo učenje temeljnih šolskih veščin, kot so branje, pisanje, pravopis in računanje. Motnje so notranje, nevrofiziološke narave in niso primarno pogojene z vidnimi, slušnimi ali motoričnimi okvarami, motnjami v duševnem razvoju, čustvenimi motnjami ali neustreznimi okoljskimi dejavniki, čeprav se lahko pojavljajo skupaj z njimi). [3]

V delu Kesič Dimic iz leta 2010 lahko zasledimo, da je za učence s primanjkljaji na posameznih področjih učenja značilno, da imajo načeto ali slabo samopodobo, imajo slabši slušni spomin (tako kratkotrajni kot dolgotrajni), težko se dalj časa osredotočijo na zastavljeno nalogo, vsaka malenkost jih hitro zmoti pri usmerjenjem delu, so spontani v izražanju, pogosto ne zmorejo nadzirati čustev, hitro se zmedejo (tudi, če so se snov hitro naučili), večinoma težje delajo v skupini, težje si zapomnijo zapletena ali dolgoročna navodila, težave se pojavijo pri koordinaciji (fina in groba motorika), imajo težave z grafomotoriko, imajo slab občutek za čas. [4]

Učenci s posebnimi potrebami imajo pogosto lahko tudi čustvene stiske, zato je še kako pomemben osebni stik z učencem. Delo specialnega pedagoga ni vezano samo na učenca samega, dobro mora sodelovati z učitelji in starši otrok s posebnimi potrebami, predstavlja pomembno vez med šolo, starši in učencem. Pri poučevanju na daljavo se je ta osebni, individualen pristop žal zelo zmanjšal. Informacijska tehnologija je postala nujno orodje, delo z učenci se je preselilo v spletno okolje (e-pošta, spletne učilnice, zoom, viber ...).

1.2 Analiza vprašalnika

Učenci so reševali anketo s pomočjo orodja 1ka - spletno anketiranje.

Na anketni vprašalnik je odgovorilo 25 učencev s primanjkljaji na posameznih področjih učenja (v nadaljevanju PPU), 16 dečkov in 9 deklic. Največ učencev je bilo iz 7. razreda (10), sledili so 8. razred, 5. razred in 6. razred s po tremi učenci, iz 3. razreda in 9. razreda dva učenca, iz 2. in 4. razreda pa po en učenec.

Na vprašanje, kako samostojen si bil/bila prielu za šolo na daljavo, je večina učencev (10) odgovorila, da so potrebovali nekaj pomoči, 7 jih je odgovorilo, da so večino ali vse delo opravili sami, 5 učencev je potrebovalo veliko pomoči, 3 učenci so odgovorili, da so zelo težko delali sami.

Kakšno se ti je zdelo delo za šolo od doma, v »domači učilnici«?

Kar 15 učencev je odgovorilo, da se jim je zdelo delo za šolo od doma »v redu«, trije so odgovorili, da jim je bilo zelo všeč, 6 učencem delo od doma ni bilo všeč, eden pa je izbral odgovor, da mu delo od doma sploh ni bilo všeč.

Kako samostojen/a si bil/a pri delu za šolo na daljavo?

Največ učencev (10) je izbralo odgovor, da so pri delu za šolo na daljavo potrebovali nekaj pomoči, 7 učencev je odgovorilo, da so vse delo za šolo opravili samostojno, 5 učencev je potrebovalo nekaj pomoči, trije učenci pa so potrebovali veliko pomoči.

Koliko časa dnevno si pri delu na daljavo porabil/a za šolsko delo (od ponedeljka do petka)?

Večina učencev je odgovorila, da je pri delu na daljavo porabila za šolsko delo dnevno 2 do 3 ure, 8 učencev 4 do 5 ur dnevno, 7 učencev več kot 5 ur in 1 učenec do 2 uri dnevno.

Kdo ti je pomagal, ko si potreboval/a pomoč pri delu na daljavo?

Pri tem vprašanju je bilo možnih več odgovorov.

23-krat je bil izbran odgovor starši, 17-krat učiteljica DSP, 5-krat brat ali sestra, 2-krat učitelj predmeta, pri katerem sem potreboval pomoč, 1-krat razrednik in 1-krat prijatelj.

Kako uspešen/a si bil/a pri opravljanju tedenskih učnih nalog?

20 učencev je odgovorilo, da jim je uspelo narediti vse naloge za tekoči teden, štirim je uspelo narediti polovico nalog za tekoči teden, en učenec pa je naredil manj kot polovico nalog za tekoči teden.

Kakšen se ti je zdel obseg (količina) snovi, ki jo je bilo treba opraviti doma v primerjavi z učnim delom, ko smo v šoli?

Večina učencev (11) je odgovorila, da je bil obseg snovi na daljavo prav takšen, kot je bil v šoli, 9 učencev meni, da je bil obseg snovi na daljavo večji, kot takrat ko smo bili v šoli, 3 učenci so izbrali odgovor, da je bil obseg snovi preobsežen in veliko večji kot takrat, ko so bili v šoli. Dva učenca sta napisala, da je bil obseg snovi manjši, vendar je bilo nalog več, eden pa je napisal, da je bilo manj nalog kot v šoli.

Ali si razumel učiteljeva navodila za delo?

12 učencev je izbralo odgovor, da so razumeli učiteljeva navodila, 12 jih meni, da so jih delno razumeli, en učenec pa učiteljevih navodil ni razumel in je potreboval pomoč.

Oceni, koliko rad/a se učiš in delaš v šoli v primerjavi z učnim delom doma – delo na daljavo!

12 učencev je odgovorilo, da so raje v šoli, sedmim učencem je bolj všeč šola na daljavo, petim učencem pa je všeč tako šolanje na daljavo kot tudi pouk v šoli.

Kako si bil/a zadovoljen/a z izvajanjem DSP na daljavo?

10 učencev je bilo zelo zadovoljnih z izvajanjem DSP na daljavo, 15 pa jih je izbralo odgovor dobro. Nihče ni bil nezadovoljen.

Kaj ti ni bilo všeč pri izvajanju DSP na daljavo?

Učenci so zapisali naslednje odgovore:

- da smo namesto učenja igrali miselne igre;
- vse je bilo v redu;
- bolj mi je všeč osebno;
- ne vem;
- slaba internetna povezava;
- da sem imel manj ur DSP kot v šoli;
- nič
- da sem imel 1 uro manj kot v šoli;
- ni mi bilo všeč, ker sem moral biti ves čas aktiven.

Kakšne oblike pomoči ti je ponudila učiteljica za DSP?

Pri tem vprašanju je bilo možnih več odgovorov. Največkrat so učenci izbrali odgovor, da jim je učiteljica za DSP razlagala učno snov in ponazorila postopke reševanja nalog. Sledijo odgovori: pojasnjevanje navodil, motiviranje za učno delo, posredovanje napotkov, gradiv, navodil.

Ali so učitelji pri pouku na daljavo upoštevali prilagoditve, ki jih imaš zapisne v individualiziranem načrtu?

12 učencev meni, da so učitelji upoštevali prilagoditve, šest učencev je izbralo odgovor ne vem, štirje menijo, da prilagoditve učitelji niso upoštevali, dva sta izbrala možnost drugo in zapisala, da so prilagoditve včasih upoštevali, včasih pa ne, en učenec pa je zapisal, da vseh prilagoditev ni bilo mogoče upoštevati pri pouku na daljavo.

Na katerem področju si bil pri pouka na daljavo prikrajšan zaradi specifičnih težav, ki jih imaš?

Učenci so zapisali naslednje odgovore:
- pri času pisanja;
- matematiki;
- TJA, SLJ, MAT;
- pozornost;
- osebni stik;
- nisem bila prikrajšana;
- nobenih;
- pri DSP sem izgubil uro,
- nisem bil;
- vzeli so mi eno uro DSP;
- nikjer.

Katere prilagoditve, ki jih potrebuješ, pri šolanju na daljavo niso bile upoštevane?

Učenci so zapisali naslednje odgovore:
- da potrebujem več časa za delo;
- razlaga;
- nobene;
- bile so vse;
- vse so bile;
- ne vem;
- ni bilo upoštevano, da potrebujem več časa pri kakšnem predmetu. Imel sem količinsko čisto enako nalog kot drugi učenci.

Kaj bi sporočil/a učiteljem glede pouka na daljavo?

Učenci sporočajo učiteljem glede šolanja na daljavo:
- da je bilo zelo dobro;
- da naj večkrat vprašajo, ali potrebujem kakšno pomoč;
- da že pri pouku napišemo snov v zvezke in ne potem sami;
- lahko bi bilo bolj zanimivo;
- več razlage snovi v živo;
- nič;
- ne vem;
- da bolj razlaga snovi in ne, da samo pišemo;
- dobra priprava videokonferenc in gradiv v spletni učilnici;
- da so opravili odlično delo.

Kaj bi sporočil/a učiteljici za DSP glede pouka na daljavo?

Učenci z odgovori sporočajo učiteljicam, ki izvajajo DSP:
- da naj ostanejo še naprej tako super, kot so;
- kul je bilo;
- bilo je v redu;
- nič;
- več razlage snovi v živo;
- dobro;
- bilo je super in bil sem vesel njene pomoči;
- da si želim še naprej uspešno sodelovanje;
- ne vem;
- da sem se počutil enako dobro kot v šoli;
- vse super;
- ne vem;
- da bi imeli vsi, ki hodimo na DSP svojo stran za pogovarjanje.

Če bi lahko izbiral, bi izbral:

9 učencev bi izbralo šolanje na daljavo, 12 pouk v šoli, dva učenca pa oboje.

Število odgovorov o zadovoljstvu s posameznimi elementi je podano v tabeli 1.

Tabela 1: Število odgovorov na posamezna vprašanja

	Odlično	Dobro	Slabo	Zelo slabo	Ne vem
dostopom do informacij v spletni učilnici	6	15	2	1	0
povratnimi informacijami glede oddanih nalog	3	15	3	3	0
dostopnostjo učiteljev	4	19	1	0	0
prilagajanjem gradiv	3	14	4	2	1
organizacijo pouka in videokonferenc	5	15	3	1	0
razlago snovi pri videokonferencah	3	16	4	1	0
ocenjevanjem	7	12	2	0	3
izvajanjem DSP	12	10	1	1	0
pomočjo učiteljev	3	14	4	1	2
upoštevanjem posebnih potreb, ki jih potrebujem pri učenju	4	11	5	3	0

2 ZAKLJUČEK

Šolanje od doma med epidemijo in zaprtjem šol je za učitelje in šolarje pomenilo velik izziv, saj se je prvič v zgodovini v velikem delu sveta izobraževanje popolnoma prestavilo v virtualno okolje ter zahtevalo hitro priučitev in prilagoditev metod in načinov dela z uporabo IKT.

Za učence PPU je značilno, da so zelo heterogena skupina in so večinoma vključeni v redne osnovne šole, zato je za vse učitelje potrebno dobro poznavanje posameznih podskupin in značilnosti, da lahko pomagajo otroku in prav zaradi tega je bilo pomembno, da smo raziskali, kako je potekalo izobraževanje učencev s PPU.

Pomembno je spoznanje, da so se učenci s težavami na posameznih področjih učenja večinoma dobro prilagodili na spremenjen način pouka, saj je večina učencev odgovorila, da jim je bilo šolanje od doma všeč. Pri šolskem delu jih je večina potrebovala pomoč, ki so jim jo ponudili starši, učiteljica za dodatno in strokovno pomoč, stari starši, sorojenci …

Podatki prikazujejo, da je večina učencev pri delu na daljavo porabila za šolsko delo dnevno 2 do 3 ure, prav toliko učencev je potrebovalo 4 do 5 ur dnevno, 7 učencev pa več kot 5 ur. Večina učencev, kar 80 % vprašanih je opravilo redno tedensko naloge, nekaj jih je opravilo polovico danih nalog, en učenec pa ni delal nalog. Učiteljice za dodatno strokovno pomoč so vse ure izvajale neposredno preko aplikacije ZOOM. To se je očitno izkazalo za zelo uspešno, saj so bili vsi učenci zadovoljni z izvajanjem ur DSP. Pomoč so potrebovali pri razlagi učne snovi in ponazoritev postopkov, pomoč pri reševanju nalog, pojasnjevanju navodil, motiviranju za učno delo, posredovanju napotkov, gradiv in navodil.

Prilagoditve, ki jih imajo učenci zapisane v individualiziranem načrtu, so učitelji večinoma upoštevali, štirje učenci so napisali, da jih niso. Navedli so, da so bili prikrajšani pri podaljšanem času opravljanja nalog in pri razlagi.

Zelo pozitivno je, da so učenci pohvalili delo učiteljev, sporočajo pa, da v prihodnje prosijo učitelje, da večkrat ponudijo pomoč učencem, da bi zapisovali snov že med videokonferencami, da bi bile razlage snovi bolj zanimive in bi bilo več videokonferenc.

Učiteljicam za dodatno strokovno pomoč sporočajo, da so bili zadovoljni, da si želijo še več razlage snovi v živo, da so se počutili zelo dobro in predlagajo, da se jim v prihodnje omogoči poseben kanal za komunikacijo učencev, ki imajo DSP:

Zanimiv je podatek, da bi ob ponovnem šolanju na daljavo skoraj 40 % vprašanih učencev izbralo pouk na daljavo, več kot polovica pa bi si želela pouka v šoli.

Pridobljene informacije so za vse strokovne delavce zelo koristne predvsem pri načrtovanju vzgojno-izobraževalnega procesa v prihodnje in če bi se šole znova zapirale in bi pouk potekal na daljavo.

ZAHVALA

Zahvaljujemo se učencem za iskrenost in doslednost pri izpolnjevanju vprašalnika ter ravnateljici za podporo pri raziskovanju.

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Težave pri izobraževanju odraslih na daljavo

Difficulties in teleworking adult education

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POVZETEK

V članku je strnjen prikaz težav, ki so se izpostavile pri izobraževanju odraslih v času epidemije in dela na daljavo. Rezultati so omejeni na vodje izobraževanja odraslih, učitelje in udeležence izobraževanja odraslih. Skupek rezultatov nam poda pregled skupnih težav vseh vpletenih v proces izobraževanja na daljavo. Problematika je aktualna, saj je pogosto obravnavano redno izobraževanje, redkeje pa izobraževanje odraslih, ki se bo v prihodnjih letih še razširilo. Število udeležencev izobraževanja odraslih se namreč povečuje v skladu s politiko vseživljenjskega učenja. Podatki in rezultati članka temeljijo na raziskavah Andragoškega centra Republike Slovenije. Cilj članka je strnjeno osvetliti in prikazati težave, ki nastopajo v procesu izobraževanja odraslih in zavirajo napredek izobraževanja odraslih v procesu izobraževanja odraslih. Z opisom težav se jih lahko zavedamo in jih s skupnimi močmi odpravimo ter omogočimo boljše rezultate na področju izobraževanja odraslih, večje zadovoljstvo učiteljev in udeležencev.

KLJUČNE BESEDE

Izobraževanje odraslih, odrasli, delo na daljavo, izobraževanje odraslih na daljavo

ABSTRACT

The article highlights the problems of online adult education during the epidemic and teleworking. Outcomes are limited to adult education leaders, teachers, and adult education participants. The set of results gives us an overview of the common problems of all those involved in the distance learning process. The issue is important since there has been many articles regarding regular education but not as much describing adult eduction, the number of which is growing steadily. This increase is due to lifelong learning policy. The article is based on the results of the surveys by the Andragogy Center of the Republic of Slovenia. The article aims to summarize the problems that occur in the process of distance learning adult education, which inhibit the progress of adult. The purpose is also to raise awareness of the problems in order to find solutions and greater satisfaction of teachers and participants in adult education.

KEYWORDS

Adult education, adults, teleworking, online adult education

1 UVOD

Izobraževanje na daljavo je oblika izobraževanja z dvema temeljnima značilnostma: učitelj in učenec sta med poučevanjem prostorsko ločena, komunikacijo med njima in komunikacijo med učenci samimi pa omogočajo različne vrste tehnologij. Unesco opredeljuje izobraževanje na daljavo kot »vzgojno-izobraževalni proces in sistem, v katerem pomemben delež pouka izvaja nekdo ali nekaj, ki je časovno in prostorsko odmaknjeno od učenca. Pri izobraževanju na daljavo je tehnološka podpora celostno in načrtno integrirana v vse prvine vzgojno-izobraževalnega procesa, vpeta je tako v pedagoško kot administrativno podporo ter učno gradivo, kar omogoča izvajanje učnega procesa ob fizični ločenosti učitelja in učenca [2].

V novejšem času so v porastu hibridne prakse, ki kombinirajo sinhrono in asinhrono komunikacijo med učiteljem in učencem ter med učenci. Te prakse združujejo uporabo elektronske pošte, diskusijske skupine, spletne strani, klepeta, okolja z več uporabniki in spletnega oddajanja. Omogočajo jih različna spletna učna okolja (npr. spletne učilnice Moodle, MS Teams, Zoom) z več prednostmi (nalaganje datotek, forumi, klepeti, integrirani videokonferenčni sistemi itd.). Omejitev teh okolij pa za posameznika predstavlja potencialno preveliko število takšnih okolij in njihovih možnosti [1].

V spletni šoli opravijo udeleženci program v celoti prek spleta, učitelji pa so jim dostopni prek spletnih aplikacij ali telefona. Večina učnih gradiv in usmeritev jim je posredovanih preko spleta (asinhrono) z nekaterimi sinhronimi učnimi urami. Udeleženci se lahko učijo kjer koli in kadar koli, prek računalnika in internetne povezave, nekatere spletne šole pa zahtevajo prisotnost na sinhrono izvajanih učnih urah [1].

Hibridna šola predstavlja temeljni program za svoje udeležence (enako kot spletna šola), značilno zanjo pa je, da ima definirano fizično lokacijo, na kateri so učenci redno prisotni pri pouku, nimajo pa rednega urnika kot tradicionalne šole.

Učenci opravljajo spletne tečaje oz. dostopajo do spletnih vsebin. Dopolnilni in/ali dodatni spletni tečaji obsegajo vso vsebino nekega predmeta, učenci jih lahko opravijo prostorsko in časovno neodvisno, obenem pa obiskujejo klasično šolo. Večina navodil oziroma pouka poteka asinhrono z možnostjo razširitve s sinhronimi učnimi urami. Dopolnilni in/ali dodatni spletni tečaji s spletnim učiteljem (onsite teacher) so raznoliki, razmerje med količino samostojnega dela z gradivi ter interakcije z učiteljem pa močno variira. Učenec dela z učiteljem sam ali v majhni skupini učencev. Digitalne vsebine in programska oprema, ki omogoča trening veščin, so gradiva, ki jih uporabljajo učitelji v tradicionalni šoli kot del rednega pouka ali za učenčevo domače delo. Vsebino oblikuje ponudnik ali učitelj sam, lahko pa učitelj uporablja oboje. Umeščena je na učiteljevo spletno stran, v spletno učno okolje (learning management system –

LMS) ali aplikacijo. V našem prostoru je bila uporaba tehnologije za namene poučevanja do prvega vala epidemije raziskovana predvsem kot del pouka v živo [1].

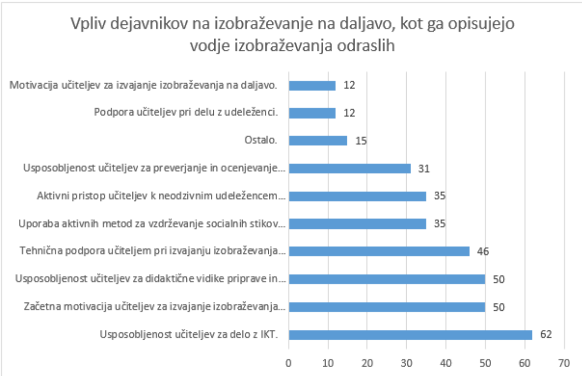
2 REZULTATI

V spletni šoli opravijo učenci ves program v celoti prek spleta, učitelji pa so jim dostopni prek spletnih aplikacij ali telefona. Večina učnih gradiv in usmeritev je učencem posredovana prek spleta (asinhrono) z nekaterimi sinhronimi učnimi urami. Učenci se učijo kjer koli in kadar koli, prek računalnika in internetne povezave. Nekatere spletne šole zahtevajo prisotnost na sinhrono izvajanih učnih urah. Hibridna šola predstavlja temeljni program za svoje učence (enako kot spletna šola), značilno zanjo pa je, da ima definirano fizično lokacijo, na kateri so učenci redno prisotni pri pouku, nimajo pa rednega urnika kot tradicionalne šole. Učenci opravljajo spletne tečaje oz. dostopajo do spletnih vsebin. Dopolnilni in/ali dodatni spletni tečaji obsegajo vso vsebino nekega predmeta, učenci jih lahko opravijo prostorsko in časovno neodvisno, obenem pa obiskujejo klasično šolo. Večina navodil oz. pouka poteka asinhrono z možnostjo razširitve s sinhronimi učnimi urami. Dopolnilni in/ali dodatni spletni tečaji s spletnim učiteljem (onsite teacher) so raznoliki, razmerje med količino samostojnega dela z gradivi ter interakcije z učiteljem pa močno variira. Učenec dela z učiteljem sam ali v majhni skupini učencev. Digitalne vsebine in programska oprema, ki omogoča trening veščin, so gradiva, ki jih uporabljajo učitelji v tradicionalni šoli kot del rednega pouka ali za učenčevo domače delo. Vsebino oblikuje ponudnik ali učitelj sam, lahko pa učitelj uporablja oboje. Umeščena je na učiteljevo spletno stran, v spletno učno okolje (learning management system – LMS) ali aplikacijo. Programska oprema za ocenjevanje znanja in prikaz rezultatov daje možnosti preverjanja in ocenjevanja znanja, največkrat pa jo (v ZDA) uporabljajo na ravni šole ali na nacionalni ravni [1].

V našem prostoru je bila uporaba tehnologije za namene poučevanja do prvega vala epidemije raziskovana predvsem kot del pouka v živo. V svoji razpravi o inovativnih učnih okoljih [3] omenja različna pojmovanja inovativnih učnih okolij in v sklopu pojmovanja inovativnega učnega okolja kot tehnološko podprtega sistema navajata deset kategorij učnih okolij, podprtih z informacijsko komunikacijsko tehnologijo (IKT), po našem mnenju uporabnih tudi pri poučevanju na daljavo:

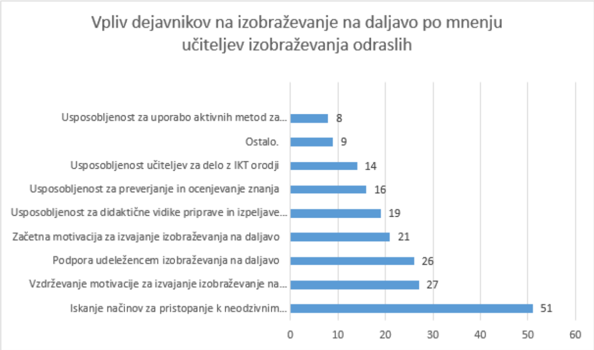
1. usposabljanje s pomočjo računalnika (učna enota, preverjanje in povratna informacija prek računalniškega zaslona, učenec napreduje na naslednjo raven, ko opravi predhodne),
2. multimedia (poučevanje, sestavljeno iz vizualnih delov, npr. ilustracije, videoposnetki, in besedilnih delov, npr. natisnjenih ali govorjenih),
3. interaktivna simulacija (omogočajo nadzor učenca, npr. spreminjanje vhodnih parametrov),
4. hipertekst in hipermedia (učna gradiva, sestavljena iz povezav na klik),
5. inteligentni tutorski sistemi (sistemi, ki učencu prilagajajo učno pot),
6. pridobitev informacij preko uporabe sodobnih e-storitev in zapletov,
7. animirani pedagoški posredniki (liki, ki vodijo učenca skozi učno enoto na računalniku),
8. virtualna okolja s posredniki (vizualno resnična okolja, ki simulirajo interakcije z resničnimi ljudmi in uporabljajo tudi resnični jezik),
9. didaktične igre (igre, ki so namenjene poučevanju),
10. računalniško podprto sodelovalno učenje in projektno delo [3].

V nadaljevanju so prikazani rezultati anket vodij izobraževanja, učiteljev in udeležencev izobraževanja odraslih. V anketah so predstavljeni odgovori, ki po mnenju anketirancev predstavlja oviro pri uspešnem izvajanju izobraževanja odraslih. Anketa je opravljena na manjšem številu anketirancev, ki so izpostavili težave pri delu na daljavo. Iz tega razloga ankete in sklepi temeljijo na osnovi vzorčne skupine anketirancev in ne predstavljajo natančnega stanja, ampak so strnjen prikaz stanja na področju problematike izobraževanja na daljavo izobraževanja odraslih [1].



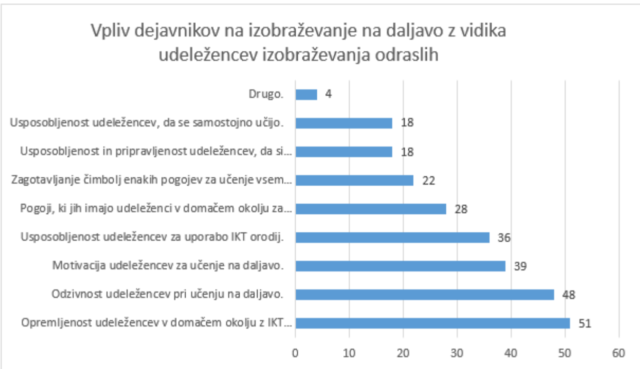
Graf 1: Na grafu je predstavljenih več dejavnikov, ki vplivajo na kakovost izobraževanja na daljavo, stolpci na desni pa prikazujejo njihovo vrednost, kot so jo opisali vodje izobraževanja odraslih. Število ob stolpcu predstavlja odstotek vprašanih, ki so posamezni dejavnik izbrali kot največjo težavo pri delu na daljavo[1].

Na Grafu 1 lahko jasno vidimo, da je največji delež vprašanih kot največjo težavo opisal usposobljenost učiteljev za delo z IKT. Iz tega lahko sklepamo, da moramo posodobiti izobraževanje učiteljev in v sistem vključiti vse sodobne tehnologije za izobraževanje na daljavo, s katerimi so bili soočeni ob pandemiji Covid-19. To velja tako za izobraževanje odraslih kot tudi za ostale učitelje, ki so bili postavljeni pred enak izziv. Ta rešitev bi vključila tudi naslednje tri dejavnike, za katere so anketiranci odločili, da predstavljajo ravno tako pomemben del težav izobraževanja na daljavo in jih v grafu vidimo nad opisanim dejavnikom. Začetna motivacija učiteljev bi bila višja, če jim nove tehnologije ne bi bile tuje in bi v njih videli mnogo možnosti, s katerimi lahko motivirajo sebe in udeležence izobraževanja za učenje. Poleg tega bi izobraževanje izpopolnilo tudi njihovo znanje z didaktičnega vidika in jim nudilo tehnično podporo tudi med letom, ne le v začetku.



Graf 2: Dejavniki, ki najbolj vplivajo na kakovost izobraževanja na daljavo po mnenju učiteljev izobraževanja odraslih [1].

Na Grafu 2 je za razliko od Grafa 1 prikazano mnenje učiteljev izobraževanja odraslih, ki nakazuje, da največja težava ni v sami usposobljenosti ali motivaciji učiteljev, temveč v neodzivnosti udeležencev izobraževanja. Omejitev spletnih orodij in izobraževanja na daljavo je ravno predstavljeni dejavnik, kjer udeleženci, ki se ne vključujejo v spletne aktivnosti nimajo nobenih koristi od njega, niti ga učitelji ne morejo prisiliti v sodelovanje. Ta težava je deloma odgovornost posameznega udeleženca, ki se mora za opravljanje programa aktivno vključevati v vse dogodke programa. Drugi vzrok pa je lahko znanje IKT udeležencev, ki morajo za vključevanje znati uporabljati programe in spletna orodja, ki jih uporabljajo učitelji. Posledično je ključno, da tudi udeležencem izobraževanja zagotovimo ustrezna izobraževanja, znanje in pripomočke, s katerimi se bodo lahko aktivno vključili v program. Tudi naslednji dejavnik, vzdrževanje motivacije za izvajanje izobraževanja je precej odvisen od udeležencev in učiteljev, ter njihovega znanja uporabe orodij, ki bi ga lahko rešili z opisanimi rešitvami.



Graf 3: Mnenje udeležencev izobraževanja odraslih o dejavnikih, ki najbolj vplivajo na kakovost izobraževanja na daljavo [1].

Na grafu 3 pa je prikazano mnenje udeležencev izobraževanja odraslih, ki nakazuje, da je največja težava izobraževanja odraslih opremljenost z IKT opremo v domačem okolju. V situaciji, v kateri smo se znašli, smo se morali vsi zelo hitro prilagoditi, hkrati pa je najpomembneje, da smo si pridobili vse pripomočke za izvajanje izobraževanja na daljavo, kot so ustrezen računalnik, računalniški sistemi in programi ter na primer spletne kamere, slušalke in zvočniki. Pričakovano pa je, da odrasli udeleženci, ki tega do sedaj niso potrebovali tudi niso imeli, velika možnost pa je tudi, da si tega niso mogli priskrbeti iz finančnih ali drugih vzrokov. Zanimivo je, da so tudi udeleženci sami ugotovili, da niso bili dovolj odzivni, da bi bilo izobraževanje kakovostno izvedeno, kar se sklada z ugotovitvijo učiteljev na Grafu 2. Pomembno pa je poudariti, da prvi opisani dejavnik, pomanjkanje pripomočkov, vpliva na vse ostale dejavnike kot so odzivnost in motivacija udeležencev ter njihova usposobljenost za uporabo IKT.

Na grafih 1, 2 in 3 so prikazani nekateri pomembni dejavniki, ki vplivajo na kakovost izvedbe izobraževanja odraslih na daljavo, ki pa se med seboj močno povezujejo. Kot opisano, bi bila enostavna rešitev pripraviti sistem izobraževanja učiteljev in udeležencev izobraževanja, ki bi vključevala sistem spletnih okolij za izvedbo izobraževanja. Najbolj enostavno bi bilo, da bi se javni učni zavodi v Sloveniji poenotili in izbrali en skupen sistem, po katerem bi potekalo izobraževanje na daljavo na več stopnjah, tako v osnovnih kot srednjih šolah in po možnosti na fakultetah ter na izobraževanju odraslih. Poleg tega bi morali udeležencem izobraževanja in učiteljem skozi izobraževanje nuditi tehnično podporo, poleg tega pa udeležencem nuditi tudi pripomočke za izvedbo programa, ki so opisani zgoraj.

3 ZAKLJUČEK

Pri primerjavi vseh treh grafov lahko sklepamo, da pri izobraževalnih institucijah največ težav predstavlja usposobljenost učiteljev in mentorjev za delo z IKT opremo, naslednja šibka točka, je motivacija izvajalcev andragoškega izobraževalnega procesa. Sklepam, da večinoma učitelji in mentorji niso vajeni nenadne spremembe načina poučevanja. Neposredni izvajalci so večino časa izvajali proces v neposrednem stiku z udeleženci izobraževanja odraslih. Metode poučevanja so se za večino zelo močno spremenile v smislu načina poučevanja, uporabljenih pripomočkov in pa občutkov pri načinu podajanja snovi. Pri udeležencih izobraževanja odraslih se srečujemo z s starostno močno različnimi skupinami. Največ težav se izkazuje pri opremljenosti in znanju uporabe IKT opreme. Odzivnost udeležencev izobraževanja je močno odvisna od posameznika. Skupni imenovalec učiteljev in udeležencev izobraževanja je slaba začetna motivacija in vzdrževanje motivacije, ki je posledica sodelovanja preko IKT opreme ne pa v fizičnem stiku in socialnih stikih. Predlog avtorja članka je krepitev didaktičnih kompetenc za izobraževanje na daljavo v smislu izobraževanj. Opremljanje z ustrezno IKT opremo učiteljev in udeležencev izobraževanja odraslih. Poenotenje uporabe spletnih orodij za izobraževanje na daljavo. Glede na hitre spremembe pa lahko ugotovimo, da se z vsakim dnem dela na daljavo razmere izboljšujejo, saj uporabniki pridobivajo izkušnje in znanje glede izobraževanja na daljavo.

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Digitalizacija doma

Digitalized home

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POVZETEK

Sodoben bivanjski prostor postaja pametni dom. To je digitalizirana oblika enodružinske zasebne stavbe, ki je domovanje ali počitniška hiša družine. Opremljena je z avtomatiziranimi, digitaliziranimi in v sistem povezanimi napravami in modernimi tehnologijami, ki delujejo v komunikacijskem omrežju, in omogočajo boljše udobje, varčevanje z energijo, lažje in bolj učinkovito vzdrževanje, večjo varnost stanovalcev in druge prilagoditve doma načinu življenja družine. Stanovalci imajo dostop do storitev in nadzor nad delovanjem sistema preko posebnih prikazovalnikov in krmilnikov, kot so stenski zasloni; preko osebnih pametnih naprav, kot so pametni telefoni, tablični računalniki ali pametne ure; preko daljinskih upravljalnikov ter računalnikov in/ali več naprav hkrati. Članek predstavlja opremo in uporabo pametne hiše ter združevanje pametnih hiš v pametna mesta s stališča sedanjosti in s pogledom v prihodnost. Digitalizacija doma je zelo aktualna tematika, zato jo vsebinsko vključujemo v predavanja in vaje predmeta Varovanje informacijskih sistemov v drugem letniku višješolskega strokovnega programa Varovanje.

KLJUČNE BESEDE

Digitalizacija, pametni dom, pametno mesto

ABSTRACT

Intelligent home is becoming a modern dwelling. This is a digitalised form of a single-family private building, the home, or the holiday house of a family. It is equipped with automated and digitalised devices and modern technologies, connected to a system, which operate in a communication network, and provide a better comfort, energy saving, an easier and more efficient maintenance, better safety for the residents, and other adjustments of the home to the way of life of the family. The residents have access to the services and control over the operation of the system through specific displays and controls, such as wall screens; through personal smart devices, such as smart phones, tablet computers, or smart watches; via remote controls and computers, and/or several devices at the same time. This paper presents the equipment and use of an intelligent home as well as the integration of intelligent houses into intelligent cities, from the point of view of the present and with a view to the future. Digitisation of homes is a very topical subject, which is why we include it in the lectures and tutorials of the Information Systems Security course in the second year of the Security higher educational programme.

KEYWORDS

Digitisation, intelligent home, intelligent city

1 UVOD

Tehnologija pametnega doma, ki jo pogosto imenujejo tudi avtomatizacija doma ali domotika (iz latinskega "domus", kar pomeni dom), lastnikom domov zagotavlja varnost, udobje in energijsko učinkovitost, tako da jim omogoča nadzor pametnih naprav, pogosto s pametno domačo aplikacijo na svojih pametnih telefonih ali drugih omrežnih napravah. Internet stvari (IoT), pametni domači sistemi in naprave pogosto delujejo skupaj, medsebojno izmenjujejo podatke o porabi potrošnikov in avtomatizirajo ukrepe na podlagi preferenc lastnikov domov [12]. Naprave je mogoče samodejno nadzorovati na daljavo od koderkoli z uporabo mobilne ali druge omrežne naprave. Pametni dom ima svoje naprave med seboj povezane preko interneta, ki nadzoruje funkcije, kot so ogrevanje, klimatizacija, prezračevanje, upravljanje z električno energijo ter varnostne sisteme in domači kino [9].

Pametni dom je sestavljen iz več pametnih aplikacij, ki so v večini primerov povezane med seboj in je do njih mogoče dostopati prek osrednje točke. Primeri osrednjih točk so prenosniki, tablični računalniki, pametni telefoni ali druge pametne naprave [9]. Bistveni del je povezovanje osrednjih sistemov - elektrike, vode in varnostnih sistemov. Senzorji so bistveni za spremljanje vsakega sistema in zbiranje podatkov. Ti podatki, ko jih analiziramo, nam pomagajo pri odločitvi o razporeditvi virov. Obremenitve, povezane z vsako nadzorno napravo, morajo biti prednostne, od najvišje do najnižje. Varnost podatkov in zasebnost sta bistvenega pomena, ne glede na vrsto stavbe - dom ali poslovni prostor.

Izraz, s katerim se lahko srečamo, je tudi povezan dom. Gartner je povezane domače rešitve opredelil na naslednji način: »Povezane rešitve za dom sestavlja niz naprav in storitev, ki so povezane med seboj z internetom in se lahko samodejno odzovejo na pred-nastavljena pravila, dostopajo do njih in upravljajo mobilne aplikacije ali brskalnik na daljavo in uporabnikom pošljejo opozorila ali sporočila« [6].

Pametni dom se zdi "inteligenten", ker lahko njegovi računalniški sistemi spremljajo toliko vidikov vsakdanjega življenja. Hladilnik lahko na primer nadzoruje vsebino, predlaga menije in nakupovalne sezname, priporoča zdrave alternative in celo naroči živila. Sistemi pametnih domov bi lahko zagotovili celo stalno očiščeno škatlo za smeti za mačke ali zalivali hišno rastlino [2].

Pomemben del pametnega doma je, da lahko zmanjšamo režijske stroške in odpravimo težavo, tako da se napaka ne ponovi. Natančen problem je mogoče takoj ugotoviti in odpraviti. Pametni domovi delajo ljudi produktivne in varne, okolje pa zdravo. Infrastruktura pomaga lastnikom in operaterjem, da sprejmejo učinkovite rešitve za kakršna koli vprašanja in izboljšajo zanesljivost. "Pametno" daje na videz neživim stvarem novo dimenzijo in zasluga gre hitro rastočemu internetu stvari (IoT).

Vsebine, povezane z digitalizacijo doma, kot zelo aktualno tematiko vsebinsko vključujemo v predavanja in vaje predmeta Varovanje informacijskih sistemov v drugem letniku višješolskega strokovnega programa Varovanje. S tem študentom zagotovimo sodobno znanje, ki ga bodo v profesionalnem življenju uporabili v praksi, saj bodo usposobljeni za svetovanje in pomoč pri učinkovitem zagotavljanju varnosti domov in drugih objektov.

2 TEHNOLOGIJA V PAMETNIH DOMOVIH

Tehnologija pametnih domov je splošni izraz, ki se nanaša na osnovne pripomočke za dom, ki so opremljeni s komunikacijsko tehnologijo in omogoča določeno stopnjo avtomatizacije ali daljinskega upravljanja.

Tehnologija vključuje tudi različne naprave, kot so ZigBee, Z-Wave, Lutron in Wink. To so sistemi, ki združujejo vse vaše pametne naprave in vam omogočajo eno vozlišče za dostop do ostalih naprav, tako da se lahko povežete od kjer koli želite v domu ali zunaj njega [3].

Doslej je bil razvoj pametnih domačih tehnologij modularen, poleg nekaj eksperimentov ali namenskih projektov. Danes modularni razvoj sestavljajo programi, ki lastnikom pametnih domov omogočajo, da dodajo ali odvzemajo pametne naprave [3].

Tehnologija pametnega doma postaja vse bolj izpopolnjena. Kodirani signali se žično ali brezžično pošiljajo na stikala in vtičnice, ki so programirani za upravljanje naprav v vseh delih doma. Avtomatizacija doma je lahko še posebej koristna za starejše, osebe s telesnimi ali kognitivnimi okvarami in invalide, ki želijo samostojno živeti. Tehnologije v pametnemu domu: Pametni televizorji se povežejo z internetom in dostopajo do vsebin prek aplikacij, kot sta video na zahtevo in glasba. Nekateri pametni televizorji vključujejo tudi prepoznavanje glasu ali kretnje; Pametni sistemi razsvetljave Hue podjetja Philips Lighting Holding BV, ki poleg tega, da jih je mogoče nadzorovati na daljavo in jih prilagoditi, lahko zaznajo, kdaj so uporabniki v prostoru in po potrebi prilagodijo osvetlitev; Pametne žarnice se lahko regulirajo tudi glede na razpoložljivost dnevne svetlobe; Pametni termostati, kot je Nest podjetja Nest Labs Inc. so opremljeni z integriranim Wi-Fi-jem, ki uporabnikom omogoča načrtovanje, spremljanje in daljinsko nadziranje temperatur na domu. Te naprave se tudi naučijo vedenja lastnikov stanovanj in samodejno spreminjajo nastavitve, da prebivalcem zagotavljajo maksimalno udobje in učinkovitost. Pametni termostati lahko med drugim poročajo o porabi energije in uporabnike opomnijo, naj med drugim zamenjajo filtre; S pametnimi ključavnicami za vhodna in garažna vrata lahko lastniki dovolijo ali onemogočijo dostop obiskovalcem. Pametne ključavnice lahko zaznajo tudi, kdaj so stanovalci v bližini in odklenejo vrata; S pametnimi varnostnimi kamerami lahko prebivalci nadzirajo svoje domove, ko so odsotni ali na dopustu; Pametni senzorji gibanja prav tako lahko ugotovijo razliko med lastniki, obiskovalci, hišnimi ljubljenčki in vlomilci ter lahko obvestijo organe pregona, če odkrijejo sumljivo vedenje; Nega hišnih ljubljenčkov je mogoče avtomatizirati s povezanimi hranilniki; Hišne rastline in trato lahko zalivate s pomočjo povezanih ur; Na voljo so kuhinjski aparati vseh vrst, vključno s pametnimi aparati za kavo, ki vam lahko skuhajo svežo skodelico takoj, ko se prebudite; Pametni hladilniki, ki spremljajo datume roka uporabnosti, sestavljajo nakupovalne sezname ali celo ustvarjajo recepte na podlagi trenutne zaloge hrane; Monitorji gospodinjskih sistemov lahko na primer zaznajo električni tlak in izklopijo naprave. Lahko zaznajo zamašeno cev in okvaro vodovoda in izklopijo vodo, tako da v kleti ne pride do poplave [12]; V kuhinji imajo pametne pečice digitalne termometre za uravnavanje toplote vaše posode ko kuhate. Funkcija zagotavlja, da ne boste prekuhali obroka. Je tudi dodatna varnostna funkcija za zaščito pred požari; Pametne rokavice zaznajo temperaturo kože in izberejo oblačila, ki ustrezajo tem odčitkom. Če menite, da vaša garderoba potrebuje posodobitev, lahko kupite oblačila prek spleta; Oblačila lahko izberete tudi s pomočjo pametnega ogledala. Če se ne morete odločiti za ustrezno barvo, so zdaj na voljo pametna oblačila, ki lahko spremenijo odtenke, odvisno od vašega razpoloženja; Starejše ljudi lahko spremljate s pomočjo varnostnih kamer; Pametni telefoni imajo dostop do dnevnih prostorov; Obstajajo tudi senzorji gibanja, ki lahko opozorijo ljudi, v primeru kriminalnega dejanja; Pametni tuši lahko predhodno pripravijo želeno temperaturo vode [13].

Tehnologija pametnega doma je tudi igrača premožnih, kot je dom Billa Gatesa v zvezni državi Washington imenovana Xanadu 2.0, ki je tako visokotehnološka, da obiskovalcem omogoča celo izbiro glasbe za razpoloženje za vsako sobo, ki jo obiščejo [2].

Slika 1: Tehnologija v pametnih domovih

2.1 Domotika in avtomatizacija doma

Področje domotike obsega vse faze tehnologije pametnega doma, vključno z zelo izpopolnjenimi senzorji in krmilniki, ki spremljajo in avtomatizirajo temperaturo, osvetlitev, varnostne sisteme in številne druge funkcije [2].

Avtomatizacija doma omogoča oddaljen dostop do naprav v gospodinjstvu in je mogoče nadzorovati in prilagajati različne kontrole z razdalje, kot so temperatura, svetlobni sistemi, gospodinjski aparati in paketi za domači kino. Pametni pripomočki so povezani s vozliščem, kot so stenski terminali, računalniki, spletni vmesniki ali aplikacije za pametne telefone. Uporabniki lahko dostopajo do teh naprav prek teh vozlišč na spletu. Zaradi zanesljivosti tega sistema na svetovnem spletu je bil uveden izraz Internet stvari (IoT). IoT je koncept, ki funkcije interneta širi izven običajnega računalništva. Ponuja platformo, da naprave medsebojno komunicirajo. Mednje spadajo sistemi za spremljanje varnosti na domu, detektorji dima, hladilniki, ključavnice vrat, pralni stroji, gospodinjski roboti za čiščenje in merilniki porabe energije [13].

Večina gospodinjstev že ima nekatere pametne naprave: digitalne televizorje, računalnike z dostopom do interneta, mikroprocesorske naprave. Vedno večji odstotek gospodinjstev je naredil prve korake v prihodnost z internetno televizijo, brezžičnimi varnostnimi sistemi in naraščajočim številom glasovnih naprav in pametnimi telefoni [1].

Da bi bili domovi resnično “pametni” potrebujemo senzorje, aktuatorje in naprave, ki upoštevajo ukaze in zagotavljajo informacije o stanju. Na trgu je že na stotine, če ne na tisoče pametnih izdelkov za dom. Te so se v zadnjih letih razvile od preprostih senzorjev vrat in svetlobnih stikal do pametnih termostatov, kot so naprave Nest in naprave na govorni ukaz, kot je Amazon Echo [1].

Potrebni so protokoli in orodja, ki vsem tem napravam omogočajo medsebojno komunikacijo. Aplikacije za pametne telefone, komunikacijska središča in storitve v oblaku omogočajo praktične rešitve, ki jih je trenutno mogoče implementirati [1].

Pametni dom ustvarja priložnosti za podjetja na področjih, kot so varnost na domu, upravljanje z energijo in zdravstvena oskrba. Podjetja, ki prodajajo varnostne alarme, detektorje dima in senzorje za vodo, lahko nudijo daljinsko spremljanje in poročanje. S staranjem prebivalstva bodo storitve daljinskega spremljanja starejšim in kronično bolnikom omogočale, da še naprej živijo v svojih domovih [1].

Avtomatizacija doma izvaja nadzor doma od okenskih senčil do podajalnikov za hišne živali s preprostim pritiskom na gumb ali glasovnimi ukazi. Nekatere dejavnosti, na primer nastavitev svetilke, ki jo lahko prižgete in izklopite, so preproste in relativno poceni, medtem ko napredne nadzorne kamere zahtevajo več časa za učenje [5].

2.4 Pametna mesta

Pametna mesta prevzamejo koncept pametnega doma tako, da uporabljajo internet stvari (IoT) v celotnem mestu. V omrežje so povezane različne naprave, ki zagotavljajo nadzor pri vsakodnevnih mestnih operacijah.

Če naprave uporabimo v večjem obsegu lahko pomagajo pri učinkovitejšem upravljanju mestnih virov, kot so vodovodna omrežja, elektroenergetska omrežja, odstranjevanje odpadkov, kazenski pregon, baze podatkov in upravljanje bolnišnic. Pametna tehnologija z informacijami in komunikacijo (IKT) lahko prav tako pomaga izboljšati interakcijo med ljudmi. Sistemi za zbiranje podatkov lahko analizirajo, kako prebivalstvo uporablja različne vrste tehnologije. Analiza teh informacij bo mestu pomagala učinkoviteje odreagirati glede na potrebe ljudi. Na primer s pomočjo podatkov IoT je zdaj mogoče raziskati ali mesto postaja bolj okoljsko odgovorno kot celota [13].

Obstaja več načinov, kako lahko IoT pomaga k uspehu pametnega mesta. Nekatera mesta uporabljajo pametne aplikacije za parkiranje, ki ljudem omogočajo, da najdejo najugodnejšo parkirno mesto. To je omogočeno s pomočjo podatkov, zbranih iz senzorjev, ki analizirajo območja za parkiranje. Pametne aplikacije omogočajo nadzor javnega prevoza in nadzor prometa v času prometnih zastojev [13].

Slika 2: Pametna mesta

3 PRIMERJALNA ANALIZA

Predstavljajmo si, da se bomo v bližnji prihodnosti zbudili v pametnem domu, v katerem bo pametna naprava samodejno zaznala, da smo se zbudili, in začela s predhodno programirano jutranjo rutino. Voda za prhanje se bo segrela na nastavljeno temperaturo, tako da lahko tuš takoj uporabimo. Po prhanju bomo že imeli pripravljene obleke. Ko bomo prišli v kuhinjo, bo kava že skuhana in pripravljena na pametnem kavnem avtomatu. Poleg tega bo že pripravljen toast. Po končanem zajtrku bo hladilnik zaznal porabo in razliko uvrstil na naš nakupovalni seznam. Naprava bo samodejno zaznala, kdaj bomo zapustili dom in zaklenila vrata, vključila varnostni sistem in ugasnila luči. Čez dan lahko dom na daljavo nadziramo preko spletnih kamer. Ko zapustimo službo, lahko pametna kuhinja že začne pripravljati vnaprej izbrano večerjo, ki bo končana do našega prihoda domov [9].

Z umetno inteligenco in zmogljivostjo strojnega učenja bodo naši domovi končno dobili pametno nadgradnjo, ki jo obupno potrebujejo. Naši gospodinjski aparati bodo imeli razširjene zmogljivosti in sposobnost intuitivnega povezovanja, z uporabo platforme IoT. Leta 2020 je bilo z internetom že povezanih približno 31 milijard naprav, število pa naj bi do leta 2025 naraslo na 75,4 milijarde [11].

Napovedi prihodnosti pametnih domov s tehnologijo, ki jo poganjata PoE in IoT je Umetna inteligenca: Pametni domovi bodo lahko spremljali vašo lokacijo v domu, bodisi prek elektronskega zatiča, ki ga nosite na oblačilih ali elektronskih senzorjev znotraj doma. Pametni dom bo vedel, kdo in kje ste, te podatke pa bo uporabil za sprejem in celo predvidevanje vaših potreb. Ta tehnologija pozicioniranja se že uporablja v domu Billa Gatesa. Pametni dom bo lahko prilagodil ogrevanja, hlajenja, glasbo in razsvetljavo, vse na podlagi zahtev osebe, ki prebiva v njem; Pametna razsvetljava: Pametna razsvetljava, ki jo poganja in nadzira PoE, bo spremenila način osvetlitve naših domov.

Pametna razsvetljava se samodejno prilagodi tako, da zazna prisotnost stanovalca v prostoru in ko stanovalec zapusti prostor, se naprave bodisi popolnoma izključijo ali ugasnejo. Senzorji lahko po določenem času ugasnejo luči, ko se uležete v posteljo. Če se na primer zbudite sredi noči in greste v kopalnico, se prižgejo luči, da boste našli pot do kopalnice. Ko se spet uležete v posteljo, se bo luč še enkrat ugasnila. Lahko nastavite svetlost luči, da ne bodo preveč svetle, ko se vklopijo sredi noči. Vaš pametni dom si bo zapomnil vašo konfiguracijo, tako da boste lahko vsako napravo v svojem domu prilagodili po svojih željah;

Pametne ključavnice lahko v primerjavi s pametno osvetlitvijo programirate glede na vaše potrebe. Obiskovalcem se lahko odobri ali zavrne dostop na podlagi določenih identifikatorjev. Serviserjem lahko dostop do doma omogoči posebna avtorizacijska koda, medtem ko neznani vsiljivci ne bodo imeli možnost vstopa;

Spremljanje doma: Pametni varnostni sistemi lahko samostojno nadzirajo dom in o morebitnih incidentih brez poročajo lastniku stanovanja in po potrebi organom pregona. Poleg tega lahko pametni domovi spremljajo starejše ljudi, ki živijo sami, kot dodatna pomoč, da bi jim pomagali in jih opomnili, naj vzamejo zdravila in poskrbijo, da bodo vsakodnevne naloge uspešno in varno opravljene. V primeru, da se kaj zgodi - nepričakovan padec - je mogoče obvestiti najbližji zdravstveni dom in se reševalce samodejno spustiti v prostor, da pomagajo [11].

4 ZAKLJUČEK

V zadnjih nekaj letih so pametni domovi pridobili priljubljenost po tehnološkem napredku v vseh gospodarskih panogah. V sporočilu za javnost Market Watch, objavljenem leta 2019, se pričakuje, da se bo trg pametnih domov do leta 2023 dvignil za 25 % letno. To rast pospešujejo dejavniki, kot so potrebe lastnikov stanovanj ali najemnikov za izboljšanje njihove energetske učinkovitosti in veliko povpraševanje po varnostnih napravah. V zvezi s pametnimi domačimi napravami se ljudje odločajo za izdelke, ki so varni, cenovno dostopni, lahko dostopni in priročni. Novi izdelki pametnih domov še naprej naredijo življenje bolj udobno in veliko bolj stilsko.

Glede na raziskavo, ki jo je leta 2019 izvedla Mordor Intelligence, trg pametnih domov raste zaradi inovativnosti brezžične tehnologije in napredka v IoT (Internet of Things). Poročilo kaže, da se bo do leta 2024 skupna letna stopnja rasti povečala za 25 %. Področja, v katere bodo velika vlaganja v prihodnje, so nadzorni in varnostni sistemi, sistemi za zabavo in nadzor klime ter sistemi za upravljanje z energijo. V bližnji prihodnosti naj bi po poročilu Mordor Intelligence za leto 2019 več kot 30 milijonov svetovnih gospodinjstev v celoti sprejeto tehnologijo pametnih domov [10].

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Primerjava simetričnih algoritmov

Comparison of symmetric algorithms

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POVZETEK

Algoritmi šifriranja na splošno temeljijo na matematiki in se lahko gibljejo od zelo preprostih do zelo zapletenih procesov, odvisno od njihove zasnove. Imajo pomembno vlogo pri zagotavljanju varnosti zaupnih podatkov pred nepooblaščenimi napadi. Obstajajo tri tehnike šifriranja: simetrično šifriranje, asimetrično šifriranje in funkcije razpršitve (brez ključa). Simetrični algoritmi za šifriranje uporabljajo isti šifrirni ključ za šifriranje in dešifriranje, za razliko od asimetričnih algoritmov šifriranja, ki uporabljajo dva različna ključa. Simetrični algoritmi veljajo za varnejše od algoritmov asimetričnih ključev. Nekaj simetričnih algoritmov velja za skoraj nezlomljive. V osnovi je izbira kriptografske metode odvisna od zahtev aplikacije, kot so odzivni čas, pasovna širina, zaupnost in integriteta. Vendar ima vsak kriptografski algoritem svoje šibke in močne točke. Algoritmi simetričnih ključev so tudi zelo hitri, zato se pogosto uporabljajo v situacijah, ko je veliko podatkov, ki jih je potrebno šifrirati. V članku so primerjani nekateri simetrični algoritmi glede na arhitekturo, razširljivost, prilagodljivost, zanesljivost ter varnost z namenom olajšati izbiro primernega algoritma uporabnikom za varno pošiljanje podatkov preko spleta. Ker gre za zelo aktualno tematiko, jo aktivno vključujemo v predavanja in vaje predmeta Varnost in zaščita v drugem letniku višješolskega strokovnega programa Informatika, kjer se študenti o njej poučijo po komparativni metodi.

KLJUČNE BESEDE

Kriptografija, simetrično in asimetrično šifriranje, arhitektura in varnost algoritmov

ABSTRACT

Encryption algorithms are generally based on mathematics and can range from very simple to very complex processes, depending on their design. They play an important role in ensuring that confidential data is secure from unauthorised attacks. There are three encryption techniques: symmetric encryption, asymmetric encryption and hash functions (keyless). Symmetric encryption algorithms use the same encryption key for encryption and decryption, whereas asymmetric encryption algorithms use two different keys. Symmetric algorithms are considered more secure than asymmetric key algorithms. There are a few symmetric algorithms which are considered almost unbreakable. Basically, the choice of cryptographic method depends on the requirements of the application, such as response time, bandwidth, confidentiality and integrity. However, every cryptographic algorithm has its weak and strong points. Symmetric key algorithms are also very fast, so they are often used in situations where a lot of data need to be encrypted. This paper compares some symmetric algorithms in terms of architecture, scalability, flexibility, reliability and security, with the aim of facilitating the selection of the appropriate algorithm for users to send data via the Internet securely. As it is a very topical subject, it is actively included in the lectures and tutorials of the Safety and Security course in the second year of the Informatics programme, where students are taught about it using a comparative method.

KEYWORDS

Cryptography, symmetric and asymmetric encryption, architecture and algorithm security

1 UVOD

Kriptologija je veda o tajnosti, šifriranju, zakrivanju sporočil (kriptografija) in o razkrivanju šifriranih podatkov (kriptoanaliza). Ukvarja se s študijem in razvojem metod in metodologij za šifriranje, kjer se običajno uporabljajo skrivni ključi, s katerimi je mogoče dešifrirati šifrirano sporočilo ali informacijo. Omogoča shranjevanje zelo občutljivih informacij ali njihov prenos preko nezavarovanega omrežja (kot je Internet) na tak način, da jih ne more prebrati nihče, razen tistega, kateremu je informacija namenjena. Sodobna kriptografija je sestavljena iz različnih študijskih področij. Nekatera najpomembnejša so tista, ki obravnavajo simetrično šifriranje, asimetrično šifriranje, zgoščevalne funkcije in digitalne podpise. Protokol Bitcoin uporablja kriptografske metode, da zaščiti omrežje in zagotovi veljavnost vsake transakcije.

Kriptografija simetričnega ključa (ali simetrično šifriranje) se je v zadnjih desetletjih v veliki meri uporabljala za olajšanje tajne komunikacije med vladami in vojsko. Dandanes se algoritmi simetričnih ključev pogosto uporabljajo v različnih vrstah računalniških sistemov za povečanje varnosti podatkov. Simetrično šifriranje se zanaša na en sam ključ, ki si ga delita dva ali več uporabnikov. Isti ključ se uporablja za šifriranje in dešifriranje tako imenovanega odprtega besedila (ki predstavlja sporočilo ali del podatkov, ki se kodira). Proces šifriranja je sestavljen iz navadnega besedila (vnosa) prek šifrirnega algoritma, imenovanega šifra, ki nato generira šifrirano besedilo (izhod). Z uporabo simetričnih algoritmov za šifriranje se podatki pretvorijo v obliko, ki je ne more nihče razumeti in tudi nihče nima skrivnega ključa za dešifriranje. Ko prejemnik, ki ima ključ, dobi sporočilo, algoritem obrne svoje dejanje tako, da se sporočilo vrne v prvotno in razumljivo obliko. Skrivni ključ, ki ga uporabljata pošiljatelj in prejemnik, je lahko določeno geslo/koda ali pa je lahko naključni niz črk ali številk, ki jih je ustvaril varen generator naključnih števil. Če je šifrirna shema dovolj močna, je edini način, da oseba prebere ali dostopa do informacij, ki jih vsebuje šifrirano besedilo, z uporabo ustreznega ključa za njihovo dešifriranje. Postopek dešifriranja v bistvu pretvori šifrirano besedilo nazaj v navadno besedilo.

Dve najpogostejši sodobni shemi simetričnega šifriranja temeljita na blokovnih in tokovnih šifrah. Nekateri algoritmi podpirajo oba načina, drugi samo en način. V tokovnem načinu je vsaka številka (običajno en bit) vhodnega sporočila šifrirana ločeno. V blokovnem načinu kriptografski algoritem razdeli vhodno sporočilo v niz majhnih blokov fiksne velikosti, nato pa bloke šifrira ali dešifrira enega za drugim. Blokovne šifre združujejo podatke v bloke z vnaprej določeno velikostjo, vsak blok pa se šifrira z ustreznim ključem in algoritmom šifriranja (npr. 128-bitno navadno besedilo je šifrirano v 128-bitno šifrirano besedilo). Po drugi strani tokovne šifre ne šifrirajo podatkov navadnega besedila z bloki, temveč z 1-bitnimi koraki (1-bitno navadno besedilo je naenkrat šifrirano v 1-bitno šifrirano besedilo). Blokovna šifra naenkrat šifrira en blok podatkov s fiksno velikostjo. V blokovnem šifriranju bo dani blok navadnega besedila vedno šifriran na isti šifrirani tekst, če uporablja isti ključ, medtem ko bo isti navadni tekst šifriran na drugačen šifrirani tekst v tokovni šifri. V bločnem šifrirnem algoritmu je najpogosteje uporabljena Feistelova šifra, poimenovana po kriptografu Horstu Feistelu (IBM). Feistelova šifra je model oblikovanja, iz katerega izhaja veliko različnih blokovnih šifer (npr. DES) in združuje elemente zamenjave, permutacije (transpozicije) in razširitve ključev [11]. Prednost zasnove Feistelove šifre je v tem, da sta stopnji šifriranja in dešifriranja podobni, včasih enaki, s čimer se dramatično zmanjša velikost kode ali vezja, ki je potrebna, da se šifra implementira v programsko ali strojno opremo.

V članku primerjamo nekatere simetrične algoritme glede na arhitekturo, razširljivost, prilagodljivost, zanesljivost ter varnost, kakor jih primerjamo v okviru predavanj in vaj pri predmetu Varnost in zaščita v drugem letniku višješolskega strokovnega programa Informatika.

Komparativno razmišljanje je ena prvih in najbolj naravnih oblik človekovega mišljenja. Učenje po komparativni metodi zagotavlja razumevanje podobnosti in razlik, izboljša pomnjenje, hkrati pa zagotavlja tudi sposobnost evaluacije [10].

Namen takega načina poučevanja je olajšati študentom izbiro primernega algoritma za varno pošiljanje podatkov preko spleta.

2 SIMETRIČNI ALGORITMI

Da bi uporabili ustrezen algoritem v določeni aplikaciji, moramo poznati njeno moč in omejitev. Dobro pa je poznati tudi lastnosti posameznega algoritma, zato nekatere v nadaljevanju na kratko opišemo.

2.1 DES

Data Encryption Standard (DES) je najbolj znan bločni šifrirni postopek s simetričnim ključem. Temelji na dveh zelo splošnih konceptih – produktnih šifrirnih postopkih ter Feistelovih šifrirnih postopkih. Oba koncepta vključujeta ponavljanje skupne sekvence oziroma zaporedja operacij. DES je bil razvit v zgodnjih sedemdesetih letih prejšnjega stoletja v IBM-u. Po pozivu ameriškega Nacionalnega urada za standarde (NBS, sedaj: NIST), da bi predlagal kandidata za zaščito občutljivih nerazvrščenih vladnih podatkov, je IBM predlagal DES algoritem. NBS je po posvetovanju z ameriško Nacionalno varnostno agencijo (NSA) leta 1976 sčasoma izbrala nekoliko spremenjeno različico, ki je bila okrepljena proti diferencialni kriptoanalizi, vendar je bila oslabljena z napadi z grobo silo. Leta 1977 je bil objavljen kot uradni zvezni standard za obdelavo informacij (FIPS) za ZDA. DES je nastal kot izpeljanka šifrirnega algoritma, ki ga je uporabljala ameriška vojska in je uporabljala 64-bitni ključ [5].

2.2 Triple DES

Trojni DES (3DES, Triple-DES, TDEA) pomeni algoritem trojnega šifriranja podatkov in je nadgrajena različice algoritma DES. 3DES je bil razvit za premagovanje pomanjkljivosti algoritma DES in je bil uporabljen v poznih devetdesetih letih. Pred uporabo 3DES-a uporabnik najprej generira in distribuira 3DES ključ K, ki je sestavljen iz treh različnih DES ključev K1, K2 in K3. To pomeni, da ima dejanski ključ 3DES dolžino $3 \times 56 = 168$ bitov [6].

3DES trikrat uporabi algoritem DES za vsak podatkovni blok. Zaradi tega je 3DES veliko težje razbiti kot DES. Je tudi pogosto uporabljen algoritem šifriranja v plačilnih sistemih, standardih in tehnologijah v finančni industriji. Prav tako je postal del kriptografskih protokolov, kot so TLS, SSH, IPsec in OpenVPN [6].

2.3 IDEA

International Data Encryption Algorithm (IDEA) sta razvila James L.Massey in Xuejia Lai v Zuerichu in objavila leta 1990. To je manjša revizija starejše šifre PES (angl. Proposed Encryption Standard). IDEA se je prvotno imenoval IPES (izboljšan PES) in je bil razvit, da bi nadomestil DES. Struktura algoritma je bila izbrana tako, da je pri uporabi različnih ključnih pod blokov proces enkripcije enak postopku dešifriranja. Patent zanj ima Ascom-Tech iz Švice. Obstajata dva glavna razloga, da se IDEA ne uporablja tako pogosto, kot je bilo načrtovano. Prvi je dejstvo, da je IDEA podvržena vrsti šibkih ključev. Drugi razlog je, da trenutno obstajajo hitrejši algoritmi, ki proizvajajo enako raven varnosti. IDEA je simetrična blok-šifra, ki za vhodni 28-bitni ključ sprejme 64-bitni ključ in izvede 8 enakih krogov za šifriranje, v katerih se uporablja 6 različnih podključev in štirje ključi za izhodno transformacijo [2][5].

2.4 Blowfish

Blowfish je bil prvič objavljen leta 1993. Gre za simetrično blokovno šifro s spremenljivo dolžino ključa od 32 do 448 bitov in velikostjo bloka 64 bitov. Blowfish se lahko uporablja kot neformalna zamenjava za DES ali IDEA in je idealen za domačo in komercialno uporabo Blowfish je zasnoval Bruce Schneier kot hitro in brezplačno alternativo obstoječim algoritmom šifriranja. Od takrat je bil precej analiziran in počasi postaja priljubljen kot robusten šifrirni algoritem, noben napad ni znan kot uspešen. Blowfish ni patentiran, ima brezplačno licenco in je prosto dostopen za vse [4] [5].

2.5 AES - Rijndael

Napredni standard šifriranja AES (angl. Advanced Encryption Standard) je odobril NIST konec leta 2000 kot nadomestilo za DES. Postopek se je začel z zahtevami NIST za objavo novega simetričnega algoritma in predlogov. Zahteve so pokazale, da mora biti novi algoritem hiter in delovati pri starejših računalniki z 8-bitnimi procesorji ter 32-bitnimi in 64-bitnimi procesorji. NIST je v svojih zahtevah določil, da mora novi standardni algoritem za napredno šifriranje biti blok šifra, ki lahko obdeluje 128-bitne bloke s ključi velikosti 128, 192 in 256 bitov. AES uporablja algoritem Rijndael in deluje na metodah substitucije in permutacije [1].

2.6 AES - RC6

Razvili so ga Ronald Rivest, Sidney in Yin leta 1998. RC6 uporablja rotacije, odvisne od podatkov. Funkcije RC6 vključujejo uporabo štirih delovnih registratorjev namesto dveh in vključitev množenja številk kot dodatno varnost. Uporaba množenja števil močno poveča difuzijo, doseženo na krog, kar omogoča večjo varnost, manj krogov in večjo prepustnost. Glavna pomanjkljivost RC6 algoritma je njegova uporaba 32 bitnih rotacijskih spremenljivk v množiteljih integriranih podatkovnih tipih in zato naj ne bi bila najbolj primerna za uporabo na določenih platformah. RC6 ponuja dobro zmogljivost v smislu varnosti in združljivosti.

2.7 AES - Serpent

Oblikovali so ga Ross Anderson, Eli Biham in Lars Knudsen leta 1998. Uporablja 256-bitni ključ, 128-bitni blok in deluje v načinu XTS. Serpent je bločna šifra in ne uporablja Feistelovih krogov. Na videz je preprost, z uporabo navadnih 4-bitnih S-polj brez dodatnih vhodov in standardnih operacij računalniške logike. Vključuje tudi začetno permutacijo in inverzno začetno permutacijo, tako da se S-polja lahko izvajajo z logičnimi operacijami namesto iskanjem tabel. To je mogoče, ker se osem S-polj, ki jih uporablja algoritem, uporablja zaporedno in ne vzporedno [8] [13].

2.8 AES - Twofish

Twofish je naslednik Blowfish-a in tako kot njegov predhodnik uporablja simetrično šifriranje, zato je potreben le en 256-bitni ključ. Ta tehnika je ena najhitrejših algoritmov šifriranja in je idealna tako za strojno kot programsko okolje. Ko je bil Twofish izdan, je bil finalist natečaja Nacionalnega inštituta za tehnologijo in znanost (NIST) za iskanje nadomestka za šifrirni algoritem Data Encryption Standard (DES) [13].

2.9 AES - MARS

Šifrirni algoritem MARS je razvil IBM. To je simetrična šifra ključa, ki uporablja 128-bitne bloke in podpira spremenljive velikosti ključev (od 128 do 1248 bitov). Algoritem je omrežje Feistel tipa 3, ki je besedno (32-bitno) usmerjeno. Besedna orientacija bi morala prinesti uspešnost pri implementaciji programske opreme na večino danes dostopnih računalniških arhitektur. MARS je edinstven po tem, da združuje skoraj vse tehnike oblikovanja, ki so znane kriptografom v enem algoritmu. Uporablja seštevanje in odštevanje, polja S, fiksne in od podatkov odvisne rotacije ter množenje [3].

2.10 CAST-128

CAST-128 (ali CAST5), opisan v RFC 2144, je DES-u podoben kriptografski algoritem za zamenjavo-permutacijo, ki uporablja 128-bitni ključ, ki deluje na 64-bitnem bloku. CAST-256 (ali CAST6), opisan v RFC 2612, je razširitev CAST-128, ki uporablja 128-bitno velikost bloka in ključ s spremenljivo dolžino (128, 160, 192, 224 ali 256 bitov). CAST je dobil ime po svojih razvijalcih, Carlisle Adams in Stafford Tavares in je na voljo po vsem svetu.

2.11 ARIA

ARIA je 128-bitna blokovna šifra, ki jo je leta 2003 oblikovala skupina korejskih strokovnjakov. Leta 2004 jo je korejska agencija za tehnologijo in standarde izbrala kot standardno kriptografsko tehniko. Velikost bloka je 128 bitov. Velikosti ključa so: 128, 192 ali 256 bitov označene kot ARIA-128, ARIA-192 in ARIA-256. Število krogov za te tri različice je 12, 14 in 16.

2.12 CHACHA20_POLY1305

Pretočna šifra ChaCha20 in preverjevalnik Poly1305 sta kriptografska algoritma, ki ju je oblikoval Daniel J. Bernstein z namenom zagotoviti visoko stopnjo varnosti, hkrati pa doseči visoko zmogljivost. IETF je objavil RFC7905 in RFC7539 za spodbujanje uporabe in standardizacije pretočne šifre ChaCha20 in preverjevalnik Poly1305 v protokolu TLS. RFC7539 določa, kako združiti pretočno šifro ChaCha20 in Poly1305 za izdelavo sheme avtentificiranega šifriranja s povezanimi podatki (AEAD) za zagotovitev zaupnosti, celovitosti in verodostojnosti podatkov.

ChaCha 20 uporablja simetrično šifriranje, Poly1305 pa se uporablja za preverjanje pristnosti v OpenSSL in NSS. ChaCha 20 je pri izvedbah samo s programsko opremo veliko hitrejši od AES. Na platformah, ki nimajo specializirane strojne opreme AES, je ChaCha 20 približno 3-krat hitrejši.

Poly1305 ustvari MAC (angl. Message Authentication Code) in ga doda v šifrirano besedilo. Med dešifriranjem algoritem preveri MAC, da se prepriča, da nihče ni spremenil šifriranega besedila. ChaCha20 za šifriranje uporablja ključ in IV (inicializacijska vrednost, nonce) za šifriranje navadnega besedila v šifrirani besedilo enake dolžine. Na koncu je dolžina šifriranega in navadnega besedila različna [7].

2.13 Kamelija

Kriptografski algoritem s tajnim ključem in blokovno šifro sta skupaj razvila Nippon Telegraph in Telephone (NTT) Corporation in Mitsubishi Electric Corporation (MEC) leta 2000. Kamelija ima nekaj skupnih značilnosti z AES: velikost 128-bitnega bloka, podpora za 128-, 192- in 256-bitne dolžine ključev ter primernost za programsko in strojno implementacijo na običajnih 32-bitnih procesorjih in 8-bitnih procesorjih (npr. pametne kartice, kriptografska strojna oprema in vgrajeni sistemi). Opisana je tudi v RFC 3713. Aplikacija kamelija v IPsec je opisana v RFC 4312, uporaba v OpenPGP pa v RFC 5581. Kamelija je del protokola NESSIE.

2.14 Simon in Speck

Simon in Speck sta par lahkih blokovnih šifer, ki jih je leta 2013 predlagala NSA, namenjenih za zelo omejena programska ali strojna okolja. Medtem ko se obe družini šifer dobro obneseta tako v strojni kot programski opremi, je bil Simon optimiziran za visoko zmogljivost na strojnih napravah, Speck pa za delovanje v programski opremi. Oba sta Feistelove šifre in podpirata deset kombinacij velikosti bloka in ključa.

3 PRIMERJAVA SIMETRIČNIH ALGORITMOV

Naša primerjava nekaterih simetričnih algoritmov temelji na določenih parametrih, kot so arhitektura, varnost, razširljivost (hitrost šifriranja, uporaba pomnilnika, strojna oprema programske opreme zmogljivost in računski čas), omejitve in prilagodljivost. V nadaljevanju bomo primerjali nekatere simetrične algoritme po preprosti metodologiji. Uporabili smo spletne vire, kot so priročniki, in raziskovalni članki, ter proučevali izvorne kode. Vsak algoritem je bil ovrednoten na podlagi prej omenjenih parametrov.

3.1 Arhitektura

Arhitektura določa strukturo in operacije, ki jih algoritem lahko definira, njegove lastnosti in način njihove izvedbe. Določa tudi, ali je algoritem simetričen ali asimetričen, se pravi, ali uporablja tajni ali javni ključ za šifriranje in dešifriranje.

DES temelji na hrbtenici koncepta Feistelove strukture. Ključ je dolžine 64 bitov, od tega se 56 bitov uporablja za šifriranje in 8 za preverjanje napak. DES pretvori 64-bitne bloke podatkov iz navadnega besedila v šifrirano besedilo tako, da ga razdeli na dva ločena 32-bitna bloka in za vsak postopek neodvisno uporabi postopek šifriranja. To vključuje 16 krogov različnih procesov kot so razširitev, permutacija, zamenjava ali operacija XOR z okroglim ključem skozi katere bodo šli podatki med šifriranjem. Na koncu se kot izhod ustvarijo 64-bitni bloki šifriranega besedila. Čeprav imamo na razpolago le 56 bitov obstaja 7,2 x1016 (256) različnih možnosti za izbiro ključa.

Bločni šifrirni postopek IDEA šifrira 64 bitne bloke izvornega sporočila v 64 bitne bloke šifriranega sporočila z uporabo 128 bitnega vhodnega ključa. Njegova podlaga je posplošen model Feistelove strukture. Sestavljen je iz 8 računsko identičnih faz, ki jim sledi še transformacija izhodnega rezultata. 128-bitni ključ je razdeljen na osem 16-bitnih podblokov, ki se nato neposredno uporabijo kot prvih osem ključnih v bloku. 128-bitni ključ se ciklično pomakne v levo za 25 položajev, nato pa se dobljeni 128-bitni blok ponovno razdeli na osem 16-bitnih podblokov, ki se neposredno uporabijo kot naslednji osmi ključni podblok. Postopek cikličnega premika se ponavlja, dokler niso ustvarjeni vsi potrebni 52 16-bitni podbloki ključa [5].

Blowfish je tudi simetrični Feistel strukturirani algoritem sestavljen iz 2 delov: del razširitve ključa in del šifriranja podatkov. Deluje na blokih dolžine 64 bitov in ključi, ki so lahko dolgi do 448 bitov. Računsko precej zahteven postopek razširitve ključa naredi osemnajst 32 bitnih podključev in 8 x 32 bitne S škatle, ki se izpeljejo iz vhodnega ključa [4].

CAST-128/256 temelji na hrbtenici koncepta Feistelove strukture. CAST-128 (CAST5), opisan v RFC 2144, je DES-u podoben kriptografski algoritem za zamenjavo-permutacijo, ki uporablja 128-bitni ključ, ki deluje na 64-bitnem bloku. CAST-256 (ali CAST6), opisan v RFC 2612, je razširitev CAST-128, ki uporablja 128-bitno velikost bloka in ključ s spremenljivo dolžino (128, 160, 192, 224 ali 256 bitov). Vsebuje tudi 4 S-škatle algoritem, ki se uporablja v obratnem načinu za dešifriranje.

Trojni DES izvede 3 ponovitve šifriranje DES na vsakem bloku. Ker gre za izboljšano različico DES temelji na konceptu Feistelove strukture. 3DES uporablja 64-bitno navadno besedilo z 48 krogi in dolžino ključa 168-bitov, pretvorjenih v 16 podključev, vsak s 48-bitno dolžino. Tudi vsebuje 8 S-polj in isti algoritem je uporabljen v obratnem za dešifriranje. 3DES uporablja tri primerke DES na istem navadnem besedilu. Uporablja različne vrste tehnike izbire ključev, najprej so vsi uporabljeni ključi različni, na drugem sta dva ključa enaka, eden je drugačen, v tretjem pa so vsi ključi enaki [5].

AES temelji na Feistelu strukturi z dolžino bloka 128 bitov in možnimi različnimi dolžinami ključa: 126, 192 in 256 bitov. Deluje nad 128 bitnimi bloki podatkov, ki predstavljajo stanja. Stanja so predstavljena obliki 4 x 4 matrik 8 bitnih zlogov. AES se izvaja kot zaporedje različnih funkcij nad stanji, ki se izvajajo v zaporednih ciklusih. Med postopkom šifriranja sistem AES preide 10 krogov za I28-bitne ključe, 12 krogov za I92-bitne ključe in 14 krogov za 256-bitne ključe, da dostavi končno šifrirano besedilo ali pridobi izvorni AES z navadnim besedilom. Preden pride do zadnjega kroga, gre ta rezultat skozi devet glavnih krogov, med vsakim od teh krogov se izvedejo štiri transformacije; 1- podbajti, 2- premik vrstic, 3- stolpci za mešanje, 4- dodajanje okrogle tipke. V zadnjem (10.) krogu ni transformacije stolpca. Dešifriranje je obratni postopek šifriranja in uporablja inverzne funkcije: inverzni nadomestni bajti, vrstice s obratnim premikom in stolpci inverzne mešanice.

AES - RC6 je Feistelov strukturirani algoritem zasebnega ključa, ki uporablja 128-bitno navadno besedilo z 20 krogi in spremenljivo dolžino ključa 128, 192 in 256 bitov. Ker RC6 deluje po principu RC, lahko vzdržuje širok razpon dolžin besed, velikosti ključev in število krogov, RC6 ne vsebuje polj S in isti algoritem se uporablja pri obrnjenem za dešifriranje.

AES Serpent je simetrični algoritem ključa, na katerem temelji nadomestna permutacijska mreža. Sestavljen je iz 128 bitov navadnega besedila z 32 krogi in spremenljivo dolžino ključa 128, 192 in 256 bitov. Vsebuje tudi 8 S-polj in isti algoritem se uporablja v obratnem vrstnem redu za dešifriranje [8] [13].

AES Twofish tudi temelji na Feistelu strukturi. AES je blok šifra, ki uporablja 128-bitno navadno besedilo s 16 krogi in spremenljivo dolžino ključa 128, 192, 256 bit. Uporablja 4 S-škatle (odvisno od ključa) in isti algoritem se uporablja v obratnem načinu za dešifriranje [13].

AES MARS temelji na heterogeni strukturi in uporablja 128-bitno navadno besedilo z 32 krogi in spremenljivo dolžino ključa od 128 do 448 bitov (več 32-bitni). Vsebuje samo en S-box, isti algoritem se uporablja v obratni obliki za dešifriranje [3].

Najbolj pomembni elementi algoritma Kamelija so F-funkcije. Uporabljajo se med šifriranjem, dešifriranjem in ustvarjanjem pomožnih spremenljivk ključa. Funkcija F sprejme 128 vhodnih bitov, jih pomeša z biti podključev in vrne 128 novih bitov. Sprememba bitov v F-funkciji se imenuje en krog algoritma. Klici s funkcijo F so zbrani v blokih. Vsak blok vsebuje šest krogov. Šestkrožni bloki (to pomeni blok šestih klicev F-funkcije) so ločeni s klici FL-funkcij in FL-1 funkcij. Upravljajo se z 64-bitnimi dolgimi deli podatkov in jih mešajo s podključi kli. Tako šifrirni kot dešifrirni algoritem bosta izvedli nekaj ponovitev zgoraj opisanih 6-krožnih blokov. Število ponovitev je odvisno od dolžine trenutno uporabljenega tajnega ključa: 3 ponovitve 6-okroglih blokov-za 128-bitni tajni ključ, 4 ponovitve 6-okroglih blokov-za 192-bitne ali 256-bitne tajne ključe. Poleg tega se na začetku in na koncu šifrirnega in dešifrirnega algoritma izvedejo dodatne operacije, kjer se podatkovni biti dodajo bitom podključev kwi. Podključi, ki se uporabljajo za šifriranje vsakega podatkovnega bloka (ali za dešifriranje vsakega bloka šifriranega besedila), se ustvarijo v ločenem procesu. Na podlagi skrivnega ključa za vsak blok, se izračuna na desetine podključev. Uporabljajo se za različne operacije v glavnem algoritmu.

Tako CHACHA20_POLY1305 kot POLY1305 veljata za enostavna izvedbo in zagotavljata odlično zmogljivost. CHACHA20_POLY1305 uporablja 256-bitni ključ in 96-bitni blok. POLY1305 lahko uporabimo tudi kot algoritem zgoščevanja. Med postopkom šifriranja/preverjanja pristnosti se iz 256-bitnega ključa in bloka generira enkratni ključ POLY1305. CHACHA20 nato izvede svoje šifriranje z uporabo istega ključa in bloka. POLY1305 preveri pristnost sporočila. Izhod je del šifriranega besedila enake dolžine kot navadni tekst, ki je bil vnesen, pa tudi 128-bitna oznaka MAC [7].

3.2 Varnost

Varnost določa, kako natančno deluje algoritem z uporabo računalniških virov, ki so mu na voljo. Simetrični algoritmi zagotavljajo dokaj visoko raven varnosti, hkrati pa omogočajo hitro šifriranje in dešifriranje sporočil. Relativna enostavnost simetričnih sistemov je tudi logistična prednost, saj zahtevajo manj računalniške moči kot asimetrični. Poleg tega lahko varnost, ki jo zagotavlja simetrično šifriranje, povečamo preprosto s povečanjem dolžin ključev. Za vsak bit, dodan dolžini simetričnega ključa, se težava razbijanja šifriranja z napadom surove sile eksponentno poveča.

Varnost simetričnih šifrirnih sistemov temelji na tem, kako težko je naključno uganiti ustrezen ključ. Za razbitje 128-bitnega ključa bi na primer porabili milijarde let, da bi ključ uganili z običajno računalniško strojno opremo. Daljši kot je šifrirni ključ, težje ga je razbiti. Ključi, ki so dolgi 256 bitov, na splošno veljajo za zelo varne in teoretično odporne na kvantne računalniške napade s surovo silo.

Danes DES ni več primeren za uporabo, saj so ga razbili številni raziskovalci varnosti. Leta 2005 je bil DES uradno zastarel in ga je nadomestil algoritem za šifriranje AES. Največja slabost DES-a je bila dolžina ključa za šifriranje, zaradi česar je bilo razbijanje šifre enostavno. Danes najpogosteje uporabljani protokol TLS, ne uporablja metode šifriranja DES.

V 3DES algoritmu so raziskovalci odkrili ranljivost Sweet32. To odkritje je povzročilo, da je varnostna industrija začela razmišljati o opuščanju algoritma, Nacionalni inštitut za standarde in tehnologijo (NIST) pa je opustitev objavil v osnutku smernic, objavljenem leta 2019. Uporaba 3DES bo ukinjena v vseh novih aplikacijah po letu 2023. TLS 1.3, najnovejši standard za protokole SSL/TLS, ga bo tudi prenehal uporabljati.

Blowfish je ranljiv za rojstnodnevne napade, zlasti v kontekstih, kot je HTTPS. Leta 2016 je napad SWEET32 pokazal, kako izkoristiti rojstnodnevne napade (dešifriranje šifriranega besedila) proti šifram s 64-bitno velikostjo bloka. Projekt GnuPG priporoča, da se Blowfish zaradi majhnosti bloka ne uporablja za šifriranje datotek, večjih od 4 GB [4][14].

IDEI je zaradi svoje odpornosti proti kriptoanalitičnim napadom in zaradi vključitve v več znanih kriptografskih poslov mogoče zaupati [2].

CAST uporabi operacijo spremenljive velikosti ključa, da jo poveča varnost, CAST je na visoki ravni odporen proti linearnim in diferencialnim napadom.

Strokovnjaki za varnost trdijo, da je AES - Rijndael varen, če se pravilno izvaja. Vendar je treba šifrirne ključe AES - Rijndael zaščititi. Tudi najobsežnejši kriptografski sistemi so lahko ranljivi, če heker dobi dostop do šifrirnega ključa. Leta 2009 je bil znan napad ključnega pomena na AES-128. Za prepoznavanje strukture šifriranja je bil uporabljen znani ključ. Vendar je bil napad namenjen le 8-krožni različici AES-128, ne pa standardni 10-krožni različici, zaradi česar je grožnja razmeroma majhna [1]. Za primer varnosti AES-a si poglejmo, kako dolgo bi nekdo razbijal eno geslo, šifrirano z 256-bitnim ključem AES. Če želite prekiniti en 16-bajtni del podatkov, šifriranih z AES-256-bitnim ključem, bi s pomočjo grobe sile (metoda Brute Force) trajalo stoletja. Skupna količina permutacij, ki so možne s 256-bitnim ključem, je 2256, zaradi česar je razbijanje šifriranega sporočila AES-256 skoraj nemogoče. Tudi z uporabo 128-bitnega ključa, ki je najmanjša velikosti, je še vedno na voljo 2128 različnih permutacij, kar bi še vedno trajalo več desetletij.

Varnost AES - RC6 je v povsem naključnem nizu njegovih izhodov bitov s 15 krogi ali manj, ki se izvajajo na vhodnih blokih 128 bitov, eden od parametrov za izdelavo algoritma šifriranja odporen proti napadom je, da njegova proizvodnja popolnoma sledi naključni niz bitov. Napad linearne kriptalize je lahko izveden za 16 krogov RC6, vendar zahteva 2119 znanih navadnih besedil, ki onemogočajo izvedljivost takega napada. Tudi algoritem RC6 je močan v primerjavi z diferencialom kriptanalize, ki je delovala v več kot 12 krogih.

Po besedah avtorja AES - Serpent je 16 krogov Serpent čisto primernih proti vsem znanim vrstam napadov, vendar je zaradi večje varnosti povečan na 32 krogov [13].

AES Twofish je izjemno varen za uporabo. Razlog, da NIST ni hotel uporabiti Twofish je, da je počasnejši v primerjavi z algoritmom šifriranja Rjindael. Eden od razlogov, da je Twofish tako varen je, da uporablja 128-bitni ključ, ki je skoraj neprepusten za napade z grobo silo. Količina procesorske moči in čas, potreben za napad z grobo silo 128-bitnega ključa šifriranega sporočila, naredi vse dešifrirane informacije nedejavne, saj lahko dešifriranje enega sporočila traja desetletja. To pa ne pomeni, da Twofish ni odporen na vse napade. Del šifrirnega algoritma Twofish uporablja vnaprejšne izračune. Predračunavanje teh vrednosti naredi Twofish ranljiv za napade stranskih vrat, vendar pa odvisnost ključa z zamenjavo pomaga zaščititi pred napadi stranskih vrat. Na Twofish je bilo izvedenih več napadov, toda ustvarjalec algoritma Bruce Schneier trdi, da to niso bili resnični napadi kriptoanalize. To pomeni, da do praktičnega preloma algoritma Twofish še ni prišlo.

AES MARS ponuja večjo varnost in hitrost kot trojni DES in DES. To je ponovljena šifra z nenavadno 32 krogi različnih tipov. Upoštevani so srednji krogi MARS kot njegov močni varnostni del. Varnost MARS je odvisna od podatkov rotacije (ali funkcije z logično zapletenostjo). MARS algoritem je zelo odporen na vse vrste napadov relativnega ključa in časovnih napadov.

Kamelija velja za sodobno, varno šifro. Tudi z možnostjo manjše velikosti ključa (128 bitov) se jo zdi nemogoče razbiti z uporabo grobe sile. Do sedaj ni znanih uspešnih napadov, ki bi znatno oslabili šifro. Japonska šifra ima stopnje varnosti in sposobnosti obdelave, ki so primerljivi s šifro AES/Rijndael [14].

Varnost CHACHA20_POLY1305 je zelo blizu osnovnemu algoritmu blokovnega šifriranja AES. Posledično je edini način, da napadalec zlomi Poly1305, zlom AES [7].

3.3 Razširljivost

Razširljivost je eden glavnih elementov, na katerih temeljijo algoritmi šifriranja, ki jih lahko analiziramo. Razširljivost je odvisna od določenih parametrov, kot so uporaba pomnilnika, stopnja šifriranja, strojna oprema programske opreme izvedba.

Porabo pomnilnika lahko definiramo kot število funkcij izvede algoritem, manjša kot je poraba pomnilnika večja bo učinkovitost. Stopnja šifriranja je čas obdelave algoritma za določeno velikost podatkov. Stopnja šifriranja je odvisno od hitrosti procesorja in zapletenosti algoritma itd. Zaželena je najmanjša vrednost stopnje šifriranja. Strojna in programska oprema mora biti v skladu z algoritem za boljše delovanje.

Če primerjamo algoritme lahko opazimo, da je algoritem Blowfish najboljši med vsemi ostalimi obstoječi algoritem v smislu učinkovitosti šifriranja (visoko) in poraba pomnilnika (najmanj). Toda njegova varnost je bila ogrožen, zato je trenutno zastarel. Da bi bila primerjava čimbolj natančna je potrebno primerjati tudi druge funkcije (varnost, arhitektura, prilagodljivost in robustnost), vendar je zelo težko pravilno oceniti algoritme, ki bi bili prilagodljivi za vse platforme.

4 PRIMERJALNA ANALIZA

Ko želijo hekerji dostopati do sistema, si bodo prizadevali za dostop do najšibkejše točke, ki običajno ni šifriranje, ne glede na to ali gre za 128-bitni ključ ali 256-bitni ključ. Uporabniki morajo poskrbeti, da programska oprema varuje uporabniške podatke tako, kot se pričakuje in da celotni proces nima šibkih točk. Poleg tega ne sme biti sive cone ali negotovosti glede shranjevanja in ravnanja s podatki. Na primer, če so podatki v oblaku, bi morali uporabniki poznati lokacijo oblaka. Najpomembneje je, da mora biti izbrana varnostna programska oprema enostavna za uporabo, da uporabnikom ne bo treba izvajati nezaščitenih rešitev za opravljanje svojega dela.

Ameriška vlada je pred več desetletji razvila algoritme DES, da bi zagotovila, da vsi vladni sistemi uporabljajo enak, varen standard za olajšanje medsebojne povezanosti. DES je leta služil kot vez vladne kriptografije, ko so raziskovalci s porazdeljenim računalniškim sistemom razbili 56-bitni ključ algoritma. Leta 2000 se je ameriška vlada odločila uporabiti AES za zaščito tajnih podatkov. DES se v nekaterih primerih še vedno uporablja združljivost za nazaj.

Na splošno varnostni strokovnjaki menijo, da je AES varen pred napadi z grobo silo, pri katerem se preverijo vse možne kombinacije tipk, dokler se ne najde pravilen ključ. Vendar mora biti velikost ključa, ki se uporablja za šifriranje, dovolj velika, da je sodobni računalniki ne morejo razbiti, tudi če upoštevamo napredek v hitrosti procesorja, ki temelji na Moorejevem zakonu. 256-bitni šifrirni ključ je pri napadih z grobo silo bistveno težje uganiti kot 128-bitni ključ; ki pa se dolgo ugiba. Kljub temu 256-bitni ključi zahtevajo tudi več procesorske moči, njihovo izvajanje pa lahko traja dlje. Kadar je napajanje težava, zlasti pri majhnih napravah ali kjer je prenos počasnejši, so 128-bitni ključi boljša možnost izbire.

AES se pogosto uporablja za zaščito podatkov v mirovanju. Aplikacije za AES vključujejo diskovne pogone, šifriranje baze podatkov in šifriranje pomnilnika. Po drugi strani se algoritem RSA (Rivest-Shamir-Adleman) pogosto uporablja v spletnih brskalnikih za povezavo s spletnimi mesti, v povezavah navideznega zasebnega omrežja (VPN) in v številnih drugih aplikacijah.

Za razliko od AES, ki uporablja simetrično šifriranje, je RSA osnova asimetrične kriptografije. Simetrično šifriranje vključuje pretvorbo navadnega besedila v šifrirano besedilo z istim ključem ali tajnim ključem za njegovo šifriranje in dešifriranje. Asimetrično šifriranje za šifriranje uporablja dva ključa: javni in zasebni ključ. Če se šifriranje izvede z javnim ključem, se lahko dešifriranje zgodi le s povezanim zasebnim ključem in obratno. Običajno se ključi RSA uporabljajo, če obstajata dve ločeni končni točki. Čeprav šifriranje RSA dobro deluje pri zaščiti prenosa podatkov na večje razdalje, je njegovo delovanje slabo. Rešitev je združiti šifriranje RSA s šifriranjem AES, da bi tako izkoristili varnost RSA z zmogljivostjo AES. To se lahko doseže tako, da ustvarimo začasni ključ AES in ga zaščitimo s šifriranjem RSA.

Če primerjamo DES in AES, je AES matematično učinkovitejši. Glavna prednost AES je v ključnih možnostih dolžine. Čas, potreben za razbijanje šifrirnega algoritma, je neposredno povezan z dolžino ključa, ki se uporablja za zaščito komunikacije-128-bitni, 192-bitni ali 256-bitni ključi. Zato je AES eksponentno močnejši od 56-bitnega ključa DES. Šifriranje AES je tudi bistveno hitrejše, zato je idealno za aplikacije, vdelano programsko opremo in strojno opremo, ki zahtevajo nizko zakasnitev ali visoko prepustnost.

Na simetrične algoritme Twofish, Serpent in AES trenutno ni znanih napadov, zato lahko kar zadeva varnost, uporabite katero koli od njih. AES ima rahlo prednost, ker se zelo pogosto uporablja, zato boste, bolj verjetno hitro dobili ustrezne posodobitve programske opreme. Sestava Twofish je pravzaprav bolj varna kot AES in je s teoretičnega vidika nezlomljiva.

Tabela 1: Primerjava simetričnih algoritmov

Algoritem	Izdana	Struktura algoritma	Dolžina besedila	Velikost ključa	# Školjke	Število krogov	Oblikovalci
DES	1975	Uravnoteženo omrežje Feistel	64 bitov	56	8.	16.	IBM
IDEA	1991	Substitucijsko-permutacijska struktura	64 bitov	128		8.	Xuejia Lai in James Massey
Blowfish	1993	Uravnoteženo omrežje Feistel	64 bitov	32-448	4.	16.	Bruce Schneier
CAST	1996	Uravnoteženo omrežje Feistel	64 bitov	40-128	4.	12-16	Carlisle Adams in Stafford Tavares
3DES	1998	Uravnoteženo omrežje Feistel	64 bitov	168	8.	48	IBM
AES (Rijendal)	1998	Uravnoteženo omrežje Feistel	128 bitov	128, 192, 256	1.	10,12, 14	Vincent Rijmen
RC6	1998	Uravnoteženo omrežje Feistel	128 bitov	128, 192, 256		20.	Ron Rivest idr.
AES (Serpent)	1998	Uravnoteženo omrežje Feistel	128 bitov	128, 192, 256	8.	32	Ross Anderson, Eli Biham in Lars Knudsen
Twofish	1998	Uravnoteženo omrežje Feistel	128 bitov	128, 192, 256	4.	16.	Bruce Schneier
Mars	1998	Uravnoteženo omrežje Feistel	128 bitov	128-448	1.	32	IBM
Kamelija	2000	Uravnoteženo omrežje Feistel	128 bitov	128,192, 256	4	18 ali 24	Nippon Telegraph
Chacha20	2008	ARX	64 bitov	128, 256		20	Daniel J. Bernstein
Speck	2013	Uravnoteženo omrežje Feistel	32, 48, 64, 96, 128 bitov	64, 72, 96, 128, 144, 192, 256	10	32-72	NSA

5 ZAKLJUČEK

Vsak od kriptografskih algoritmov ima slabosti in prednosti. Kriptografski algoritem izberemo glede na zahteve aplikacije, ki bo uporabljena. Algoritmi so predstavljeni na podlagi različnih parametrov. Glavni cilj je bil analizirati uspešnost večine priljubljenih simetričnih algoritmov v smislu preverjanja pristnosti, prilagodljivosti, zanesljivosti, robustnosti, razširljivost, varnosti. Želeli smo poudariti glavno slabost omenjenih algoritmov, zagotavljanje preglednosti moči in omejitve vsakega algoritma za aplikacijo.

Primerjali smo nekatere simetrične algoritme glede na arhitekturo, razširljivost, prilagodljivost, zanesljivost ter varnost, kakor jih primerjamo v okviru predavanj in vaj pri predmetu Varnost in zaščita v drugem letniku višješolskega strokovnega programa Informatika. Učenje po komparativni metodi zagotavlja razumevanje podobnosti in razlik, izboljša pomnjenje, hkrati pa zagotavlja tudi sposobnost evaluacije [10]. Študenti znajo izbirati primerne algoritme za varno pošiljanje podatkov preko spleta.

Na podlagi primerjave je algoritem Blowfish odlična izbira v primeru časa in pomnilnika glede na merila ugibanja napadov in zahtevane lastnosti, saj beleži najkrajši čas med vsemi algoritmi in porabi najmanj pomnilnika. Če sta zaupnost in integriteta glavna dejavnika, lahko izberemo algoritem AES. Če je povpraševanje po aplikaciji omrežna pasovna širina, je DES najboljša možnost. Menimo, da se algoritma Blowfish in AES uporabljata za preprečevanje napadov in jih je mogoče uporabiti poleg vseh internetnih protokolov, ki temeljijo na IPv4 in IPv6.

Med analizo je bilo ugotovljeno tudi, da je AES - Rijndael glede varnosti, prilagodljivosti, uporabe pomnilnika in zmogljivost šifriranja najboljši med vsemi. Predstavljeni so bili različni dejavniki, kot so dolžina ključa, vrsta šifriranja, velikost bloka in možni ključi. Vsi ti algoritmi se primerjajo v smislu šifriranja in časa dešifriranja ter njihovih rezultatov.

Splošna teoretična in praktična primerjava je pokazala, da je AES boljši v smislu izvajanja hitrost, poraba časa, čas za prekinitev algoritma in varnost. Za povečanje velikosti ključa od 128 do 448 Blowfish algoritem daje sporočilom več zasebnosti in zagotavlja visoko kakovost podatkov prenašanje prek katerega koli nevarnega medija. RC6 in Twofish delujeta hitreje kot AES, pri čemer so bile 256-bitne različice ključev 42-odstotno hitrejše pri velikosti paketa 10 MB. Poleg tega večje velikosti ključev v RC6 in Twofish niso bistveno vplivale na čas izvajanja, medtem ko je v AES velikost ključa opazno vplivala na zmogljivost [9]. MAES in IDEA sta učinkovitejša in potrebujeta manj časa za šifriranje, medtem ko sta MAES in AES učinkovita v smislu časa dešifriranja in porabe pomnilnika [12].

Naše prihodnje delo se bo osredotočilo na primerjavo simetričnih in asimetričnih algoritmov.

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E-učenje in e-poučevanje naravoslovnih vsebin

E-learning and e-teaching of science

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POVZETEK

Ker sta učitelj in učenec med šolanjem na daljavo prostorsko ločena, je pri poučevanju naravoslovnih predmetov glavni izziv kako učencem približati naravoslovno (kritično) razmišljanje, ki ga v največji meri omogočajo opazovanje različnih materialov in modelov, predvsem pa izvajanje poskusov. Slednje je na prvi pogled v času šolanja na daljavo težko izvedljivo, a je z dobrim načrtovanjem, domiselnim strukturiranjem učnih enot, uporabo učinkovitih didaktičnih strategij in optimalno komunikacijo preko elektronskih tehnologij, prav tako mogoče in dovoli usvojiti zastavljene učne cilje. Sprotno spremljanje znanj in spretnosti posameznega učenca je pokazalo njegov napredek ali pa potrebo po dodatni pomoči in spodbudi. Skozi primere dobrih praks prikažem možne načine e-poučevanja naravoslovja v 6. in 7. razredu ter biologije v 8. in 9. razredu osnovne šole. Glavna spodbuda za delo je bila redna komunikacija, ustna razlaga ob slikah, zapisih, diagramih, videih, sprotno preverjanje razumevanja na različne načine (ustno, preko kviza, z učnim listom, z izdelanim miselnim vzorcem, s Kahoot-om), ustno in pisno podajanje navodil za samostojno ali skupinsko delo ter naknadni pregled le-tega, kar je potekalo preko skupnih video konferenc in po potrebi tudi individualnih video klicev ali kratkih sporočil. Med razlago novih vsebin sem s pomočjo modelov uspela bolj nazorno prikazati zgradbo, delovanje nekaterih struktur in procesov. Večina učencev je z veseljem in zelo kvalitetno opravila poskuse ter druge praktične vaje za katere so kot izkaz opravljenega dela oddali sliko ali posnetek. Boljši vpogled v mikro strukture (tkivne preparate, drobne organizme, na primer protiste in vodne bolhe) je omogočila projekcija mikroskopiranja z okularno kamero in softwerom Motic Play [3]. Zelo dobre rezultate in večjo angažiranost vseh učencev je prineslo tudi delo v manjših skupinah. Uporaba različnih metod, ki jih sodobna tehnolgija omogoča, se je izkazala kot dober način dela za dosego boljšega razumevanja naravoslovnih vsebin in temeljnih bioloških konceptov.

KLJUČNE BESEDE

E-učenje, e-poučevanje, naravoslovje, biologija, eksperimentalno delo

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ABSTRACT

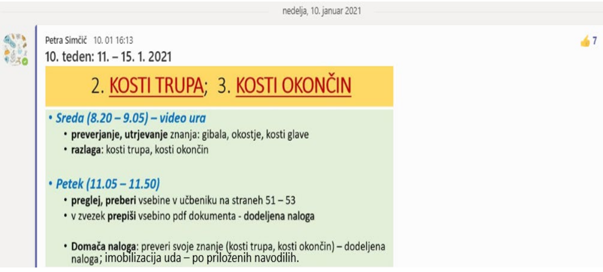
Since the teacher and the student are spatially separated during distance learning, the main challenge in teaching science subjects is how to bring students closer to science (critical) thinking, which is mostly enabled by observing different materials and models, and especially conducting experiments. At first glance, conducting experiments is difficult to do during distance learning, but with good planning, imaginative structuring of learning units, use of effective didactic strategies and optimal communication via electronic technologies, it is also possible and allows to learn the set learning goals. Ongoing monitoring of the knowledge and skills of an individual student has shown his progress or the need for additional help and encouragement. Through examples of good practice, I show possible ways of e-teaching science in 6th and 7th grade and biology in 8th and 9th grade of primary school. The main stimulus for the work was regular communication, verbal explanation with pictures, notes, diagrams, videos, real-time checking of comprehension in various ways (orally, through a quiz, with a worksheet, with a thought pattern, with Kahoot), verbally and in writing giving instructions for individual or group work and subsequent review of it, which took place through joint video conferences and, if necessary, individual video calls or short messages. During the explanation of the new content, I was able to use models to show more clearly the structure, operation of some structures and processes. Most of the students happily and with high quality performed experiments and other practical exercises for which they submitted a picture or recording as a statement of the work done. Better insight into micro structures (tissue preparations, tiny organisms such as protists and water fleas) was provided by the projection of microscopy with an ocular camera and Motic Play software [3]. Very good results and greater engagement of all students was achieved by working in small groups. The use of various methods provided by modern technology has proven to be a good way to work to achieve a better understanding of natural science content and basic biological concepts.

KEYWORDS

E-learning, e-teaching, natural science, biology, experiments in science

1 UVOD

Pouk na daljavo sem vodila preko okolja Microsoft Teams. Za vsak predmet in oddelek sem ustvarila ekipo, v kateri so bila na strani objave podana tedenska navodila – urnik, vsebine in dejavnosti, ki so se v tistem tednu izvajale (Slika 1).



Slika 1: Tedenski razpored dejavnosti; objava v Teams ekipi

Pri vsem tem sem sledila letni pripravi in interaktivnemu učnemu načrtu [4], ki je poudaril operativne cilje in vsebine, ki naj bi se v celoti obravnavale in naj bi jih učenci usvojili. Skozi ta prispevek predstavljam nekaj primerov svojega poučevanja naravoslovnih predmetov na daljavo, pri katerem sem se trudila izvesti čim več praktičnega dela in učencem omogočiti učenje s poskusi ali tako imenovano izkustveno učenje, za katero menim, da je najuspešnejša pot k razumevanju naravoslovnih zakonitosti.

2 PREGLED LITERATURE

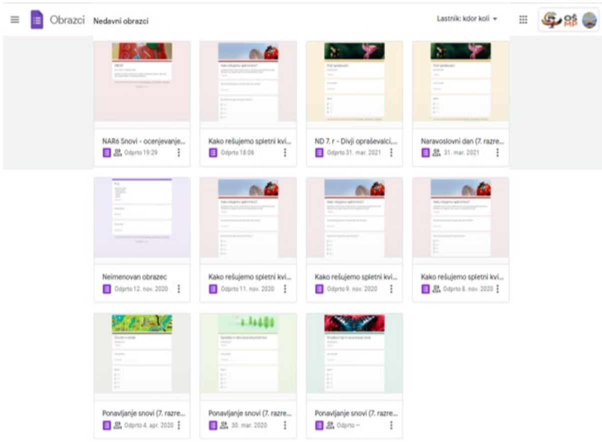
Učitelji podajamo znanje na različne načine. Še vedno se najpogosteje uporablja tradicionalen pouk, to je frontalna učna oblika, pri kateri učitelj usmerja vse učence hkrati, ti pa so ob takšnem načinu poučevanja manj aktivni [6]. Vedno bolj pa se oblikujejo smernice sodobnega pouka, ki imajo za poudarek eksperimentalno delo, ki učencu omogoča pridobivanje konkretnih izkušenj iz katerih išče odgovore na vprašanja, hkrati pridobiva nove veščine in miselna aktivnost je večja [6]. Do takšnih zaključkov je najverjetneje prišel že vsak učitelj, ki že kakšno leto poučuje naravoslovni predmet. Prav iz takšnih izkušenj izhajam tudi sama in te so bile glavno vodilo pri pripravi pouka naravoslovja in biologije na daljavo. Rezultati raziskav, opravljenih po prvem valu epidemije covida-19, so nakazali številne aktivnosti, ki jih je smiselno vpeljati na ravni šol in sistema, da bi izboljšali ustreznost organizacije in izvajanja izobraževanja, povečali učinkovitost učenja in poučevanja z uporabo digitalne tehnologije ter izboljšali kakovost pedagoškega vodenja [7].

Ena od prednosti e-izobraževanja je prav gotovo učinkovitejša organizacija dela, saj so gradiva dostopna 24 ur ves teden in hkrati omogoča vključitev vseh različnih čutil v procesu učenja, če je le motivacija in stik (čeprav posredni) med učiteljem in učencem zadosten. Od učitelja pa je pričakovati, da bo zmogel glavni fokus iskanja znanja prenesti na učenca. To vlogo uspešno opravi izkustveno učenje z eksperimentalnim delom.

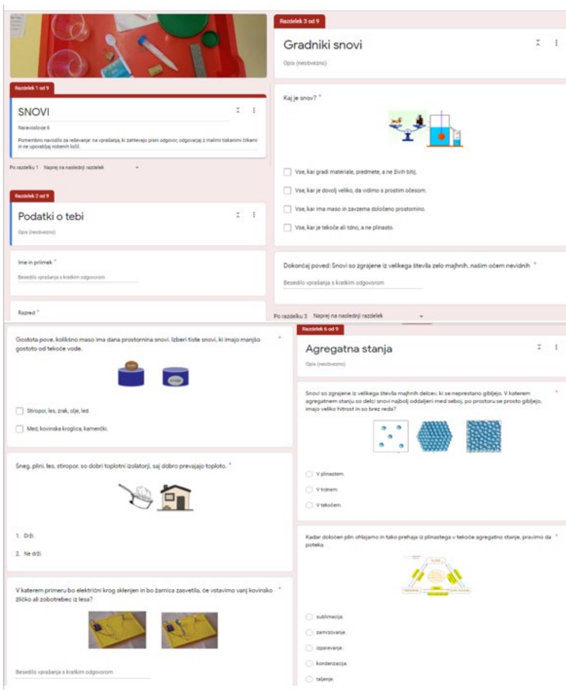
Pri naravoslovju v 6. razredu smo poglavje o snoveh obravnavali med video konferencami ob uporabi učbenika [5], kjer sem razlago podpirala z različnimi materiali, z demonstracijo (npr. električni krog v katerega vstavljamo različne materiale in ugotavljamo, kdaj je sklenjen in kdaj ne, kateri materiali so električni prevodniki in kateri ne (Slika 4)), pred tem pa na podlagi vprašanj, na katera so učenci odgovarjali, ugotovila predznanje.

Sledila so navodila za delo doma v času ure naravoslovja, ki ni bila vodena kot video ura (dodeljena naloga), pri čemer so učenci izvajali poskuse z materiali, predmeti, ki jih uporabljajo v vsakodanjem življenju (žlica, kuhalnica, kamen, voda, plastika). Vsak učenec je poslikal in poslal vsaj dva opravljena poskusa, ki so jih med naslednjo video konferenco predstavili ostalim in skupaj smo po potrebi dodali še kakšen komentar. Pokazala sem jim pladenj s predmeti, ki so iz različnih materialov in jih z lahkoto najdejo doma in nato izpolnijo učni list, ki jim pomaga bolje opazovati snovi, jih razvrstiti po različnih ključih in pridobiti izkušnjo (Slika 12).

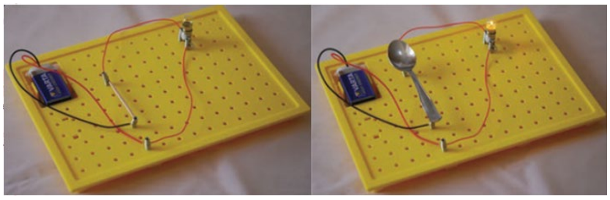
Sledilo je ustno preverjanje znanja o poznavanju gradnikov in lastnosti snovi. Vsak učenec je ustno dobil najmanj tri vprašanja, na tri pa je moral pisno odgovoriti in odgovore oddati, rezultate sem sproti beležila v tabelo. Vsakemu odgovoru je sledila povratna informacija, pri čemer so sodelovali tudi ostali učenci. Po enem tednu semznanjepreverjala s kvizom (Slika 2, Slika 3), tudi te rezultate sem vpisala v tabelo.



Slika 2: Google obrazci

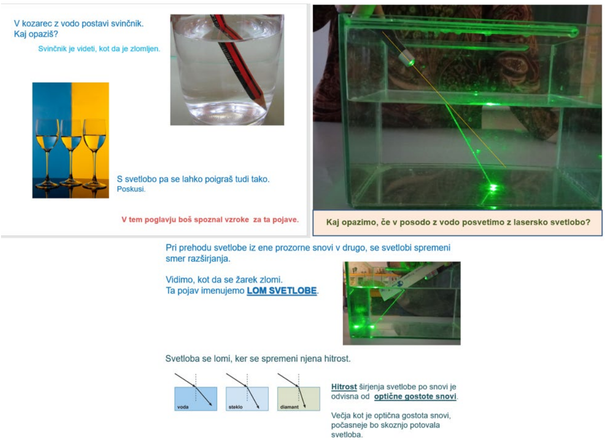


Slika 3: Snovi - kviz za preverjanje znanja

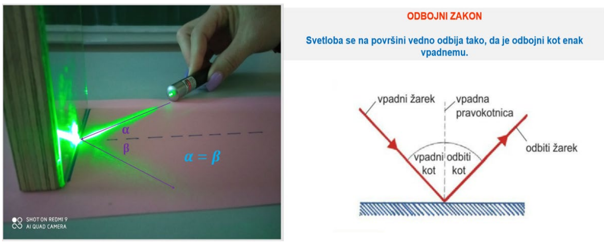


Slika 4: Električni krog - demonstracijski poskus

Pri obravnavi učne enote svetloba, zvok, valovanje pri naravoslovju v 7. razredu, je k boljšemu razumevanju pojavov doprineslo, poleg razlage, demonstracije z laserji, svetilkami, prozornimi, prosojnimi, neprozornimi snovmi, zvočili, vrvmi in drugim, poleg besedila in slik v učbeniku [1], predvsem v šoli posneti poskusi, ki nazorno pokažejo lom in odboj svetlobe, na podlagi česar smo lahko lažje razložili tudi izbirna znanja: vpadni in lomni kot (Slika 5) ter odbojni zakon (Slika 6).



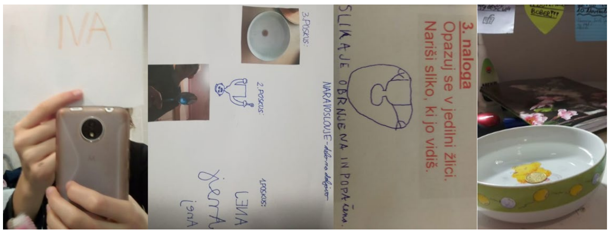
Slika 5: Lom svetlobe - posnetek poskusa



Slika 6: Odboj svetlobe - posnetek poskusa

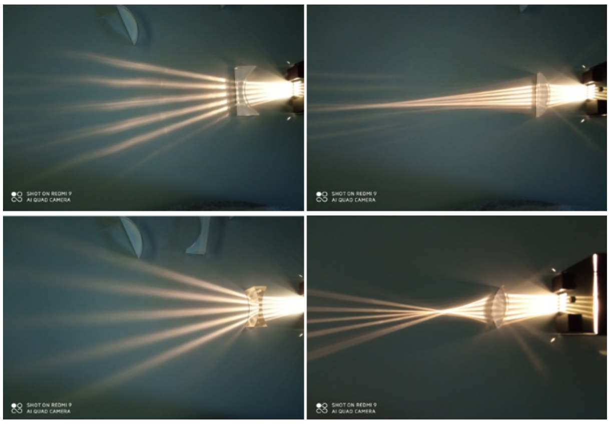
Sledila so navodila za samostojno opravljanje poskusov, pri čemer so imeli na razpolago navodila za 6 različnih poskusov (Slika 7), dovolj je bilo, če so opravili tri, jih poslikali in poslali preko dodeljene naloge (Slika 8), kar smo skupaj pregledali na naslednji uri naravoslovja.

Slika 7: Navodila za samostojno opravljanje poskusov



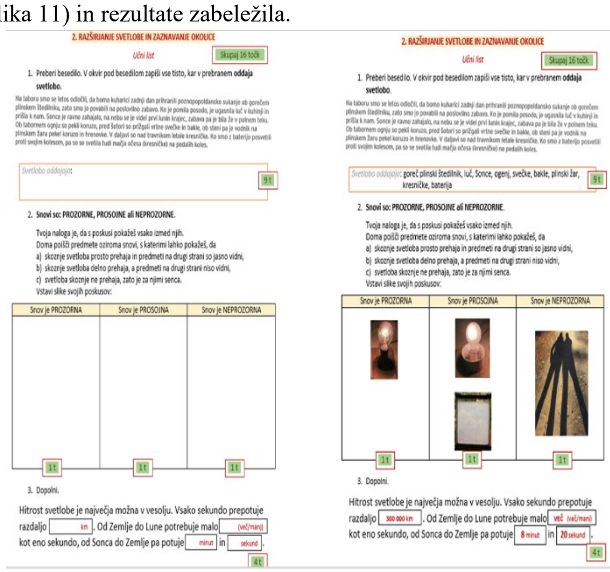
Slika 8: Primeri oddanih nalog o opravljenih poskusih

Sledilo je še veliko demonstracijskih poskusov, posnetih eksperimentov za boljše razumevanje delovanja leč in razlikovanja med različno ukrivljenimi lečami (Slika 9).

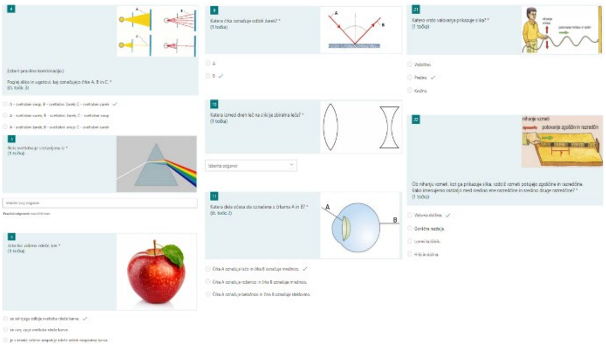


Slika 9: Lom svetlobe na različno ukrivljenih lečah

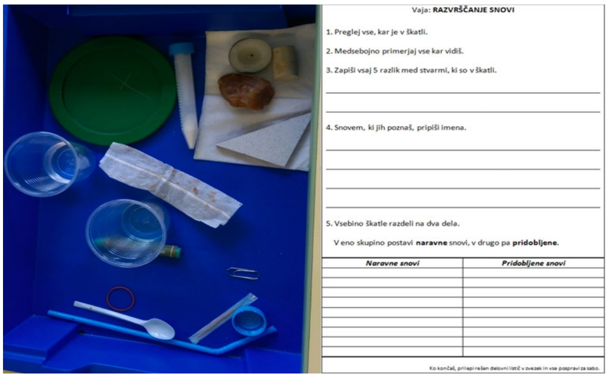
Zgradbo in delovanje očesa sem razlagala ob pomoči modela. Za več spodbude pri usvajanju novih znanj in več samostojnega spoznavanja naravnih zakonitosti, sem pripravljala tudi različne učne liste, ki so jih učenci direktno reševali v predpripravljen obrazec v dodeljeni nalogi (primer: Slika 10). Po analizi in utrjevanju zaključene učne enote, sem znanje preverila s kvizom (Slika 11) in rezultate zabeležila.



Slika 10: Razširjanje svetlobe in zaznavanje okolice – delovni list



Slika 11: Svetloba, zvok, valovanje - preverjanje znanja



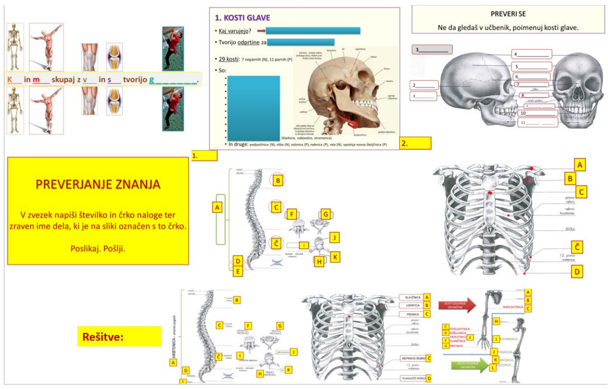
Slika 12: razvrščanje snovi - učenje s poskusi; učni list

Podoben model poučevanja sem uporabljala tudi pri biologiji. V 8. razredu izpostavljam poglavji dihala in gibala, pri katerih sem poleg uporabe modelov med razlago in navodil za poskuse in vaje, ki so jih učenci samostojno opravili doma v času tiste tedenske ure biologije, ki ni bila izvedena kot video konferenca, velik poudarek namenila varovanju zdravja ter prvi pomoči in temeljnim postopkom oživljanja. Začeli smo s teoretičnim delom (Slika 13) obogatenim s prikazi ob modelih, z ogledi poučnih filmčkov, razlago, pregledom vsebin v učbeniku [2], preverjanjem razumevanja z učnim listom in šele nato so sledila navodila za praktično delo, zajeta v izčrpni Power Point predstavitvi, ki poleg pisnih in slikovnih vsebin, zajema tudi povezave do videov, ki nazorno pokažejo pravilno izvajanje postopkov, ki morda rešijo življenje. Učenci so se zelo izkazali in poslali fotografije sebe – izvajalca, ki na družinskem članu vadi različne postopke prve pomoči, na primer preverjanje, če poškodovanec diha; imobilizacija poškodovanega uda in drugo (Slika 14).

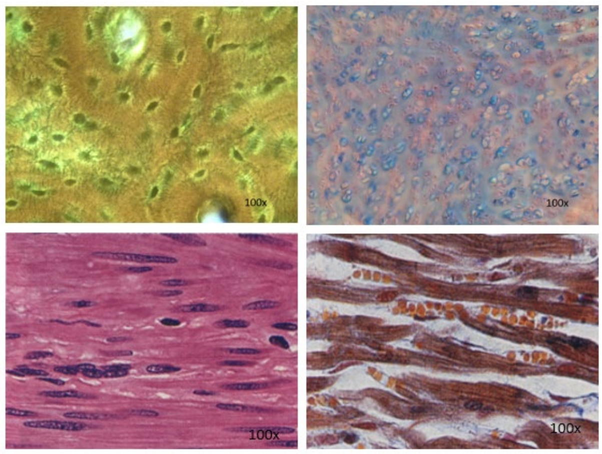
Slika 13: Dihala

Slika 14: Prva pomoč s TPO - praktično delo učencev

Učno enoto gibala smo poleg teoretičnega dela ob uporabi modelov in utrjevanju znanja s pomočjo učnih listov (Slika 15), podkrepili tudi z mikroskopiranjem trajnih preparatov hrustančnega, kostnega tkiva, srčne mišice, skeletnih mišic in gladkih mišic z uporabo monokularnega mikroskopa s kamero, kar mi je omogočalo ob delitvi zaslona in uporabi Motic Play softwera, učencem direktno prikazovati preparate, ki smo jih tudi s posnetkom zaslona ujeli v sliko, tako so lahko kritično presojali o zgradbi posameznega tkiva v povezavi s funkcijo v telesu (Slika 16).



Slika 15: Gibala - obravnava učne snovi z vajami za utrjevanje znanja



Slika 16: Opazovanje histoloških preparatov - kostno, hrustančno, mišično tkivo

Učenci so po navodilih opravili še en poskus, s katerim so po izkustveni poti ugotavljali, kako je kostno tkivo sestavljeno (Slika 17).

Sestava kosti

Po navodilih:

a) namakanje kosti v 10 % ocetni kislini – kaj se bo zgodilo, kakšna bo kost po tem?

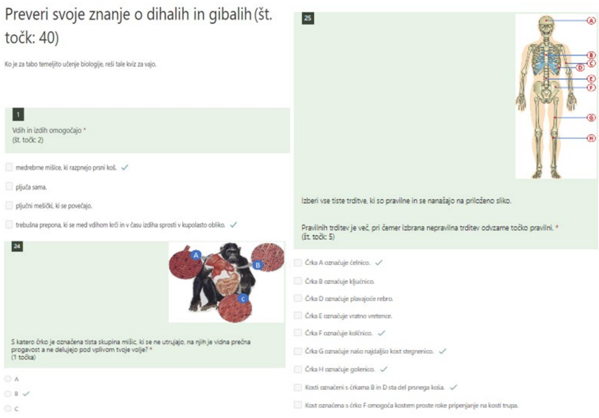
b) žgemo kost – vsebnost katerih snovi dokazujemo?

Slika 17: Sestava kosti - eksperimentalno delo

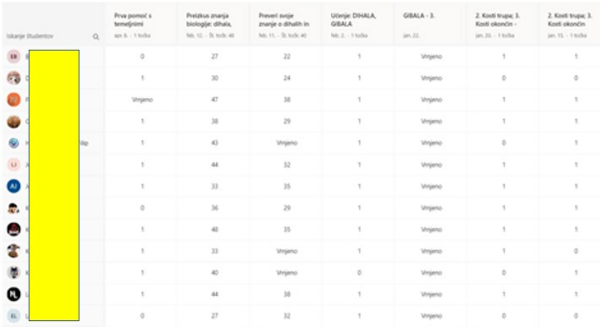
Pri tem poskusu je bil pogoj, da je ob izvajanju prisotna odrasla oseba. O rezultatih poskusov smo se pogovarjali na naslednji video konferenci, pri čemer so se učenci kar borili za besedo, pokazali so veliko navdušenja, predvsem pa so znali smiselno kritično analizirati opravljene poskuse.

3 REZULTATI

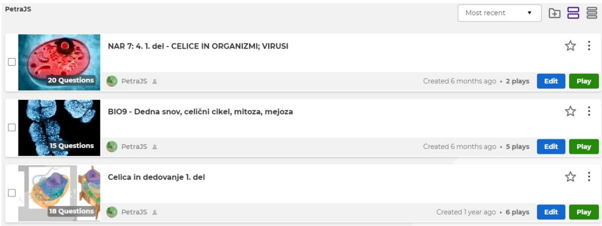
Rezultati so pokazali, da so vsi učenci usvojili temeljna znanja naravoslovja oziroma biologije, da jih je opazovanje modelov, ogled videov, opravljanje eksperimentov ali druge vrste praktičnega dela bolj motiviralo za šolsko delo kot učenje iz učbenika ali prepisovanje učne snovi iz Power Point drsnic, kar so na začetku vsake ure, po predhodnem praktičnem delu, brez da bi jih o tem sploh uspela povprašati, izrazili sami. Vse dosežke – sprotno odgovarjanje na vprašanja med video uro, uspešnost oddanih nalog, dosežene točke pri kvizih (Google obrazci (Slika 2), Microsoft Forms (Slika 18), Kahoot (Slika 20)), učnih listih, sem za vsakega učenca sproti beležila v tabele (Slika 19), kar je pokazalo, da so bili učenci pri vsebinah, pri katerih je bilo več praktičnega dela – izkustvenega učenja in manj faktografije, uspešnejši in so pri ocenjevanju znanja v večini primerov uspešno odgovarjali na vprašanja višjih taksonomskih ravni.



Slika 18: Dihala in gibala - preverjanje znanja



Slika 19: Dosežki učencev z oddanimi nalogami



Slika 20: Preverjanje znanja – Kahoot

4 ZAKLJUČEK

Z dejavnostmi, ki sem jih uporabljala pri poučevanju v času pouka na daljavo, sem skušala ustvariti čim boljše pogoje, da lahko učenci sami doživljajo in odkrivajo znanja ter aktivno sodelujejo v učnem procesu. Zato sem posredovanje naravoslovnih vsebin največkrat zasnovala na izkustvenem učenju, saj ugotovim, da če učence na osnovnošolski stopnji izobraževanja navadimo na lastno odkrivanje znanj po izkustveni poti, smo jih dobro pripravili in morda tudi navdušili za nadaljnje poglobljeno spoznavanje naravoslovnih vsebin.

ZAHVALA

Zahvaljujem se članicam naravoslovnega aktiva za uspešno sodelovanje in kvalitetno delo na področju poučevanja naravoslovnih vsebin na naši šoli. Računalnikarju Alešu Drinovcu gre posebna zahvala za sprotno izobraževanje s področja IKT in dela v okolju Microsoft Teams.

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Zaznavanje stresa pri srednješolcih v prvem valu epidemije COVID-19

Stress perception in high school students in the first wave of the COVID-19 epidemic

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POVZETEK

Prvi val epidemije COVID-19 je prinesel veliko negotovosti, saj smo se s tako strogimi ukrepi za omejevanje prenosa okužbe, kot je zaprtje šol, omejitve druženja, nezmožnost opravljanja dela ipd., srečali prvič. Za marsikoga je to predstavljalo velik stres, zato nas je zanimalo, kako so v prvem valu epidemije zaznavali stres slovenski srednješolci? V ta namen smo oblikovali spletno anketo in jo po metodi snežne kepe razširili po srednjih šolah in dijaških domovih. Podatki na vzorcu 1492 srednješolcev kažejo, da je večina dijaške populacije (69,9%) v prvem valu epidemije zaznavala srednje močan stres (kategorije nizek-srednji-visok), dobra šestina dijakov (17,8%) pa visok stres. Več težav s spanjem, razdražljivosti, več močnih in/ali neprijetnih čustev, občutkov nemoči in pomanjkanja energije kot v času pred epidemijo je doživljalo 34 - 44% srednješolcev, tistih, ki so to doživljali občutno bolj kot pred epidemijo, je bilo 8-10%. Raziskava je tudi pokazala, da je stopnja zaznanega stresa statistično pomembno povezana s spolom, programom šolanja, (ne)bivanjem v dijaškem domu in kroničnimi težavami oz. bolezenskimi stanji.

KLJUČNE BESEDE

Zaznavanje stresa, srednješolci, prvi val epidemije, COVID-19, koronavirus

ABSTRACT

The first wave of the COVID-19 epidemic brought a lot of uncertainty, as it was the first time, we encountered such stringent measures to limit the transmission of the infection, such as school closures, social-distancing, inability to work, etc. and for many, that posed great stress. The aim of this study was to investigate the perceived stress of Slovenian high school students in the first wave of the epidemic. For this purpose, we conducted an online survey sent to secondary schools and student dormitories. Data on a sample of 1492 students show that the majority of the student population (69.9%) perceived moderate stress (low-medium-high categories) in the first wave of the epidemic and a good sixth of students (17.8%) high stress. 34-44% of students had more sleep problems, were more irritable, had stronger and/or unpleasant emotions, more feelings of helplessness and lack of energy than before the epidemic. 8-10% of students experienced it significantly more than before the epidemic. The research also showed that the level of perceived stress is significantly related to gender, school program, (non)staying in the dormitory, and chronic diseases.

KEYWORDS

Stress perception, high school students, the first wave of the epidemic, COVID-19, coronavirus

1 UVOD

Soočanje z epidemijo in strogimi ukrepi za omejevanje prenosa okužbe je za marsikoga predstavljalo velik stres. Raziskave [1, 2, 3] kažejo, da so nekateri razvili celo simptome, ki so značilni za posttravmatsko stresno motnjo. To so bili predvsem tisti, ki so sami trpeli za resno obliko COVID-19 in jim je grozila smrt; ki so bili kot družinski člani ali kot zdravstveni delavci priča trpljenju in smrti drugih; ki so izvedeli za smrt ali tveganje smrti družinskega člana ali prijatelja; in posamezniki, ki so bili zelo izpostavljeni grozljivim podrobnostim epidemije (npr. novinarji, zdravniki in bolnišnično osebje) [4].

Mladostniki spadajo v manj rizično skupino za okužbo s COVID-19 in jih virus večinoma neposredno ne prizadene. Raziskave tako ugotavljajo, da je epidemija prizadela predvsem starejše generacije, posledice ukrepov za njeno zajezitev pa predvsem mlajše [5]. Na Inštitutu RS za socialno varstvo [6] ugotavljajo, da je epidemija na otroke vplivala predvsem 1.) s psihološko obremenitvijo zaradi neznane situacije in strahu pred tem, da bi zboleli njihovi bližnji; 2.) povečano negotovostjo in večjo možnostjo, da bodo njihovi bližnji izgubili zaposlitev; 3.) z ukrepi, ki so prekinili ustaljeni tok življenja družin in omejili nekatere svoboščine.

Prvi val je s seboj prinesel posebej veliko negotovosti, saj smo se s tako strogimi ukrepi za omejevanje prenosa okužbe, kot je zaprtje šol, omejitve druženja, nezmožnost opravljanja dela ipd., srečali prvič. V raziskavi kitajskih mladostnikov, ki so ostali doma v karanteni v prvem mesecu izbruha COVID-19, jih je kar 12,8% doživljalo stresne simptome, ki so dosegali raven posttravmatske stresne motnje [7]. Kako so v prvem valu epidemije zaznavali stres slovenski srednješolci, pa bomo poskušali odgovoriti s pričujočo raziskavo.

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2 METODOLOGIJA

2.1 Vzorec

V raziskavi je sodelovalo 1492 srednješolcev, od tega je bilo 58,1% (867) dijakinj. 0,9% srednješolcev je obiskovalo nižji poklicni program, 11.3% srednji poklicni program (triletni), 53,8% srednji strokovni program (štiriletni) in 34,0% srednji splošni program (gimnazije). 24,3% (365) srednješolcev je bilo iz dijaških domov, 10,3% srednješolcev pa se je soočalo s kroničnimi težavami oz. bolezenskimi stanji. Geografska zastopanost je predstavljena v tabeli 1.

Tabela 1: Razporeditev dijakov po pokrajinah

Pokrajina	Frekvenca	Procent
Gorenjska	151	10,0
Osrednjeslovenska	187	12,4
Štajerska	533	35,4
Prekmurje	28	1,9
Koroška	28	1,9
Notranjska	50	3,3
Dolenjska	330	21,9
Primorska	197	13,1

2.2 Instrumenti in postopek

Za namene raziskave smo pripravili spletni vprašalnik z orodjem 1ka. Vključeval je sociodemografska vprašanja, primerjavo življenjskega sloga (preživljanje časa na socialnih omrežjih, prehranjevanje, spanje/nespečnost ipd.) s stanjem pred epidemijo in Lestvico zaznanega stresa (The Perceived Stress Scale – Cohen, Kamarck in Mermelstein, 1983), ki meri, kako pogosto anketiranci zaznavajo svoje življenje kot stresno, nepredvidljivo, preobremenjujoče in nenadzorljivo. Rezultat PSS-ja se razvrsti v eno od treh kategorij, in sicer nizko, srednje in visoko zaznani stres. Z višjim rezultatom se povečuje verjetnost, da stres v posameznikovem življenju presega njegove sposobnosti soočanja z njim.

Zbiranje podatkov je trajalo od 20.-26.4.2020 preko socialnih mrež svetovalnih delavcev v srednjih šolah in vzgojiteljev dijaških domov (t.i. metoda snežne kepe). Analiza podatkov je bila narejena s programom SPSS, uporabili smo deskriptivno statistiko ter hi-kvadrat test in Pearsonov korelacijski koeficient.

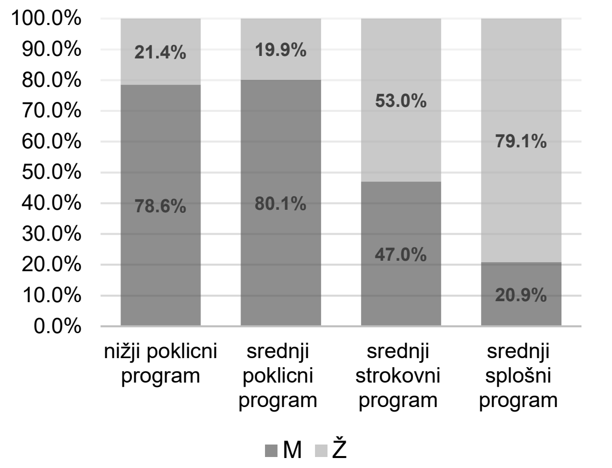
3 REZULTATI

Kot prikazuje Tabela 2 je velika večina srednješolcev (69,9%) v prvem valu epidemije zaznavala srednje močan stres. Visok stres je zaznavalo 23,8% vseh dijakinj in 9,4% dijakov. Dijaki in dijakinje se statistično pomembno razlikujejo v stopnji zaznavanja stresa ($\chi^2(2)=57.816$, $p<0.01$).

Statistično pomembna razlika pri zaznavanju stresa se kaže tudi glede na program šolanja ($\chi^2(6)=27.582$, $p<0.01$). Če izvzamemo nižje poklicno izobraževanje, kjer je bil numerus izrazito majhen (0,9% vseh srednješolcev), je delež srednješolcev, ki zaznavajo nizek stres približno enak, in sicer 12,3-13%. Procent visoko zaznanega stresa narašča po zahtevnosti programa (z izjemo nižjega poklicnega programa). Pri tem je potrebno omeniti, da v srednjem strokovnem in splošnem programu prevladujejo ženske (**Slika** 1).

Tabela 2: Zaznavanje stresa po spolu in vrsti šolanja

STRES					
SPOL		nizki	srednji	visoki	SKUPAJ
moški	N	101	465	59	625
	%	16,2%	74,4%	9,4%	100%
ženski	N	83	578	206	867
	%	9,6%	66,7%	23,8%	100%
VRSTA ŠOLANJA					
nižji poklicni program	N	0	12	1	13
	%	0,0%	92,3%	7,7%	100%
srednji poklicni program (triletni)	N	22	139	8	169
	%	13,0%	82,2%	4,7%	100%
srednji strokovni program (štiriletni)	N	99	555	149	803
	%	12,3%	69,1%	18,6%	100%
srednji splošni program (gimnazija)	N	63	337	107	507
	%	12,4%	66,5%	21,1%	100%
SKUPAJ	N	184	1043	265	1492
	%	12,3%	69,9%	17,8%	100%

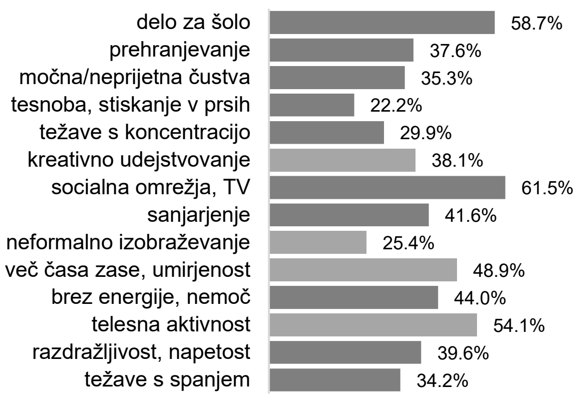


Slika 1: Zastopanost spola po vrsti šolanja

Statistično pomembna razlika v zaznavanju stresa obstaja tudi glede na to, ali se srednješolci soočajo s kroničnimi težavami oz. bolezenskimi stanji ($\chi^2(2)=41.877$, $p<0.01$), pri čemer večina le-teh zaznava srednje močan stres (55,6%).

Stopnja stresa je odvisna tudi od tega, ali srednješolci živijo v dijaškem domu ali ne ($\chi^2(2)=12.772$, $p<0.01$). Najvišja razlika se kaže pri visoko zaznanem stresu, ki ga zaznava 23,1% srednješolcev iz dijaških domov in 16,1% tistih, ki ne živijo v dijaškem domu.

Slika 2 prikazuje procent srednješolcev, ki naštete vidike izkuša oz. opravlja "več" in "občutno več" kot pred epidemijo. Svetleješi stolpci prikazujejo pozitivno spremembo, in sicer več kreativnega udejstvovanja (ustvarjanje, risanje ipd.), neformalnega izobraževanja, več časa zase oz. več umirjenosti ter več telesne aktivnosti kot pred epidemijo.



Slika 2: Vidiki doživljanja in aktivnosti, ki jih srednješolci opravljajo oz. izkušajo več kot pred epidemijo

Po drugi strani je najvišji delež tistih srednješolcev, ki preživljajo več časa na socialnih omrežjih, gledajo TV, serije ipd. Od tega jih je 20,2%, ki to počno občutno več kot pred epidemijo. Preživljanje časa na socialnih omrežjih, z gledanjem serij oz. pred TV se pomembno šibko povezuje s sanjarjenjem oz. zatekanjem v domišljijo ($r=0.202$, $p<0.01$).

37,6% srednješolcev pojé več kot pred epidemijo. Prehranjevanje se statistično pomembno, a neznatno pozitivno povezuje z napetostjo ($r=0.133$, $p<0.01$), tesnobo ($r=0.078$, $p<0.01$), pomanjkanjem energije ($r=0.141$, $p<0.01$), zatekanjem v domišljijo ($r=0.074$, $p<0.01$), gledanjem serij, TVja, preživljanjem časa na socialnih omrežjih ($r=0.154$, $p<0.01$), težavami s koncentracijo ($r=0.111$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r=0.126$, $p<0.01$), negativno pa s telesno aktivnostjo ($r=0.072$, $p<0.01$).

V nadaljevanju izpostavljamo tiste vidike, kjer obstaja pomembna zmerna povezanost:

- razdražljivost, napetost je pozitivno povezana s težavami s spanjem ($r=0.497$, $p<0.01$), nemočjo, pomanjkanjem energije, brezvoljnostjo ($r=0.501$, $p<0.01$), težavami s spominom in/ali koncentracijo ($r=0.406$, $p<0.01$), s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.497$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r=0.572$, $p<0.01$), negativno pa je razdražljivost povezana s časom zase in občutkom umirjenosti ($r=0.413$, $p<0.01$);
- nemoč, pomanjkanje energije in brezvoljnost je pozitivno povezana s težavami s spominom in/ali koncentracijo ($r=0.453$, $p<0.01$), s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.418$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r = 0.488$, $p<0.01$);
- težave s spominom in/ali koncentracijo so že poleg omenjenega pozitivno povezane s stiskanjem v prsih, razbijanjem srca, tesnobo ($r=0.474$, $p<0.01$) in doživljanjem močnih in/ali neprijetnih čustev ($r = 0.488$, $p<0.01$);

Vidimo, da se štirje vidiki odzivanja med epidemijo 1.) nemoč, pomanjkanje energije, brezvoljnost, 2.) težave s spominom in/ali koncentracijo, 3.) stiskanje v prsih, razbijanje srca, tesnoba in 4.) doživljanje močnih in/ali neprijetnih čustev pomembno zmerno povezujejo med seboj.

Prav tako se medsebojno zmerno povezujejo razdražljivost oz. napetost, stiskanje v prsih, razbijanje srca, tesnoba ter težave s spanjem (srednješolci težko zaspijo, se zbujajo ponoči in/ali težko vstanejo).

4 RAZPRAVA

Raziskava med 1492 srednješolci v času prvega vala epidemije v Sloveniji kaže, da je večina srednješolcev zaznavala srednje intenziven stres. Pri tem želimo opozoriti na dobro šestino srednješolcev, ki je zaznavala visok stres, v 78% so bile to ženske. Zaskrbljujoče povečanje psihične obremenjenosti med dekleti ugotavlja tudi poročilo Inštituta RS za socialno varstvo [6].

Študije mladih iz evropskih, azijskih in ameriških držav ugotavljajo povečanje težav z duševnim zdravjem, kot so razdražljivost, tesnoba, depresivni simptomi, simptomi posttravmatske stresne motnje ipd. [5, 6, 7]. Nemška študija je na reprezentativnem vzorcu pokazala, da je dve tretjini otrok in mladostnikov zaradi pandemije COVID-19 močno obremenjena. Poročali so o bistveno nižji kakovosti življenja, povezani z zdravjem (40% proti 15%), več težavah z duševnim zdravjem (18% proti 10%) in višjo stopnjo tesnobe (24% proti 15%) kot pred pandemijo [11]. V naši raziskavi doživlja težave s spanjem, močna in/ali neprijetna čustva, razdražljivost, občutke nemoči, brezvoljnost in pomanjkanje energije "več" in "občutno več" kot pred epidemijo med 34 in 44% srednješolcev. Tistih, ki so to doživljali občutno bolj kot pred epidemijo in jih v tem pogledu lahko štejemo kot rizične, je bilo 8-10% (že v prvem valu). Na porast duševnih stisk med otroki in mladimi v času prvega vala epidemije kažejo tudi podatki TOM telefona. Čeprav je bilo v letu 2020 skupno število klicev manjše kot v preteklih letih, pa je bilo klicev, ki so poročali o psihičnih težavah, 33% več kot v povprečju zadnjih petih let [12].

Naša raziskava kaže, da je 62% srednješolcev preživljalo čas na socialnih omrežjih, z gledanjem videev, serij ipd. "več" in "občutno več" kot pred epidemijo. Čeprav je bil porast ob ukrepu omejevanju druženja pričakovan, ne gre prezreti ugotovitve Inštituta RS za socialno varstvo, da se je precej povečala ranljivost otrok na ravni aktivnosti, ki vodijo v odvisnost in odtujitev, kot npr. igranje računalniških igric, gledanje videoposnetkov na youtube in televizije [6].

Izpostavili bi še en potencialen način soočanja s stresom oz. prilagoditveni odziv na epidemijo, in sicer v naši raziskavi je 9% srednješolcev označilo, da se prehranjuje "občutno več" kot prej. Raziskave opozarjajo na naraščanje teže pri mladostnikih v času karantene [13], še posebej pri tistih, ki so se že prej soočali s povišano telesno težo [11, 12, 13]. Ta pojav je dobil celo svoje ime – ang. covibesity [17].

V razpravi smo izpostavili predvsem tiste vidike, ki so že ob začetku epidemije nakazovali morebitne kasnejše težave. Rezultate je namreč potrebno gledati retrospektivno, saj se nanašajo na april 2020, tj. čas prvega zapiranja šol, in jih tako lahko jemljemo kot prikaz, kakšen je bil prvi odziv srednješolcev na ukrepe za omejitev širjenja virusa COVID-19.

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Uporaba spletnega socialnega omrežja Facebook pri učenju na daljavo

Using the online social network Facebook in distance learning

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POVZETEK

V prispevku je predstavljeno delo na daljavo v času epidemije SARS-CoV-2, ki je potekalo preko spletnega socialnega omrežja Facebook za učno šibkejše učence devetega razreda pri matematiki. Facebook smo izbrali na željo učencev. Pri delu na daljavo so učenci vsa navodila za delo, evalvacije, preverjanja znanja, spletne povezave, rešitve nalog, povabila na videokonference ipd. dobili znotraj zaprte skupine na Facebooku. Preko dela na socialnem omrežju so spoznali prednosti in slabosti Facebooka za učne namene, ki so predstavljeni v prispevku. Prednosti so predvsem dostopanje kjerkoli in kadarkoli s katerokoli pametno napravo, visoka aktivnost učencev, samostojno razporejanje časa in snovi, možnosti razprave in sodelovanja, močno povezana spletna skupnost, preprosto in enostavno učno okolje za uporabo, možnost označevanja posameznikov in ohranjanje socialnega stika. Kot slabost bi izpostavili predvsem uporabo pogovornega jezika, nenatančno določena pravila uporabe, možnost napačnih informacij ter izvajanje spletnega nasilja med mladimi. Četudi je bila izkušnja s socialnim omrežjem pozitivna, je še vedno preveč negotovosti s soglasji staršev, z ustreznimi nastavitvami zasebnosti učencev in s preverjanjem shranjevanja podatkov.

KLJUČNE BESEDE

Spletna socialna omrežja, učenje na daljavo, matematika, deveti razred

ABSTRACT

The paper presents the distance work during the SARS-CoV-2 epidemic, which took place via the online social network Facebook for the weaker ninth-grade students in mathematics. Facebook was chosen at the request of the students. When working remotely, students have all the instructions for work, evaluations, knowledge tests, web links, task solutions, invitations to video conferences, etc. get inside a closed group on Facebook. Through working on the social network, we learned about the advantages and disadvantages of Facebook for learning purposes, which are presented in the article. The advantages are access anywhere and anytime, with any smart device, high student activity, independent scheduling of time and material, opportunities for discussion and collaboration, a highly connected online community, a learning environment that is simple and easy to use, the ability to tag individuals and maintain social contact. The disadvantages are the use of colloquial language, inaccurate rules of use, the possibility of misinformation and the implementation of cyberbullying among young people. Even though the experience with the social network has been positive, there is still too much uncertainty with parental consent, with appropriate student privacy settings and with data storage checks.

KEYWORDS

Online social network Facebook, distance learning, math, ninth grade

1 UČENJE NA DALJAVO

Izobraževanje na daljavo (distance education) je oblika izobraževanja z dvema temeljnima značilnostma: učitelj in učenec sta med poučevanjem prostorsko ločena, komunikacijo med njima in komunikacijo med učenci samimi pa omogočajo različne vrste tehnologij. Unesco [1] opredeljuje izobraževanje na daljavo kot vzgojno-izobraževalni proces in sistem, v katerem pomemben delež pouka izvaja nekdo ali nekaj, ki je časovno in prostorsko odmaknjeno od učenca.

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. V prvem valu so bili učitelji prepuščeni predvsem sami sebi in svoji iznajdljivosti.

Kasneje, ob drugem valu, je Zavod Republike Slovenije za šolstvo izdal Analizo izobraževanja na daljavo v času prvega vala epidemije covida-19 v Sloveniji [2], v kateri so podana metodična izhodišča osnovnošolskega učitelja, ko oblikuje gradiva za pouk na daljavo, ki usmerjajo učitelja v premislek o tem,

- kako skupaj z učenci ubesediti vloge in odgovornosti v procesu pouka;
- kako v učno gradivo, ne glede na to, ali je uporabljeno kontaktno, torej videokonferenčno, izključno prek pisnih navodil ali kombinirano, vtkati vse faze vzgojno-izobraževalnega procesa:
    - ponovitev stare snovi,

- osmišljanje posredovanega znanja ter spodbujanje in motiviranje udeležencev,
- podajanje, razlago in pojasnjevanje nove učne snovi,
- ponavljanje in utrjevanje,
- spodbujanje udeležencev, da usvojeno znanje prenesejo v prakso,
- preverjanje in ocenjevanje znanja.

Vsa zgoraj naštete metodična izhodišča so učitelji po večini upoštevali že v prvem valu.

Spletna socialna omrežja danes predstavljajo pomemben del vsakdanjika posameznika, predvsem s komunikacijskega vidika. Uporaba spletnih socialnih omrežij znotraj izobraževalnega procesa prinaša prednosti tako za učence kot tudi za učitelje. Kot ugotavlja avtor raziskave Uporaba spletnega socialnega omrežja Facebook za izobraževalne namene v času študija [3] socialna omrežja lahko spodbujajo sodelovalne veščine, sodelovalno učenje, refleksivno razmišljanje, socialno interakcijo z vsemi udeleženimi v izobraževalnem procesu. Da bi preizkusili, kakšne so prednosti in pomanjkljivosti uporabe socialnega omrežja Facebook, smo se na Osnovni šoli Antona Martina Slomška Vrhnika odločili, da pri pouku matematike ponudimo socialno omrežje, ki ga učenci poznajo iz vsakdanjega življenja.

2 OPIS DELA IN REZULTATI

Učiteljica matematike in računalništva je za svoje učence pri predmetu matematika ustvarila Arnesove spletne učilnice Moodle. V devetem razredu je bila oblikovana manjša učna skupina s trinajstimi učenci, kjer je bilo zanimanje za učenje matematike precej šibko. Spletnih učilnic učenci niso bili vajeni, zato je bil obisk na začetku zelo slab. Iskali smo načine, kako v devetem razredu pri matematiki motivirati učence, da bodo sledili navodilom pri delu na daljavo. Poizvedovali smo, kaj bi bilo učencem najbližje. Prva izbira je bila Viber, kar se učiteljici ni zdelo ustrezno, ker posega v osebne podatke, saj uporabnik kot svojo identiteto uporablja telefonsko številko. Nato so učenci predlagali spletno socialno omrežje Facebook. Ideja se ni zdela slaba, ker ga učitelji na šoli tudi vsakodnevno uporabljajo.

Najprej so v manjši učni skupini preverili, če imajo vsi učenci že izdelan Facebook profil. Ker je bilo ugotovljeno, da prav vsi učenci v manjši učni skupini Facebook uporabljajo, so se odločili, da bo to učno okolje, v katerem se bodo izvajale dejavnosti na daljavo. Vsi učenci so bili starejši od 13 let, kar je določena minimalna starost za uporabo družabnega omrežja. V primeru, da uporabnik nima šestnajst let, mora imeti šola za uporabo Facebook-a soglasje staršev. V manjši učni skupini so preverili, ali so učenci seznanjeni z delovanjem aplikacije do te mere, ki jo potrebujejo za nemoteno uporabo. Izkazalo se je, da učenci obvladajo spletno aplikacijo Facebook. Pred samim začetkom dela s Facebookom so učenci spoznali ustrezne nastavitve zasebnosti (skupina ni bila javno dostopna). Učitelji se zavedajo, da uporaba družabnih omrežij za šolske namene ni priporočljiva, predvsem z vidika zasebnosti, omejitve starosti, vpliva preveč motečih dejavnikov in možnih oblik spletnega nasilja. Kljub temu so se za Facebook pri matematiki v manjši učni skupini odločili zato, ker je bila motivacija za delo visoka, kar je omogočilo ohranjanje stika z učenci.

Na začetku je bil sklenjen dogovor, kakšna pravila bodo veljala v Facebook skupini. Dorečen je bil bonton in način delovanja. V skupini so bili le člani manjše učne skupine, učiteljica matematike in učiteljice dodatne strokovne pomoči. Predvsem pa je bilo pomembno, da se vsi uporabniki držijo dogovora, da, kar je objavljeno v skupini, tam tudi ostane.

Nato je bila na Facebooku ustvarjena skupina Matematika 9. r OSAMS. Skupina je bila zaprta in skrita za ostale uporabnike. Delovala je od 14. 3. 2020 do 31. 8. 2020. Nekaj profilov učencev je učiteljica zlahka našla in jih povabila v skupino. Spet drugih profilov učencev ni bilo mogoče najti, zato so jih povabili v skupino preko sošolcev (slika 1). Kasneje so bile dodane tudi učiteljice dodatne strokovne pomoči, da so lahko sledile delu in imele pregled nad delom skupine ter sodelovanju učencev. Po štirih dneh delovanja skupine so bili v skupini prav vsi člani manjše učne skupine.

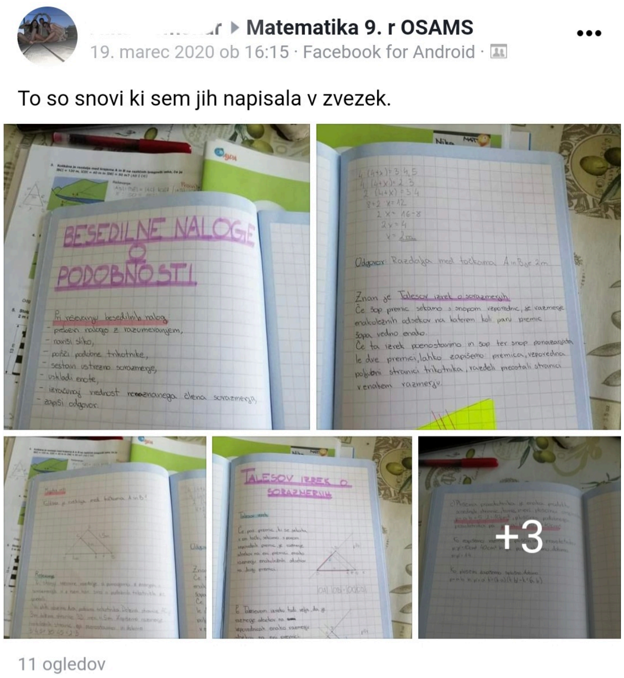
Slika 1. Pomoč pri iskanju vseh učencev.

Pri delu na daljavo je pomembno, da se ohranja stik z učenci. Zato je bilo dobro, da so učenci spremljali objave, ki niso bile povezane s samo učno snovjo (slika 2). Pri motiviranju učencev je ključen osebni stik. V razredu po navadi učitelju zelo hitro uspe vzpostaviti osebni stik, pri učenju na daljavo je bilo to bistveno težje, vendar pa še toliko bolj potrebno. Stik so gradile objave o sprehodih učiteljice, spodbudne misli, povezave do kvizov z nematematično vsebino (ki jih je rešila tudi učiteljica sama in z ostalimi uporabniki delila zbrano število točk ali druge rezultate), objave o šoli, anonimna anketa z naslovom Učiteljici bi sporočil še …, lepe želje za počitnice in vikende, fotografije prazne učilnice (ki pogreša svoje učence), hecne objave, osebni nagovori učiteljice ipd.

Slika 2. Objave za motivacijo.

V skupini so bila navodila za delo na daljavo za posamemezno učno uro. Vsaka učna ura je imela svojo objavo. Prav vse objave so učenci lahko komentirali, kar jih je spodbudilo k skupnemu oblikovanju spletnega okolja. Učenci so morali v novo objavo oddati zapiske in naloge, ki so jih reševali doma. V kolikor česa niso oddali, so bili označeni in ponovno povabljeni, da naloge oddajo (slika 3).

Učenci so lahko odprli novo objavo, kamor so postavili vprašanje za naloge, ki so jim delale težave ali pa jih niso znali rešiti. Na zastavljena vprašanja so odgovarjali tako sošolci kot učiteljica matematike. Dogovor med člani skupine je bil, da učiteljica preveri odgovore učencev in jih komentira. Prav tako so občasno delili kakšnen dogodek, ki ni bil povezan z matematiko. Na takšen način se je ohranjal stik med udeleženci skupine. Objavljene so bile tudi povezave do evalvacij šolskega tedenskega dela, narejene predvsem v Googlovih Dokumentih. V skupini so bile deljene povezave do videokonferenc, ki so potekale v spletnem okolju Zoom. Objavljene so bile tudi povezave do preverjanj znanj, ki so jih učenci reševali. Preverjanja znanja so bila večinoma preko spleta, največkrat narejena v Kahoot kvizih ali Google Drive. V skupini pa so na zidu bile dostopne tudi povezave do uporabnih strani, ki so učencem pomagale pri razumevanju snovi.



Slika 3. Primer oddanih zapiskov in nalog.

Pri delu na daljavo so pri matematiki učenke v povprečju bolj pogosto uporabljale spletno socialno omrežje Facebook v izobraževalne namene kot učenci. Učenke so bile tudi natančne v oddajanju nalog in redno zastavljale vprašanja za naloge, ki so delale težave. Do enake ugotovitve je prišla tudi avtorica [3] v svoji raziskavi.

Učiteljici je uspelo ohraniti stike z učenci tudi po zaključku poučevanja na daljavo. Zadnje besedilo je bilo namreč objavljeno 31. 8. 2020, večer preden so bivši učenci vstopili v novo srednjo šolo. Skoraj vsi učenci so odgovorili na to objavo, kar pomeni, da smo spletno socialno omrežje dobro izkoristili, ne samo za učenje, ampak tudi za ohranjanje stikov (slika 4).

Med uporabo spletnega socialnega omrežja Facebook so uporabniki zaprte skupine Matematika 9. r OSAMS prišli do ugotovitev, da so prednosti uporabe takšnih skupin naslednje:

- dostopanje kjerkoli in kadarkoli (predvsem s pametnim telefonom);
- učenci so morali biti aktivni, sicer so bili takoj označeni, da nečesa še niso naredili;
- znotraj skupine so bile omogočene prilagoditve za samostojno učenje (lahko so si razporejali čas in snov);
- učenci so imeli možnost razprave in sodelovanja;

- člani skupine so bili v močno povezani spletni skupnosti;
- na enem mestu so bile zbrane vse informacije (objave z navodili, povezavami, videoposnetki, fotografijami …);
- spletno okolje je bilo preprosto in enostavno za uporabo;
- v skupini si lahko označil posameznika (to je bilo učencem zelo všeč);
- imeli so možnost komunikacije z drugimi (delitev izkušenj);
- znotraj skupine so člani vzdrževali in ohranjali socialni stik.

Slika 4. Zadnja objava v skupini.

Kot pomanjkljivosti uporabe spletnega socialnega omrežja Facebook za učenje na daljavo so člani skupine navedli:

- pred uporabo je potrebno doreči pravila uporabe spletnega socialnega omrežja;
- učenci velikokrat uporabljajo pogovorni jezik in okrajšave, kar je bilo potrebno postopoma odpravljati;
- učitelj mora imeti nadzor nad objavami, da ne prihaja do širjenja napačnih informacij;
- potrebno je paziti, da se ne izvaja kakršnakoli oblika spletnega nasilja, zato mora skrbnik skupine vedno preverjati objave.

3 ZAKLJUČEK

22. maja 2020 se je učenje na daljavo za devetošolce zaključilo. S 25. majem 2020 so se vrnili v šolske klopi.

Na podlagi opravljene ustne analize dela na daljavo z devetošolci lahko sklepamo, da se je Facebook skupina uporabljala le pri matematiki. Tak način dela je bil učencem zelo všeč, ker je bilo podajanje informacij v socialnem omrežju zanje enostavno in preprosto. Delali so v spletnem okolju, ki zanje ni bilo novo in v katerem so se počutili dobro. Najprej je učence sicer skrbelo, da bo učiteljica videla njihove profile, a so kmalu ugotovili, da se zasebnih profilov ne vidi, če so nastavitve zasebnosti pravilno nastavljene. Učenci so pohvalili vzpostavljanje in ohranjanje socialnih stikov manjše učne skupine. Med seboj in z učiteljicami so se učenci počutili povezani tudi pri delu na daljavo. Posebej so pohvalili možnost sodelovanja pri nalogah, ki so jim delale težave, predvsem hiter odziv sošolcev in učiteljice. Povedali so, da je večina učencev do Facebook skupine dostopala preko pametnega telefona, ker je bilo to najhitreje in ker ga imajo vsi. Prav tako so vse naloge za oddajo slikali in naložili v skupino s pametnim telefonom. Tako je bilo delo najhitreje opravljeno.

Facebook skupine se kasneje pri delu na daljavo ni več uporabljalo. Četudi je bila izkušnja s socialnim omrežjem pozitivna, je še vedno preveč negotovosti s soglasji staršev, z ustreznimi nastavitvami zasebnosti učencev, s preverjanjem shranjevanja podatkov. Zato za delo na daljavo priporočamo uporabo Arnesovih spletnih učilnic, ki so mnogo bolj varne tako za učence kot za učitelje.

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Discord kot platforma za izvedbo pouka na daljavo

Discord as a distance learning platform

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POVZETEK

Na odpoved pouka, ki se je v preteklem letu zgodil zaradi pandemije koronavirusa, marsikdo ni bil pripravljen. Tukaj govorimo tako o krovnih šolskih organizacijah, kot tudi šolah samih, učiteljih, učencih, starših in institucijah, ki s šolami neposredno sodelujejo. Prispevek opisuje primer dobre prakse izvedbe pouka na daljavo z uporabo okolja Discord, ki so ga dijaki poznali in uporabljali v namene ne povezane s šolstvom. Prispevek prikazuje tudi rezultate anket, ki ju je kmalu po začetku pouka na daljavo in ob njegovem koncu izvedla komisija za kakovost..

KLJUČNE BESEDE

Discord, pouk na daljavo, video konferenca, kovid, tehnologija

ABSTRACT

o one could be prepared for the cancellation of classes, which happened last year due to the coronavirus pandemic. Not even head school organizations let alone schools themselves, teachers, students, parents and institutions that work directly with schools. The paper describes an example of good practice in conducting distance learning using the Discord environment, which students knew and used for non-educational purposes. The paper also shows the results of surveys conducted by the Quality Commission shortly after the start of distance learning and at the end of it.

KEYWORDS

Discord, distance learning, video conference, Covid, technology

1 UVOD

Na odpoved pouka, ki se je v preteklem letu zgodil zaradi pandemije korona virusa, marsikdo ni bil pripravljen. Tukaj govorimo tako o krovnih šolskih organizacijah, kot tudi šolah samih, učiteljih, učencih, starših in institucijah, ki s šolami neposredno sodelujejo. Začetna zmeda je bila zaradi precej hitrega zaprtja šol precej velika, saj časa za iskanje načina izvedbe pouka na daljavo (predvsem s strani učiteljev) praktično ni bilo.

Pri pouku na daljavo je z razvojem računalniške tehnologije, računalniške pismenosti in interneta prišlo do revolucionarnih sprememb. Izobraževalni proces se seli tudi izven učilnic v virtualni računalniški prostor [3]. Pri tem procesu ne gre za transformacijo ali za popolno nadomestitev tradicionalnega načina učenja, gre za njegovo razširitev in posodobitev [4].

Srednješolsko izobraževanje je ena ključnih faz za razvoj posameznika tako v privatnem kot tudi v njegovem poklicnem življenju. Dijakom je v tem času potrebno zagotoviti kakovostne učne vsebine za smeri izobraževanja, ki jih obiskujejo. Poleg učnih pripomočkov kot so e-gradiva, učbeniki, zapiski, ipd., pa morajo dijaki prejeti tudi ustrezno razlago obravnavanih vsebin, saj v nasprotnem primeru šola zares ne bi bila potrebna. Velika večina zaposlenih v šolstvu, pa tudi širše, je verjetno že slišala rek, da je uspešen proces izobraževanja odvisen predvsem od učiteljev, ki svoja znanja prenašajo na učence.

2 PREDSTAVITEV PROBLEMA

Večina učiteljev ni imela pripravljenih scenarijev izvedbe pouka na daljavo ob nastalih kriznih situacijah. Slovar slovenskega knjižnega jezika [1] krizo definira kot stanje v gospodarstvu, ko se ugodne razmere za razvoj začnejo hitro slabšati. Novak [2] krizo dodatno opredeli kot okoliščino, v kateri organizacija ne more več normalno delovati in ne more več dosegati svojih ciljev. Glavne značilnosti kriz so nenadnost, negotovost in časovni pritisk. Zgodijo se običajno nepričakovano in zahtevajo hiter odziv, ter povzročajo stres [2]. V kolikor pa so učitelji imeli predvidene rešitve za pouk na daljavo, pa ni nujno, da so ga v času zaprtja šol tudi dejansko lahko izvajali zaradi tehničnih težav na strani ponudnikov za zagotavljanje takšnih rešitev.

Klasičen primer prej navedenega problema je občutilo mnogo slovenskih učiteljev, ki so upali na izvedbo oddaljenega pouka preko spletnih konferenc Vox, ki jih preko spletne programske opreme Adobe Connect ponuja Arnes - javni zavod, ki zagotavlja omrežne storitve organizacijam s področja raziskovanja, izobraževanja in kulture ter omogoča njihovo povezovanje in medsebojno sodelovanje ter sodelovanje s sorodnimi organizacijami v tujini. Njihovi strežniki namreč niso prenesli izjemno povečanega omrežnega prometa, ki ga je izvajala velika množica slovenskih učiteljev (kot izvajalcev) in dijakov (kot udeležencev) ob enakem času. Precej učiteljev je tako obupalo nad izvedbo pouka na daljavo ali pa so se začeli posluževati načinov brez razlag, spet drugi pa so začeli iskati druge rešitve.

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Na Strokovni gimnaziji (v nadaljevanju SG) in Srednji tehniški šoli (v nadaljevanju STŠ) Šolskega centra Kranj, ter na Gimnaziji Franceta Prešerna (v nadaljevanju GFP) smo v dneh pred zaprtjem šol že predvideli takšen scenarij. Ravnatelj STŠ je učitelje računalništva prosil, če pripravijo predlog za izvedbo pouka na daljavo in posnamejo video vodič za sodelavce in dijake, ki teh tehnologij še ne poznajo. V sodelovanju z GFP smo pripravili dva različna predloga (Vox in Teams), ki sta v dneh ko še ni bilo pretiranega prometa na strežnikih, odlično delovala..

3 PREDLAGANA REŠITEV

Vox konference so kljub zastareli tehnologiji (zaradi potrebne uporabe Flasha) mnogim zdele najbolj logična rešitev. Marsikdo od učiteljev je ta način dela že poznal vsaj kot uporabnik, zato nadgradnja v gostitelja ni predstavljala prevelikega strahu. Vox je poleg delno poznanega okolja predstavljal tudi določene lastnosti, ki bi lahko zelo pozitivno vplivale na izvedbo pouka:

- za vsak razred in predmet se lahko izdela svoja konferenca,
- predstavlja možnost uporabe različnih načinov komuniciranja (zvokovno - preko mikrofona, vizualno - preko kamere, tekstovno – preko klepetslikalnice, grafično – preko table),
- omogoča deljenje datotek povezanih s snovjo v realnem času in kot možnost shranjevanja datotek na lastne naprave,
- prijava z osebnimi AAI računi, s čimer bi bila zagotovljena istovetnost prisotnih,
- zaščita vstopa v konference z gesli, kar bi preprečilo vstop tretjim osebam,
- možnost dostopa do konference kot gost (zgolj v začetnih fazah izvajanja, ko bi dijaki lahko imeli težave z pozabljenimi gesli, ipd.),
- možnost snemanja konferenc za dijake, ki se pouka niso mogli udeležiti,
- možnost izvajanja določenih akcij nad uporabniki (dodajanje in odvzemanje pravic komunikacije, izključitev iz konference, ipd.)

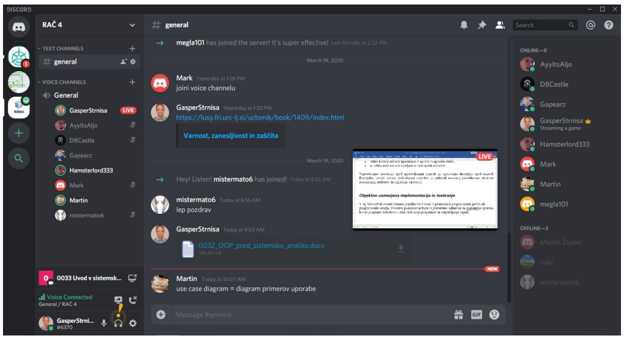
Za delo smo izobrazili tudi dijake, da bi v primeru zaprtja šola lahko z delom začeli takoj. Kot smo zapisali v prejšnjem poglavju, pa so se stvari spremenile v nedelujoče ob množični povezavi na strežnike teh storitev.

4 UPORABLJENA REŠITEV

Hitra prilagoditev situaciji je bila neizbežna, saj bi v primeru lastnega iskanja nove rešitve lahko porabili ogromno časa, s tem pa bi dijake prikrajšali za izvedbo pouka. Najbolj logična poteza se je kazala v ideji, da se tokrat učitelji posvetujemo z dijaki in se prilagodimo tehnologijam, ki jih oni najbolje poznajo in jih dnevno uporabljajo.

Discord je brezplačna aplikacija, ki je v prvi vrsti namenjena igralcem spletnih iger, pri katerih udeleženci potrebujejo tako glasovno komunikacijo kot tudi komunikacijo preko sporočil (slika 1). Uporabna je na računalnikih in pametnih napravah, saj je na voljo za operacijske sisteme MacOs, Windows, Linux, iOS in Android. Na voljo je tudi spletna različica, do katere je mogoče dostopati preko brskalnikov Firefox in Crome. Zaradi svoje preprostosti in intuitivnega grafičnega vmesnika, pa je postala ena izmed najbolj popularnih aplikacij za komunikacijo na svetu.

Aplikacija poleg klepeta po mikrofonu in tipkanja tekstovnih sporočil omogoča še vrsto drugih lastnosti, ki se lahko aplicirajo za izvedbo pouka na daljavo. Zlahka ja namreč deliti slike, videoposnetke in izvajati video konference v realnem času. Omogoča tako prijavo kot tudi začasno registracijo za tiste, ki bi želeli prisostvovati pouku v omejenem obsegu.



Slika 1: Okolje Discord

5 PREDSTAVITEV REZULTATOV

Po zaključenem prvem tednu pouka na daljavo, smo iz svetovalne službe dobili podatek, da se določeni dijaki še vedno niso vpisali v okolje MS Teams, ki ga je uporabljala večina profesorjev. To pomeni, da cel teden niso bili prisotni pri pouku. Pri urah predmetov računalništva, kjer se je za izvedbo pouka na daljavo uporabljal Discord, pa je bila udeležba 100% že od prvega dne. Zanimiv je tudi podatek, da so prav vsi dijaki že imeli ustvarjene račune v Discordu, preden smo ga začeli uporabljati v šolske namene.

Komisija za kakovost je tako kmalu po začetku, nato pa še ob koncu pouka na daljavo izvedla svoji anketi.

Anketo je izpolnilo 69 učiteljev. Zajemala je različna področja poučevanja na daljavo. Za naše ugotovitve pa so ključni rezultati, ki se nanašajo na komunikacijo z dijaki.

Po prvi anketi so bile ugotovljene naslednje ugotovitve: 94% učiteljev ja za komunikacijo z dijaki uporabljalo e-pošto in aplikacijo eAsistent. 76% jih je za pouk uporabljalo spletno učilnico, 29% pa je izvajalo pouk preko različnih video konferenc (Vox, MS Teams, Discord, Zoom). Zanimiva je bila tudi ugotovitev, da so v prvi anketi dijaki izrazili nezadovoljstvo s tem, da so različni učitelji za pouk uporabljali različne aplikacije.

V drugi anketi so zanimive tudi naslednje ugotovitve:

- tako dijaki kot tudi učitelji smo se naučili veliko novega v povezavi z uporabo sodobnih IKT tehnologij,
- priporočljiva je uporaba skupne platforme za izvedbo video konferenc,
- učitelji so si želeli tehnično pomoč za izvedbo video konferenc.

6 ZAKLJUČEK

Glede na dobljene rezultate opravljenih anket, so bili zapisani tudi določeni predlogi: določiti je potrebno pravila obnašanja na video konferencah; sprejeti je potrebno dogovor o organizaciji dela (delo po ustaljenem urniku ali izdelava novega urnika, ki bo prilagojen delu na daljavo); sprejeti je potrebno dogovor o beleženju prisotnosti oz. odsotnosti na video konferencah; priporočljiva je uporaba enotne platforme za izvedbo video konferenc.

Predlog, da šola določi uporabo enotne platforme za izvedbo video konferenc, je seveda zelo smiseln, saj na ta način pride do centralizacije znanj in izkušenj tako med učitelji kot tudi med dijaki. V primeru dobre prakse sodelovanja med učiteljem in dijaki preko ustaljene platforme pa je zadevo bolje pustiti kot je in na ta način pouk pripeljati do konca.

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Obogatitev predopismenjevanja v predšolskem obdobju

Enrichment of pre-literacy in the preschool period

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POVZETEK

V prispevku je predstavljeno, kako smo v skupini predšolskih otrok, zadnje leto pred vstopom v šolo, nadgradili ustaljene metode in aktivnosti za razvijanje predopismenjevalnih sposobnosti z uporabo spletnega orodja ABC PreSchool Kids Tracing & Phonics Learning Game (ABC predšolski otroci – učna igra).

Otroci so že v preteklih letih izkazali veliko zanimanja za sodelovanje v aktivnostih in didaktičnih igrah, ki so spodbujale predopismenjevalne veščine tako v naravi kot v igralnici. Nihče od otrok ni imel težav s t. i. pincetnim prijemom, ki so ga razvijali s trganjem papirja, z oblačenjem in slačenjem, gnetenjem testa, nizanjem perlic ipd. Marsikdo izmed njih je strokovnima delavkama kaj hitro pokazal zanimanje za izgled nekaterih črk. Posledično je vzgojiteljica načrtovala vrsto dejavnosti, ki bi nadgradile že izpeljane temeljne aktivnosti, izpeljane v zadnjih letih. Zavedali smo se, da je IKT del vsakdanjega okolja tudi predšolskih otrok, ki bi ga bilo smiselno uporabiti pri učno-vzgojnem procesu in jih podučiti o njeni didaktični vrednosti in po drugi strani izkoristiti atraktivnost in priljubljenost elektronskih naprav. Izbrala je spletno aplikacijo ABC PreSchool Kids Tracing & Phonics Learning Game, ki ponuja številne didaktične igre (npr. povezovanje točk, risanje vodoravnih in navpičnih črt, krivulj nakazuje ustrezno povezovanje črt pri zapisu velikih tiskanih črk itd.). Zaradi omejenosti s tehnično opremo (en tablični računalnik) smo izbirali oblike dela, pri kateri so bili vključeni in dejavni vsi otroci v skupini. Otroci so z veseljem sodelovali pri uporabi aplikacije, potrpežljivo so počakali, da so na vrsti, in kaj hitro so pravilno zapisali najenostavnejše črke in povezali grafem z ustreznim fonemom. Uporaba omenjenega spletnega orodja je nedvomno prispevala k učinkovitejšemu doseganju zastavljenega učnega cilja – razvijanju predopismenjevalne zmožnosti in celo napredka k zgodnjemu opismenjevanju.

KLJUČNE BESEDE

Predopismenjevanje, spletno orodje ABC PreSchool Kids Tracing & Phonics Learning Game, predšolsko obdobje, kritična uporaba IKT, učenje skozi igro

ABSTRACT

The article presents how in the group of preschool children, the last year before entering school, we upgraded the established methods and activities for developing preliteracy skills using the online tool ABC Preschool Kids Tracing & Phonics Learning Game (ABC preschool children – learning game). In recent years, children have shown great interest in participating in activities and didactic games that encouraged preliteracy skills both in nature and in the playroom. None of the children had problems with tweezers grip developed by tearing paper, dressing and undressing, kneading dough, stringing beads, and the like. Many of them quickly showed their interest in the appearance of some of the letters. As a result, the educator planned a series of activities that would upgrade the already carried out basic activities carried out in recent years. We were aware that ICT is part of the everyday environment of preschool children, which would make sense to use in the learning process and teach them about its didactic value and, on the other hand, take advantage of the attractiveness and popularity of electronic devices. She chose the ABC Preschool Kids Tracing & Phonics Learning game web application, which offers a number of didactic games (e.g. connecting points, drawing horizontal and vertical lines, curves indicating appropriate line connections when writing capital letters, etc.). Due to limitations with technical equipment (one tablet), we chose the forms of work in which all children in the group were involved and active. The children were happy to participate in using the app, patiently waiting for their turn, and what quickly they wrote the simplest letters correctly and connected the grapheme with the appropriate phoneme. The use of the mentioned online tool has undoubtedly contributed to a more effective achievement of the set learning goal – the development of pre- literacy skills and even progress towards early literacy.

KEYWORDS

Pre-literacy, online tool ABC PreSchool Kids Tracing & Phonics Learning Game, pre – school period, critical use of ICT, learning through play

1 UVOD

Vzgojitelji se zavedamo, da se razvoj pismenosti začne že pred formalnim šolanjem otroka, zato lahko k izboljšavi t. i. porajajoče se pismenosti pomembno vplivamo tudi s premišljenim načrtovanjem dejavnosti v vrtcu. Tudi L. Marjanovič Umek opozarja, da si večina ljudi napačno razlaga,

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da se opismenjevanje otrok začne šele z vstopom v šolo. Opismenjevanje je proces, ki se ne začne šele pri šestem ali sedmem letu, temveč traja tako rekoč od rojstva. Šest ali sedem let je umetna meja, ki smo jo postavili sami – takrat se je večina otrok sposobnih naučiti vse simbole naše abecede, s pomočjo katerih začnejo pisati in brati [1].

V Kurikulumu za vrtce je naveden kot eden od ciljev tudi razvijanje prstne spretnosti oz. t. i. fine motorike s primeri dejavnosti: otrok se igra oz upravlja z različnimi predmeti (vrvice, kroglice itn.) in snovmi (voda, pesek, mivka), ki omogočajo gibanje s prsti, dlanmi, rokami, nogami in stopali (gnetenje, prelivanje, presipanje, prijemanje, pretikanje itn.) [2]. Ko smo s skupino petletnikov izvedli omenjene in podobne dejavnosti, so bili otroci suvereni ne le v fino motoriki, temveč tudi pri zapisu črt in krivulj, nekatere pa je celo zanimalo, kako so oblikovane določene črke. Posledično smo se odločili nadgraditi grafomotorične vaje in jih obogatiti z vključitvijo IKT-orodja. Pri tem smo upoštevali Smernice za uporabo IKT v vrtcu, ki narekujejo, da morajo strokovni delavci otroku nuditi ustrezne možnosti in izzive (otroke učijo uporabljati IK sredstva; jih seznanjajo z možnostmi uporabe le-teh; jim približujejo internet in jih seznanjajo s prednostmi in pastmi na njem …) in tudi ozaveščati svoj odnos do nje [3].

2 POTEK DELA V SKUPINI

2.1 Uvodna motivacija

Z otroki smo se zbrali v jutranjem krogu. Pogovarjali smo se o sklenjenih in navpičnih črtah. S prsti so risali po zraku in dobro spremljali povezavo roka–oko. Naredili so tudi nekaj vijug in predlagali, da rišemo drug drugemu po hrbtu.

Na mizi so opazili mojo tablico in skupaj smo si na njej pogledali, kako se tudi na elektronskih napravah lahko zabavamo in hkrati nekaj naučimo. Pogledali smo zabavne igre, preko katerih se učimo in spoznavamo predopismenjevalne veščine, ki nas popeljejo v svet črk. Skupaj smo si ogledali aplikacijo ABC PreSchool Kids Tracing, ki je otroke takoj navdušila in želeli so jo tudi posamezno preizkusiti. Povedali smo navodila, določili pravila in preizkusili novo spletno orodje.

2.2 Glavni potek dejavnosti (Uporaba spletne aplikacije ABC PreSchool Kids tracing)

Otroci so svoje grafomotorične sposobnosti nadgradili z vključitvijo IKT-orodja. Svoje znanje so nadgradili tako, da so se preizkusili še preko tablice. Aplikacija jih je usmerjala in jim pokazala, če pravilno izpolnjujejo različne grafomotorične vaje. Vlekli so različne linije. Od krivulj, do enostavnih ravnih in poševnih črt. Lahko so si izbrali enostavne vzorce ali težje, zahtevnejše. Aplikacija jih je vodila in usmerjala v pravilen zapis. Otroci so bili zelo motivirani in zbrani. Razporedili so se v skupine. Nekateri so vaje izpolnjevali v zvezku, drugi pa preko spletnega orodja. Vsi so se preizkusili preko-IKT orodja in svoje znanje nadgradili s spoznavanjem nekaterih črk, ki jih aplikacija ponuja. Spoznali so črke I, L, M, N, T in O in jih kasneje tudi pravilno zapisovali v zvezek.

Slika 1: Otroka med reševanjem grafomotoričnih vaj.

3 ZAKLJUČEK

Spoznali smo, da je vključevanje IKT-orodja v vzgojno delo zelo koristen in v tem času tudi nujno potreben. Tako najmlajšim zagotovimo vključitev v porajajočo se digitalno pismenost, jim zagotovimo enake možnosti in tako zmanjšamo razlike med njimi. Omenjen didaktični pripomoček je otrokom popestril vzgojno delo. Šlo je za procesno učenje, katerega cilj niso bili pravilni in nepravilni odgovori, temveč spodbujanje otrokovih strategij dojemanja, izražanja in razmišljanja, ki so zanj značilne v posameznem razvojnem obdobju. V prihodnje bi aplikacijo lahko uporabljali večkrat, da bi jo otroci dobro osvojili in se tako navdušili nad drugačnim učenjem, ki je bila za mnoge zelo zabavna. V prihodnje bi aplikacijo lahko nadgradili z drugimi učnimi vsebinami in otroku omogočili, da ima več možnosti uporabe podobnih spletnih orodij in naprav. Tako bi svoje računalniško znanje izpopolnjevali. V naslednjem šolskem letu bi staršem že na začetku na sestanku predstavila različna spletna orodja in njihovo uporabo kot podporo učenju vključila v svoj letni delovni načrt.

ZAHVALA

Zahvaljujem se svoji sodelavki in vsem otrokom iz skupine, ki so z zanimanjem in z sodelovanjem pristopili k IKT- orodju in ga z veseljem preizkusili.

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Izdelava laboratorijskih vaj s PWS

Making Laboratory Exercises with PWS

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POVZETEK

Za izdelavo laboratorijskih vaj za področje elektroenergetskih omrežij sem se zgledoval po razvojnem oddelku Elektra Gorenjske d.d., Razvijajo nova in popravljajo (vzdržujejo) stara električna omrežja zaradi prodora novih razpršenih elektrarn in novih večjih porabnikov na obstoječa omrežja znotraj 10 % spremembe napetosti. S programom razvojni inženir nariše vse možne modele omrežja in hitro izračuna vse spremembe napetosti, lahko opravi simulacije moči v mreži. Na spletu sem našel brezplačni program Power World Simulator. Uporabil sem analitično, primerjalno in opisno metodo, metodo poskušanja, metodo sinteze ter za zaključek metodo anketiranja. Cilj vsake vaje je, da študent popravlja upornost in reaktanco (presek) golega voda ali kabla, da napetost na vodu ostane znotraj 10 %. Študenti najprej modelirajo omrežja, nato naredijo izračune, nato simulirajo pretoke moči in simulirajo izpade vodov in ostalih delov omrežja. Mimogrede se naučijo risati vse vrste topologij električnega omrežja (radialno, zankasto, dvostransko napajano, odprta pentlja), izračune padcev in porastov napetosti na vodih (na zbiralkah), kdo jih povzroča, prenapajanja, simulacije pretokov vseh treh moči. To so glavni pedagoški poudarki in želeni rezultati pri študentih, ki jih že 10 let radi in dobro opravijo.

KLJUČNE BESEDE

Električno omrežje, modeliranje, napetostna regulacija, simulator

ABSTRACT

For the production of laboratory exercises, I followed the development engineers of Elektro Gorenjska Ltd. They devlop new and repair (maintain) old electrical grids due to the penetration of new dispersed power plants and new major consumers to existing networks within 10% of the voltage change. With the program, the development engineer draws many grid models and quickly calculates all voltage I found the free Power World Simulator program online. I used an analytical, comparative and descriptive method, an experimental method, a synthesis method and a survey metod. The goal of each exercise is for the student to correct the resistance and reactance (cross section) of the bare line or cable so that the voltage on the line remains within 10 %. Students first model the grid, then do the calculations, then simulate the power flows and simulate the outages of the lines and other parts of the network. By the way, they learn to draw all kinds of mains topologies (radial, loop, double-sided, open loop), calculations of voltage drops and rises on lines (on busbars), who causes them, overvoltages, simulations of flows of all three powers. These are the main pedagogical highlights and desired outcomes for students, who have completed them good and satisfied for last 10 years.

KEYWORDS

Electrical grid, modeling, voltage regulation, simulator

1 UVOD

Že v srednji tehniški šoli zadnjih 22 let, še bolj pa na Višji strokovni šoli 8 let sem iskal stik s sodobno elektroenergetsko stroko s pomočjo podejtij in razvojem tudi preko strokovnih ekskurzij. V Elektro Gorenjski nam je pred desetimi leti razvojni inženir pokazal problematiko porasta priklopov sončnih elektrarn na 400 V omrežja, ki v določenih urah dneva ne dajejo v mrežo samo električne moči, ampak povzročajo tudi škodljive poraste napetosti nad standardizirano 400 V vrednostjo. Kasneje sem se večkrat oglasil v njihovi razvojni pisarni in pokazali s mi, kako njihovo delo poteka z uporabo programa Gredos. Oni pripravijo modele omrežij, Gredos pa jim izračuna, kateri model omrežja je optimalen. Ta rešitev gre protem v projektivno službo, nato pa jo gradbena enota postavi.

Cilj postavljanja laboratorijskih vaj mi je, da so te iz področja vzdrževanja, da so sodobne glede današnjega dela inženirjev v podjetjih, da so intelektualno zahtevne in pestre ter seveda, da so poceni za izvedbo, glede na to, da so stroji in elementi v elektroenergetiki zelo dragi, kar si šola težko privošči. Natančni pedagoški cilji so, da se študenti naučijo vseh topologij električnih omrežij (zanke v prenosnih omrežjih, odprto omrežje radialnih vodov v 400 V in odprte pentlje ter dvostransko napajani vodi v 20 kV omrežjih), da znajo vrisati v omrežja osnovne elemente, naprave in električne stroje. Da razumejo odnose med njimi in njihove parametre (R, X, B) in značilnosti. Vaje se modernih problemov dotikajo, ker danes distribucijska omrežja pridobivajo na osrednjem pomenu znotraj elektroenergetike, saj vanje prodira nešteto razpršenih virov elektrike, obnovljivih virov na 400 V omrežja. Na drugi strani pa vanjo prodirajo novi porabniki, saj poteka tranzicija ogrevanja in hlajenja iz fosilnih virov na elektriko (toplotne črpalke) in tranzicija transporta iz fosilnih virov na elektriko (e-avti). Za e-polnilnice pa je znano, da bodo vlekle iz omrežja velike moči.

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Tako razpršeni viri elektrike kot novi porabniki pa z velikimi tokovi v omrežju povzročajo velike poraste ali padce napetosti. Tako dobimo škodljivo nihanje napetosti, česar zadnjih sto let nismo pozanali tako izrazito. Takrat so vzdrževalci povečali moč transformatorja ali presek kabla. Sedaj pa se bližamo regulatorjem napetosti, megahranilnikom, regulacijskim distribucijskim transformatorjem, pametnim (avtomatiziranim) omrežjem, ko krmilnik regulira prej neumno omrežje s pomočjo senzorjev, aktuatorjev in podatkovnega omrežja. To področje škodljivih padcev in porastov napetosti spada v standard SIST EN50160, ki nam določa kvaliteto napetosti skozi nekaj merljivih parametrov. Mi se bomo tu ukvarjali s škodljivimi porasti napetosti, ki jih povzročajo elektrarne oz. sodobni razpršeni viri, običajno male hidroelektrarne, vetrne elektrarne, bioplinske termoelektrarne in predvsem fotovoltaične sončne elektrarne, kjer trenutno prevladujejo samooskrbne, ki rastejo v Sloveniji s približno 2.000 novimi elektrarnami letno.

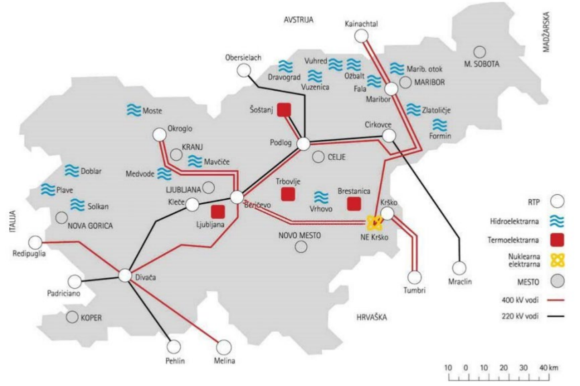
Študenti bodo morali doseči štiri osnovne cilje. Znati bodo morali iz elementov omrežij narisati več modelov omrežja (modeliranje omrežij). Znati bodo morali programsko in s formulami izračunati padce in poraste napetosti na vodih. Znati bodo morali popraviti te prevelike padce in poraste s pomočjo večanja presekov vodov in s tem resistance in reaktance voda. In nazadnje bodo morali znati tudi simulirati pretoke delovne, jalove in navidezne moči po omrežju s poudarkom, če pride do izpada dela omrežja, da znajo narediti prenapajanje in pogledati, kako to prenapajanje (novi, večji tokovi) škodljivo vpliva na poraste in padce napetosti na posameznih vodih, ki prevzamejo moč izpadlega voda zaradi delovanja zaščite ali okvare.

2 IZDELAVA PRVE VAJE

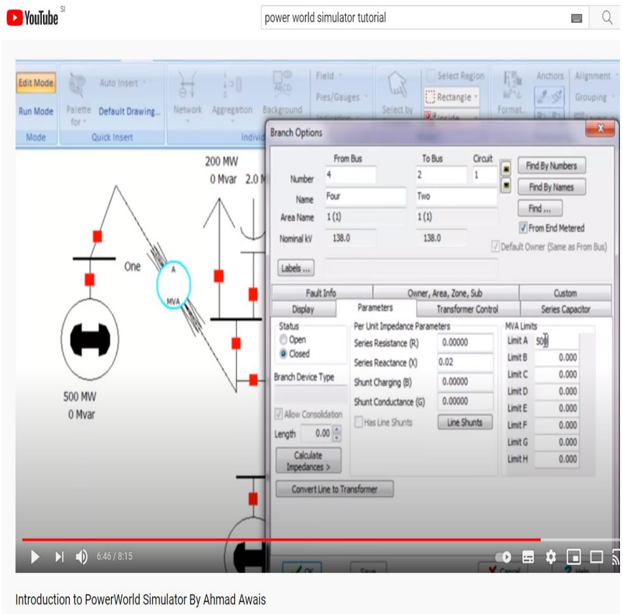
Za cilj risanja smo si s študenti ogledali prenosno omrežje Slovenije, enopolno 400 kV shemo iz rdečih črt (Slika 1), ki jo imam na plakatu v učilnici in v spletni učilnici Moodle. Naučim pa jih, da si jo lahko poiščejo na spletni strani ELES d.o.o. (Elektro Slovenija, ki je edini sistemski operater prenosnega omrežja v Sloveniji)[2]. Ogledamo si trenutne pretoke moči v prenosnem omrežju Slovenije.

Vozlišča med rdečimi črtami predstavljajo prenosne razdelilne transformatorske postaje (RTP v nadaljevanju). To so: glavna in osrednja RTP Beričevo (v njej sta tako regijski kot republiški center vodenja omrežja), ki napaja ljubljansko območje z napetostjo 110 kV, nato RTP Okroglo za gorenjsko regijo, RTP Divača za primorsko regijo, RTP Krško za dolenjsko regijo, RTP Maribor za večji del štajerske regije in Prekmurje ter RTP Podlog za šaleško dolino in celjsko območje. Trenutno se gradi RTP Cirkovce na 400 kV in iz njega daljnovodna interkonekcija z Madžarsko. Nato omenimo in narišemo tudi interkonekcije s tujimi prenosnimi omrežji Italije, Avstrije, Madžarske in Hrvaške, ki našemu sistemu omogočijo zančno topologijo in večjo stabilnost (obratovalno varnost), kar je v elektroenergetiki cilj številka 1. Pojasnim tudi, da na rdeča črta pomeni enosistemski daljnovod (L1, L2 in L3), dve črti pa dvosistemski daljnovod.

Na spletu poiščemo Power World Simulator[3], ameriško aplikacijo, ki ponuja veliko storitev za visokonapetostna omrežja. Naložimo si program PWS Simulator18, kajti ponuja nam tudi program Viewer. Vsako leto je obnovljena aplikacija, sedaj je to 18. verzija. Na začetku ga nisem znal prav nič uporabljati in tudi danes še vedno ne znam uporabiti večino funkcij, kar delajo doktorji znanosti v razvojnih oddelkih. Potreboval bi mentorja ali kak tečaj, saj se tega nismo učili na univerzitetnem študiju pred 30 leti. Zato sem si na Youtube ogledal precej kratkih in enostavnih filmčkov, kjer razni razvojni inženirji po celem svetu predstavljajo lahke in enostavne primere praktične uporabe v svojih podjetjih. Recimo video Introduction to PowerWorld, ki je nastal v tistem letu, ko sem si to ogledoval in se iz njega učil leta 2012[4]. Dolgi in zahtevni so prezahtevni zame in za študente.



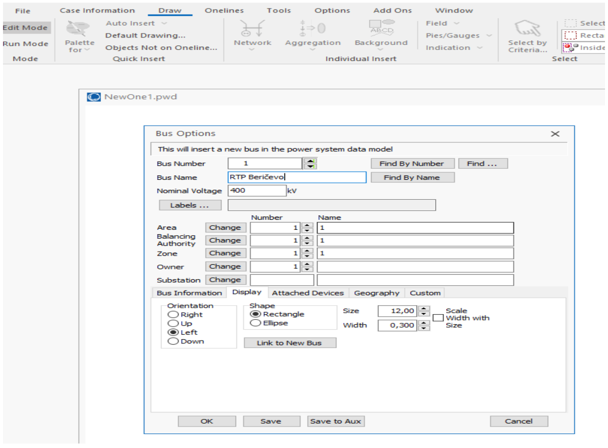
Slika 1: Prenosno, 400 kV omrežje Slovenije[1]



Slika 2: Učenje risanja modela s PWS iz videa[3]

2.1 RISANJE MODELA 400 kV PRENOSNEGA OMREŽJA

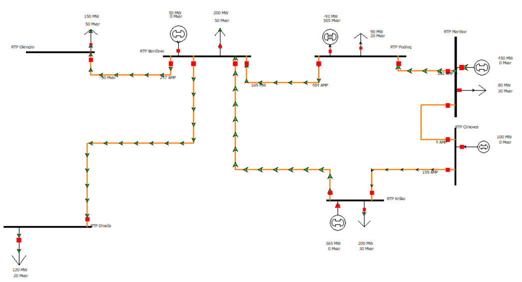
Moj prvi model ni vseboval RTP Cirkovce, ker te takrat niso imele 400 kV RTP in povezav, zgolj 220 kV in 110 kV. Najprej sem odprl nov primer (new case), začel sem risati (draw) omrežje v urejevalnem načinu (edit mode). Izberem meni Network in v njem ali Bus ali Transmission Line ali Generator ali Load. Slika 3 kaže, da sem narisal RTP Beričevo (Bus), jo poimenoval, ji določil nominalno (nazivno) napetost 400 kV in ji določil, da je glavna zbiralka (System Slack Bus). Američani imajo druge nazivne napetosti kot jih imamo v Evropi.



Slika 3: Vpisovanje parametrov zbiralkam RTP Beričevo

Nato sem narisal RTP Okroglo in še med njima daljnovod. Risal sem kar enosistemski daljnovod. Vpisal sem začetne parametre R in X in jima določil relativno vrednost 0,1 obema, ker sta relativno kratka daljonvoda. Nato sem nadaljeval z risanjem ostalih zibralk, ki so v osnovi dvosistemske zaradi varnosti, na sliki pa predstavljajo RTP prenosnega omrežja Slovenije. Dodal sem tudi sinhronske generatorje, ki predstavljajo večje elektrarne v Sloveniji in njihove moči. Na zbiralkah sem narisal puščice (Load) kot bremena moči, ki jih RTP transformirajo na 110 kV omrežje in s to ocenjeno močjo napajajo svojo regijo.

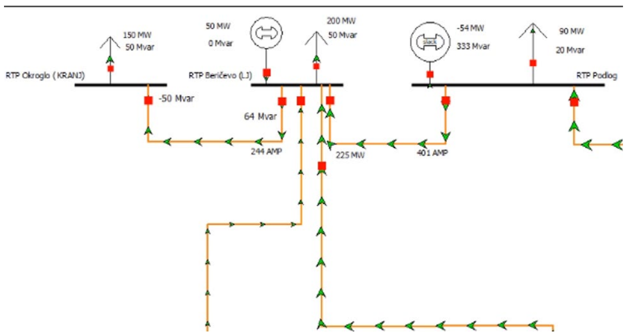
Slika 4 prikazuje končano risanje modela. Iz edit mode (urejavalnika) sem preklopil na run mode (vklopi simulacijo) in kliknil gumb play (poženi simulacijo). Prikažejo se delovne moči v megavatih na posameznih daljnovodih in smer pretoka moči. Lahko bi tudi narisal senzorje z skupne, navidezne moči v MVA in za jalove moči v MVAr po posameznih daljnovodih. Ne znam pa nastaviti senzorja, ki grafično prikaže relativno obremenitev daljnovoda od dovoljenje obremenitve. To sliko mi morajo oddati kot prvo zahtevo za uspešno laboratorijsko vajo.



Slika 4: Narisan model in zagon simulacije

Na vrhu v sredini je RTP Beričevo. Levo zgoraj RTP Okroglo, levo spodaj RTP Divača, desno spodaj RTP Krško, nad njim RTP Podlog, na desni pa smo letos že narisali RTP Cirkovce in zgoraj RTP Maribor. Dodal sem generatorje TETO Ljubljana na RTP Beričevo, Dravske elektrarne na RTP Maribor, TEŠ na RTP Podlog in JE Krško na RTP Krško. Puščice prikazujejo delovno moč P v MW, ki jo podam na začetku šolske ure študentom. In sicer dva podatka, delovna moč P in jalova moč Q (če je več motorjev v industriji), običajno v razmerju 4:1. Študent je postavil kot glavno zbiralko (System Slack Bus) v RTP Podlog zaradi TE Šoštanj.

Bolj natančno senzorje (merilce na vodu) prikazuje Slika 5, kjer sem dal na daljnovod tudi merilec toka v amperih (A, slika narobe prikazuje AMP!) , merilec P v MW in merilec jalove moči v MVAr.



Slika 5: Del posnetka simulacije modela z meritvami

2.2 SIMULACIJA PRETOKOV MOČI (P, Q in S) IN PRENAPAJANJE

Simulacijo se naredi tako, da Edit mode spremenimo v Run mode in da kliknemo zeleni gumb Play. Po narisanem modelu se začnejo pretakati večje in manjše puščice, odvisno kako velike moči tečejo po daljnovodu. Študente nato spodbudim, da kliknejo v rdeč kvadratek, ki je simbol stikalne enote (odklopnik in dva ločilnika), da pogledajo, kako se omrežje spremeni pri izpadu nekega daljnovoda zaradi okvare. Kako se vsi podatki moči in tokov spremenijo. Zelene puščice na rumenih vodih postanejo večje, ker morajo ostali daljnovodi sedaj prenašati večje moči zaradi izpada enega daljnovoda. Če študent kaj nariše narobe ali vstavi čudne vhodne podatke, se namesto simulacije prikaže črn ekran in oznaka Black Out, kar pomeni razpad sistema. To pomeni, da mora ponovno začeti risati nov model, kar se zgodi običajno polovici študentov.

2.3 IZRAČUN NAPETOSTI NA ZBIRALKAH MODELA 400 kV OMREŽJA

Tretji del laboratorijske vaje so izračuni padcev ali porastov napetosti na daljnovodih zaradi velikih tokov, ki jih določajo večje elektrarne oz. večji porabniki. Slika 6 prikazuje izračune napetosti na zbiralkah, ki povedo padce napetosti: absolutne v kV in relativne v %. Na zbiralkah imamo senzorje napetosti. Na zbiralkah so nazivne (nominalne) napetosti 400 kV (prvi stolpec), v resnici pa so napetosti manjše tam, kjer je velika poraba in večje na tistih zbiralkah, kjer so velike elektrarne. Program sam vse izračuna. Pogledamo tako, da kliknemo gumb Model Explorer, kar lahko prevedemo v naredi izračune napetosti za naš model. Tak posnetek zaslona v Model Explorerju mi morajo študenti oddati poleg simulacije moči v narisanem modelu. Modri rezultati, vrstice, pomenijo, da so vsi padci znotraj standarda 10%. Če bi risali popolnoma novo omrežje pa bi morali biti znotraj 5%. Vidimo, da ima polno napetost RTP Podlog

(100%), ker je System Slack Bus in pa RTP Krško (100%, PU Volt), ker gre vanje zelo velika moč iz elektrarn. Pri RTP Krško bi celo moralo pokazati poraste napetosti. Ostali RTP pa so porabniška vozlišča in zato na koncu daljnovodov z velikimi tokovi dobimo resnične napetosti, ki so nekaj % manjše od 100 % (PU Volt). Recimo RTP Okroglo ima 92,83 %, kar pomeni, da je na daljnovodu 7,17 % padca napetosti zaradi zelo velikega toka v njem, ki ga zahtevajo veliki industrijski porabniki, ki sem jih predpisal v nalogi za vpis v Load (breme), ki ga na slikah prikazuje puščica. To je manjše od mejnih 10 % v standardu, zato je to OK in je vrstica modra. Stolpec Angle (fazni kot med napetostjo in tokom v vodu) nam še ne predstavlja pomembnega podatka, je pa odvisen od imepdance bremena oz. od velikosti reaktance X.

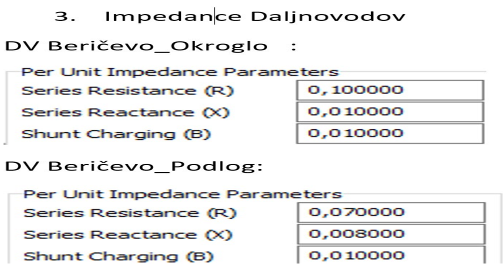
	Number	Name	Area Name	Nom kV	PU Volt	Volt (kV)	Angle (Deg)	Load MW
1	1	RTP Podlog	1	400,00	1,00000	400,000	0,00	90,00
2	2	RTP Beričevo (I	1	400,00	0,97435	389,741	-1,06	200,00
3	3	RTP Okroglo (	1	400,00	0,92834	371,337	-5,50	150,00
4	4	RTP Maribor	1	400,00	0,97362	389,448	21,53	80,00
5	5	RTP CIRKOVCE	1	400,00	0,99093	396,371	20,97	
6	6	RTP Krško	1	400,00	1,00000	400,000	17,52	365,00
7	7	RTP Divača	1	400,00	0,91718	366,871	-13,93	200,00

Slika 6: Posnetek tabele v Model Explorerju, ki prikazuje v stolpcu Volt (kV) izmerjene absolutne vrednosti napetosti

Naslednjo leto sem vpeljal drugačno prvo laboratorijsko vajo. Najprej smo »peš« računali padce in poraste napetosti iz toka in upornosti voda, preseke voda iz upornosti, razlike napetosti na zbiralkah, izgube moči na vodu. Nato pa smo skupaj narisali trikotno zanko električnega omrežja iz 3 RTP iz treh daljnovodov. Tako, da sem jih naučil, kako se nariše zbiralko (bus), ki predstavlja RTP, generator, breme (load) in daljnovod oz. kabel (transmission line) ter energetski transformator (transformer). Vse v zavihku draw (nariši) in v edit mode. Ostale vaje so delali sami, ob občasni moji pomoči.

2.4 Izpis končnih nastavitev R in X

Zadnji, tretji del vsake vaje pa je, da po večurnem poskušanju vpisovanja relativnih vrednosti (v %) R, X in B končno dobijo pravilne, modro obarvane rezultate v Model Explorerju. Običajno so vse vrstice daljnovodov iz Slike 6 obarvane rdeče, ker so padci napetosti preveliki. Gredos ponuja normirane preseke kablov in golih vodov, tukaj pa te možnosti ne znam uporabiti. V upornostih vodov R se skrivajo preseki vodov, specifična upornost aluminija in dolžina voda. Večji presek voda pomeni manjšo upornost voda in tako manjšo škodljivo spremembo napetosti zaradi toka v vodu. R je resistanca ali upornost, X je reaktanca, ki igra pri zelo dolgih daljnovodih ključno omejitev prenosa moči ter susceptanca B, v kateri se skrivajo kapacitivnosti med linijskimi vodniki in dozemne kapicativnosti. Okno v PWS, kjer študentje vpisujejo relativne vrednosti R, X in B prikazuje Slika 7.



Slika 7: Izrez iz PWS, kjer študent spreminja vrednosti R, X in B voda ali transformatorja, dokler niso padci napetosti modre barve

2.5 Povezava laboratorijskih vaj s sodobno usmeritvijo tehnologije za regulacijo U/Q

To popravljanje napetosti in hkrati jalove energije, ki ga študentje in razvojni inženirji delajo preko aplikacije PWS, se imenuje napetostno popravljanje in spada bolj v primitivno in počasno krmiljenje napetosti. Dejansko iščejo primernejši, večji presek kabla (če so padci ali porasti napetosti večji) in ta kabel zamenjajo potem delavci. Ali pa vzamejo transformator večje moči ob večjih obremenitvah na porabniški strani. To je primitivna metoda zadnjih sto let.

Vse to razložim v prvi laboratorijski vaji in si morajo v dokument zapisati pri prvi vaji. Kar pa sedanjost in prihodnost težita, pa gre tehnologija v smeri napetostne regulacije s pomočjo raznih senzorjev, krmilnikov, informacijskih prenosov in aktuatorjev (napetostna regulacija na primarju distribucijskega transformatorja).To imenujemo pametna omrežja in Slovenija bo v naslednjih 20 letih vgradila za 10 milijard € naprav v ta omrežja. In o tem jim veliko danes govorim pri prvi laboratorijski vaji, kjer si tudi študenti morajo zapisati vse načine popravljanja napetosti na vodih v omrežju, vključno z moderno napetostno regulacijo pri pametnih omrežjih, kamor spadajo tudi vgrajeni megahranilniki, virtualne elektrarne, polprevodniški L in C elementi (SVCR), ki popravljajo napetosti in jalovo energijo v omrežju, regulacija U/Q na generatorjih, magnetni stabilizatorji napetosti na vodih itd.

2.6 Delo študentov in metoda ankete

Za povratno zanko uspešnosti poučevanja takih laboratorijskih vaj sem uporabil tako moja opažanja med delom študentov, končni pregled in ocenjevanje laboratorijskih vaj in anonimne ankete na koncu šolskega leta.

Študenti so bili skozi vsako vajo vedno bolj izkušeni in samostojni. S pomočjo mojih pogovorov z njimi in sprotne pomoči študentom sem videl, kako kvalitetno in v globino razumejo vsako vajo. Predvsem pa so vedeli, kaj delajo. Pomembno je, da ima vsak svoj računalnik in vsak dela svojo, drugačno vajo, čeprav jim dovolim, da se med seboj pogovarjajo in si pomagajo. Pri poučevanju imam ves čas pred očmi izrednega študenta, znanca, ki sem ga bolj osebno spraševal, kaj so pri nekem predmetu v šoli, pri laboratorisjkih vajah z računalnikom, delali in mi je rekel, da celo leto ni imel pojma, da je samo drugim študentom sledil, ponavljal za njimi in ni nič vedel ne o ciljih, namenih in o rezultatih vaj. Kaj takega nočem, da katerikoli študent govori za moje vaje. Verjamem, da bolj kot je vaja učitelju jasna, bolj jo lahko primerno študentom razloži.

Pri ocenjevanju laboratorijskih vaj sem videl, da so dosegali visoke rezultate dela. Vaje so glede na zahteve dobro in kvalitetno opravili, nekateri odlično, nekateri malo bolj slabo. Predvsem sem pozoren, da preverim, da ni podvojenih vaj, skopiranih vaj.

Nazadnje pa še vsak september dobim anonimne ocene študentov za poučevanje vaj in predvanj, kjer dobivam visoke ocene vseh 10 let.

3 ZAKLJUČEK

Uspelo mi je izdelati 6 laboratorijskih vaj za vse topologije omrežij in za 4 napetostne nivoje v Sloveniji. Vsako leto dodam kaj novega. Narišemo model, poženemo simulacijo, se učimo prenapajanja. Veliko časa posvetim spoštljivi interakciji med nami in moji pomoči ob kateri skušam zaznati, koliko znanja so že osvojili o sami laboratorijski vaji. Nato popravljamo vse rdeče vrstice v Model Explorerju (dimenzioniramo presek vodov). Bi pa rad koga od teh specialistov za PWS spoznal, ker imam nešteto vprašanj zanj glede izboljšav vaj in glede koristnih novih vaj ali dodatkov. Vmes med vajami lahko razlagam teorijo, uporabnosti, pomen in logiko veličin in tudi električni model voda in transformatorja opisan z upornostmi (serijske), reaktancami (serijska) in susceptanco (vzporedna, shunt).

ZAHVALA

Zahvaljujem se razvojnim inženirjem Mihu Žumru, Anžetu Vilmanu in Mihu Noču, ki so v razvojnem oddelku Elektro Gorenjska d.d. Pokazali so mi svoje delo in uporabo Gredosa.

V veliko pomoč so mi bili tudi razni vzhodnjaški razvojni inženirji, ki na Youtube v videoposnetkih razlagajo osnove in kompleksnosti PWS, pa čeprav sem moral vaje postaviti malo po svoje za namen predmeta in ni nobena enaka ali podobna tem vajam, razen risanja elementov električnih omrežij na samem začetku.

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Funkcionalnosti spletnih učilnic pri izobraževanju knjižničarjev med epidemijo

The functionality of the online classrooms in librarian education during the epidemic

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POVZETEK

Izobraževalna dejavnost Narodne in univerzitetne knjižnice ima pomemben vpliv na knjižnični sistem v Sloveniji. V trenutku, ko je bila razglašena epidemija, je bilo potrebno izobraževanje prilagoditi novim razmeram. Izobraževanje na daljavo je bilo uspešno izpeljano s pomočjo spletnih orodji ter spletnih učilnic, kar je pomenilo, da je tehnološki napredek in integracija informacijske tehnologije v izobraževanje prinesla učinkovite rešitve, ki smo jih aplicirali ter se prilagodili delu med epidemijo in zagotovili nemoteno izvajanje izobraževanj. V luči spremenjenih razmer dela in izobraževanja na daljavo so spletne učilnice s svojo funkcionalnostjo zadostile potrebam.

KLJUČNE BESEDE

Ozobraževanje, spletne učilnice, epidemija, knjižničarji

ABSTRACT

The educational activities of the National Library of Slovenia has a significant impact on the library system in Slovenia. When the epidemic was declared, educational activities had to be adapted to the new situation. Distance education was successfully implemented using online tools and online classrooms, which meant that technological advances and the integration of information technology provided effective solutions that were applied and adapted to work during the epidemic and ensured the smooth transfer of education. In the light of the changed situation of work and distance education, online classrooms have met the needs with their functionality.

KEYWORDS

Education, online classrooms, epidemic, librarians

1 UVOD

Narodna in univerzitetna knjižnica (NUK) je nacionalna knjižnica Republike Slovenije, katere temeljno poslanstvo je zbiranje in varovanje ter zagotavljanje uporabe nacionalne zbirke knjižničnega gradiva, strokovna podpora knjižnicam pri izvajanju javne službe in nacionalnemu bibliografskemu sistemu ter vključevanje v mednarodne knjižnične povezave.

Knjižnica v skladu z zakonom o knjižničarstvu na podlagi posebne pogodbe med knjižnico in Univerzo v Ljubljani, v soglasju z ustanoviteljem, opravlja tudi funkcijo univerzitetne knjižnice Univerze v Ljubljani. Knjižnica na podlagi predpisov o varstvu kulturne dediščine skrbi za Plečnikovo in drugo dediščino, ki jo ima v uporabi ali jo poseduje, ter opravlja ustrezno arhivsko dejavnost [1].

NUK je torej nacionalna knjižnica Republike Slovenije in je hkrati univerzitetna knjižnica za Univerzo v Ljubljani ter osrednja državna knjižnica. Izvaja knjižnično dejavnost v okviru javne službe in skrbi za dediščino ter sodeluje v nacionalnem vzajemnem bibliografskem sistemu in opravlja tudi druge dejavnosti [2]. Med temi nalogami je tudi izobraževalna dejavnost, ki jo organizira ter izvaja oddelek za izobraževanje, razvoj in svetovanje in sicer za knjižničarje, založnike in uporabnike knjižnic. Izobraževanje je tako rekoč nepogrešljiv sestavni del razvoja vsakega knjižničarja in knjižnice, zato tej dejavnosti NUK posveča precej pozornosti.

O izobraževalni dejavnosti več v nadaljevanju. mejite na največ šest strani.

2 IZOBRAŽEVANJE KNJIŽNIČARJEV V NUK

Če povzamem besedilo Etičnega kodeksa slovenskih knjižničarjev, mora vsak knjižničar nenehno izpopolnjevati svoje strokovno znanje in ustvarjalno prispevati k razvoju knjižničarske stroke in njene dejavnosti [3]. Zato NUK vsako leto ponuja in izvaja strokovno spopolnjevanje ter permanentno izobraževanje knjižničarjev. Izvaja tudi bibliotekarske strokovne izpite ter postopke priznavanja strokovnih nazivov za knjižnično dejavnost. Informacije o izobraževalnih programih ponuja v katalogu z naslovom Program izobraževanja , ki ga vsako leto prenovi in dopolni z novostmi [4].

NUK organizira in izvaja različne oblike izobraževanj za knjižničarje, založnike in usposabljanja za uporabnike knjižnic [5]. Izobraževalni program se izvaja v računalniški učilnici NUK (Turjaška ulica 1) ter v učilnici na Leskoškovi cesti 12. Število udeležencev na posameznem tečaju je omejeno s prostorskimi zmožnostmi in dodatno opremo, ki je potrebna za posamezno izvedbo tečaja (računalniška oprema, knjižnično gradivo …). Izobraževalne vsebine so namenjene knjižničarjem začetnikom, knjižničarjem, ki želijo izpopolniti svoje znanje ter tistim, ki se želijo usposobiti za delo v sistemu vzajemne katalogizacije. Tečaje in delavnice se organizira tudi za tiste, ki niso zaposleni v knjižnici, a bi se želeli seznaniti z izobraževalnimi vsebinami.

V letu 2020 pa je v ustaljene tirnice izvajanja izobraževanj nenadoma posegla epidemija, saj je bila 13. marca 2020, na območju Republike Slovenije, razglašena epidemija nalezljive bolezni COVID-19. Življenje se je v trenutku spremenilo in med drugim so tudi knjižnice zaprla svoja vrata. S tem so odpadla oziroma so bila, za nedoločen čas, prestavljena vsa izobraževanja, ki jih NUK izvaja za knjižničarje, založnike in uporabnike. Več o izobraževanju med epidemijo v nadaljevanju.

3 EPIDEMIJA IN NOVE OBLIKE IZOBRAŽEVANJA

13. marca 2020 se je zaradi epidemije nalezljive bolezni COVID-19 vse spremenilo, izobraževalne ustanove so zaprla svoja vrata, zaposleni so prešli na delo od doma, država se je tako rekoč zaprla. Ob tem je bilo potrebno analizirati stanje ter premisliti dostopnost izobraževalne dejavnosti NUK in novih oblikah izobraževanja. Upoštevati je bilo potrebno navodila ter razmišljati o prilagajanju dejavnosti veljavnim ukrepom za preprečevanje širjenja bolezni COVID-19. Glede na takrat veljavne ukrepe je bilo potrebno vzpostaviti sistem e-izobraževanja, a vzpostavitev sistema e-izobraževanja v katerikoli instituciji je kompleksna naloga [6]. Izobraževanja se niso smela več izvajati fizično v prostorih NUK-a temveč jih je bilo potrebno preseliti v spletno okolje oziroma na daljavo. Izobraževanje na daljavo navadno pomeni namerno, smotrno, načrtovano in organizirano izobraževanje [7]. S tem se ni spremenil le način dela temveč tudi način poučevanja oziroma podajanja novih znanj in vsi deležniki so se morali prilagoditi novim razmeram. Najhitreje je bilo mogoče nemoteno izobraževanja ponuditi in izvajati s pomočjo spletne platforme ZOOM (ZOOM je spletna platforma za avdio in video komunikacijo, ki se uporablja za organiziranje sestankov, izobraževanj, delavnic in drugih oblik sodelovanja) in Microsoft Teams (platforma v sklopu izdelkov Microsoft 365 za komunikacijo), a hkrati je bilo potrebno pripraviti tudi spletne učilnice [8]. Glede na letni načrt izobraževanj je bilo potrebno načrtovati in pripraviti več spletnih učilnic. Zaradi nepoznavanja področja upravljanja spletnih učilnic, sem se najprej udeležil izobraževanj za izdelavo in delo v spletnih učilnicah. Najboljša možnost za pridobitev novih znanj s tega področja je bil Zavod Arnes , kot nacionalni servisni center za področje izobraževanja, raziskovanja in kulture, ki nudi vrsto storitev in sodobnih spletnih rešitev [9].

Ker sem se pri svojem delu do sedaj večkrat srečeval z različnimi novostmi, spremembami in uvajanjem informacijskih tehnologij, sem ravno tako sprejel izziv z možnostjo izdelave spletnih učilnic.

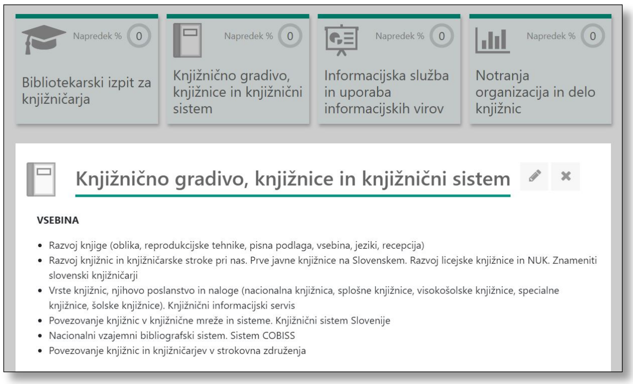
4 NAČRTOVANJE, IZDELAVA, UPORABNOST IN FUNKCIONALNOST SPLETNIH UČILNIC

Kratica LMS (Learning Management System) predstavlja spletno učno okolje, ki je mesto, kjer se v virtualnem okolju povezujejo vsi deležniki ter učne vsebine. Spletne učilnice so uporabna podpora izvajanju učnega procesa oziroma izobraževanja in torej niso le skladišče gradiv, ampak tudi prostor komunikacije, sodelovanja, oddaje nalog, vrednotenja in ocenjevanja. Spletna učilnica Moodle je torej stičišče, kjer poteka aktivno učenje [10]. Spletne učilnice imajo veliko prednosti: ni prostorske omejitve (fizični prostor - mize, stoli), učenje je lahko veliko bolj interaktivno in multimedijsko, udeleženci si lahko sami izberejo čas in hitrost učenja (ko gre za vnaprej pripravljeno usposabljanje ali del tega).

Ker sem že imel pripravljene vsebine in cilje posameznih izobraževanj ter gradiva predavateljev, sem s pomočjo sodobne informacijska in komunikacijske opreme uporabil nove oblike ter načine posredovanja in usvajanja znanja [11]. Začel sem s pripravami različnih spletnih učilnic, ki sem jih razvrstil po kategorijah (permanentno izobraževanje, izobraževanje za začetnike v stroki, Izobraževanje za vzajemno katalogizacijo ter izobraževanje za uporabnike). Vsak tečaj, ki se je do nedavnega izvajal v živo v prostorih knjižnice, je dobil svoj virtualni prostor. Med predmete učilnice Izobraževanja za knjižničarje sem uvrstil Modul 1: Knjižnično gradivo in knjižnice in Modul 2: Osnove varovanja in zaščite knjižničnega gradiva, Tečaj za pripravo na splošni del bibliotekarskega izpita ter tečaje za vzajemno katalogizacijo (vsako izobraževanje je imelo svojo učilnico). Med učilnice Izobraževanje za uporabnike pa sem uvrstil učilnice Uporaba informacijskih servisov z e-članki in e-knjigami, E-informacijski viri za pomoč pri študiju in raziskovalnemu delu in Iskanje znanstvene literature s pomočjo portala mEga iskalnik NUK v Akademski digitalni zbirki (COBISS+). Med tematske učilnice pa so bile nameščene učilnice, ki so povezane z določeno tematiko, kot denimo Knjižničarske novice (oddaja prispevkov, komunikacija z avtorji, navodila avtorjem za navajanje literature in podobno). Poskrbljeno je bilo tudi za dodatno gradivo, ki je bilo nameščeno v posebni kategoriji, do katere so lahko dostopali udeleženci izobraževanj (pri spletnih učilnicah sem, glede na potrebe, nastavil različne možnosti prijave - AAI račun, dostop gosta in prosto dostopno). Na sliki 1 je prikaz osnovnega vpogleda v kategorije in predmete spletnih učilnic NUK.

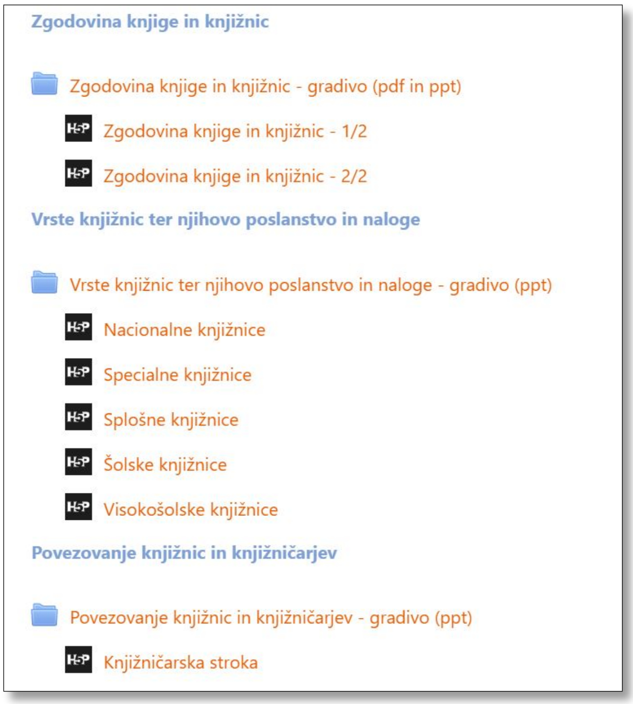
Slika 1: Vpogled v kategorije in predmete spletnih učilnic NUK.

Za vse učilnice sem uporabil sodobno in poenoteno obliko ploščic (format predmeta - pregledno, uporabno, sledljivo). Znotraj vsake učilnice sem uredil poglavja (glede na vsebine in cilje posameznega izobraževanja ali tečaja). Z uporabo različnih dejavnosti, aktivnosti ali virov pa sem dodal ter izdelal posamezne interaktivne naloge, interaktivne prosojnice kot tudi videoposnetke. V veliko pomoč je bil vtičnik H5P (omogočal je, da sem na enostaven način dodajal aktivne vsebine - interaktivni videoposnetek, predavanja v obliki predstavitev ter kvize z različnimi tipi vprašanj, s katerimi so udeleženci obnovili pridobljeno znanje). Z uporabo različnih dejavnosti in interaktivnosti je bilo poskrbljeno, da je bilo e-izobraževanje pripravljeno zanimivo, privlačno ter predvsem uporabno. Naslednja slika prikazuje vpogled v učilnico, ki je namenjena udeleženem, ki spremljajo izobraževanje.



Slika 2: Vpogled v učilnico pred začetkom pregledovanja, spremljanja in reševanja nalog. Vsak udeleženec je lahko sam spremljal svoj napredek, kar se mu je v vsakem poglavju izpisovalo v odstotkih.

Na naslednji sliki (3) je viden pogled v učilnico modula 1, kjer so za udeležence (skladno s cilji izobraževanja) pripravljeni posamezni sklopi oziroma teme tečaja.



Slika 3: Vpogled v učilnico modula 1: knjižnice in knjižnični sistemi, kjer so pripravljene naloge (vtičnik H5P z interaktivnimi vsebinami) po sklopih oziroma temah tečaja.

Na naslednji sliki je prikaz začetka interaktivnega videoposnetka (del tečaja za začetnike, modul 1: knjižnice in knjižnični sistemi), kjer so udeleženci spremljali vsebino o šolskih knjižnicah ter aktivno sodelovali s povratnimi informacijami.

Slika 4: Zaslonska slika pripravljenega interaktivnega videoposnetka predavanj, kjer so udeleženci sodelovali (na vsaki drsnici, kjer je viden krog, je bila pripravljena dodatna interaktivna vsebina).

Poleg vseh uporabnih virov, dejavnosti in funkcij je bil uporaben tudi forum, kjer je potekala komunikacija med udeleženci (postavljanje vprašanja, odgovorov ter nasvetov v povezavi z delom, vsebinami). Udeleženci so pridobili in nadgradili sposobnosti sodelovanja, komuniciranja, reševanja in uporabe spletne učilnice ter krepili posamezne stopnje digitalnih kompetenc (digitalne kompetence segajo na področje informacijske pismenosti, komuniciranje in sodelovanje, izdelovanje digitalnih vsebin, varnost in reševanje problemov) [12].

5 ZAKLJUČEK

V prispevku sem predstavil izobraževalno dejavnost NUK ter kako je v izvajanje izobraževanj posegla epidemija in s tem spodbudila prilagoditve in vpeljavo spletnega izobraževanja. Izvajati se je začelo izobraževanje na daljavo s pomočjo ZOOM, Microsoft Teams ter spletnih učilnic. V poučevanje na daljavo smo tako rekoč stopili čez noč, saj so se z razglasitvijo epidemije ustavili vsi izobraževalni procesi, zaposleni so opravljali delo od doma, zaprle so se šole in knjižnice. Ob novi situaciji je bilo potrebno prilagoditi tudi izobraževanje za knjižničarje, založnike in uporabnike, ki ga izvaja NUK.

Nova realnost je imela tudi velik vpliv na prilagoditve in nove pristope pri izobraževanju v NUK. Tehnološki napredek in integracija informacijske tehnologije v izobraževanje je prinesla učinkovite rešitve, ki smo jih aplicirali ter se prilagodili delu med epidemijo in zagotovili nemoteno izvajanje izobraževanj. Torej so spletne učilnice s svojo funkcionalnostjo, v določenem časovnem obdobju, opravile želene funkcije v zahtevanih okvirjih (spletne učilnice so postregle z različnimi možnostmi in sodobnimi načini priprave e-izobraževanja, e-gradiv in komunikacije, kar je omogočilo izobraževanje na daljavo za vse deležnike). Ob tem je pomembno tudi dejstvo, da uporaba in delo s spletnimi učilnicami vpliva na razvijanje in krepitev ključnih kompetenc, ki so potrebne za uspešno delovanje v današnji informacijski družbi.

Če torej povzamem, je spletna učilnica odprla nove možnosti za povezovanje ter izobraževanje in vpeljavo novih učnih strategij, kjer se neposredno razvijajo določene kompetence. Poleg tega pa je učenje ter delo s sodobno informacijsko komunikacijsko tehnologijo, ob ustrezno pripravljenimi in izbranimi viri ter dejavnostmi v spletni učilnici, vsekakor pomemben prispevek k večji dostopnosti učnih vsebin.

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Primerjava pouka angleščine od 1. do 5. razreda na daljavo

Comparison of English lessons from 1^{st} to 5^{th} grade in distance learning

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POVZETEK

Pouk na daljavo v vsakem izobraževalnem obdobju poteka drugače. Z vidika tujega jezika je zelo zanimivo spremljanje podobnosti in razlik v pristopih in uporabi interaktivnih orodij za učence različnih starostnih skupin. Kot učitelji se moramo zavedati, katere oblike in pristopi (tudi orodja) so primerni za katero starost ter v kolikšni meri so učenci samostojni. V prispevku bom obravnavala uporabljena orodja v posameznem razredu (1. – 5. razred) ter povzela kako smo preko le teh zbirali dokaze o učenju ter na kakšen način in kako ustrezno je bila podana povratna informacija učencem.

KLJUČNE BESEDE

Pouk na daljavo, angleščina, interaktivni materiali, povratna informacija

ABSTRACT

Distance learning takes place differently in each educational period. From the point of view of a foreign language, it is very interesting to monitor the similarities and differences in approaches and the use of interactive tools for students of different age groups. As teachers, we need to be aware of which forms, and approaches (including tools) are appropriate for which age and to what extent students are independent. In this article, I will discuss the tools used in each class (1st - 5th grade) and summarize how we collected evidence of learning through them and in what way and how appropriate feedback was given to students.

KEYWORDS

Distance learning, English, interactive materials, feedback

1 UVOD

Pouk na daljavo nam lahko, poleg težav, predstavlja tudi nov izziv. Uporaba IKT nam lahko omogoča vključevanje interaktivnosti, vizualizacije, posredovanje povratnih informacij, ocenjevanje znanja, sodelovalno delo in še marsikaj drugega. »IKT vpliva na način, kako učenci, dijaki in študenti pridobivajo znanje, na izvajanje pedagoškega procesa ter delovno in učno okolje učitelja.« Uporaba IKT lahko omogoča bolj kakovostno vzgojno-izobraževalno delo, in večji učinek učenja, hkrati pa lahko poveča tudi sodelovanje med učenci. Z uporabo IKT (tako pri rednem pouku kot pri pouku na daljavo) lahko dosegamo boljše rezultate, učni proces je lahko bolj dinamičen in za učence bolj zanimiv [1].

»Premislek o ustrezni didaktični uporabi IKT je za učitelja in pouk ključen, saj učitelju pomaga pri odločanju, kdaj, kako in zakaj ga vključiti v pouk. Zahteva poznavanje pristopov za ustrezno uporabo IKT v izobraževalnem procesu ter znanja za pripravo didaktično ustreznih učnih gradiv in za ustrezen način vključevanja v pouk.« Tako ima učitelj pri vključevanju IKT v pouk izjemno pomembno vlogo. Učitelj namreč »opredeli didaktični pristop in izbira tehnologijo za uporabo pri pouku.« [1]

Pri pouku tujega jezika so najbolj pogosta orodja za učenje besedišča. Ta morajo omogočati, da učenci »hitro opazijo ciljno besedišče, nuditi morajo razlago ciljnega besedišča, ter vsebovati raznovrstne vaje in naloge, s katerimi učenci spoznajo vse vidike razumevanja besed.« Učenci morajo videti svoje napake pri rabi besedišča in jih odpraviti. Naloge morajo omogočati tudi možnosti za ponavljanje in utrjevanje novega besedišča. Nekatere raziskave potrjujejo pozitiven vpliv uporabe IKT orodij za učenje tujega jezika. Poročajo predvsem o izboljšanju motivacije za učenje. Predvsem v 1. in 2. razredu je motivacija za učenje tujega jezika zelo pomembna. Raziskava pravi, da se pri uporabi tabličnega računalnika ali računalnika (pri pouku ali doma) za reševanje poučnih nalog v angleščini, dvigne motivacija učencev in se na tak način raje učijo angleščino [1].

2 PREGLED UPORABLJENIH ORODIJ V POSAMEZNIH RAZREDIH

V različnih razredih smo za potek pouka uporabili različna orodja, prilagojena starosti in ciljem pouka. V učnih načrtih za tuje jezike je zapisano, da je »Vključevanje informacijske in komunikacijske tehnologije v pouk/…/smiselno le, če ta prispeva k lažjemu razumevanju učnih vsebin, ohranjanju motivacije za učenje in izboljšanju učnih rezultatov.« Prav tako je poudarjeno, naj učitelj razmisli o prednostih IKT ter izbere ustrezno učno in programsko okolje [2].

V spodnji tabeli so, glede na namen, zapisana vsa orodja, ki smo jih uporabili pri pouku na daljavo od 1. do 5. razreda.

Tabela 1: Namen in uporabljena orodja IKT pri pouku na daljavo

Namen	Orodja IKT
Organizacija učnega procesa	e-pošta, Xooltime, ZOOM
Predstavitev vsebine	Word, Genially, PPT, ZOOM, Youtube, Quizlet, Padlet
Objavljanje gradiv	e-pošta, Xooltime
Skupinsko delo	Xooltime, ZOOM, Padlet
Sporočanje in oddaja	Xooltime
Sprotno preverjanje znanja	Liveworksheets, Quizlet, LearningApps, Bookwidgets, Xooltime

2.1 1. razred

V 1. razredu se učenci z angleščino spoznajo v sklopu neobveznega izbirnega predmeta (NIP). Pouk angleščine je na urniku dve uri tedensko. V času pouka na daljavo so učenci (in njihovi starši) navodila za delo prejemali enkrat tedensko. Komunikacija je potekala preko e-pošte.

Učenci v 1. razredu še ne morejo samostojno slediti navodilom za pouk, zato je bila velika teža pouka na daljavo predvsem na starših. Učitelji smo se trudili, da bi bil proces pouka za starše čim manj obremenjujoč, za učence pa čim bolj zanimiv in podoben tistemu v šoli. Pri pouku angleščine v šoli gre namreč za proces učenja preko igre, kar je na daljavo težko uresničiti.

Pouk na daljavo smo izvedli preko naslednjih orodij:

- <u>Youtube</u> [3] (Učenci so poslušali različne videoposnetke. Ob angleških pesmih so se gibali in utrjevali besede, ob posnetkih učiteljic so ponavljali ali usvajali novo besedišče, občasno pa po navodilih kaj narisali ali pobarvali v zvezku).
- <u>Educaplay</u> [4] (Učenci so se preizkusili v preprostih igrah spomina, kjer so sličice povezali z izgovorjeno besedo).

Pomembno je, da pri poučevanju tujega jezika v 1. razredu ohranjamo motivacijo, interes in veselje do učenja tujega jezika. Pri izbiri vsebin, učnih metod in pristopov smo bili pozorni na učenčevo kratkotrajno pozornost in da so bili materiali privlačni, uporabni in zabavni. Tako kot pri pouku v šoli smo tudi tu pouk organizirali z uporabo vizualnih podpor (fotografije) in glasbe (pesmi, izštevanke, gibalne pesmi). Pri pouku na daljavo je bistveno manj možnosti za individualizacijo in diferenciacijo, s tem pa se izgubi tudi nadzor nad posamezniki s težavami saj jim, brez direktnega vpogleda v njihovo delo, zelo težko prilagodimo vsebine, metode in oblike dela [5].

2.2 2. razred

V 2. razredu imajo učenci na urniku dve uri pouka angleščine na teden. Navodila za delo smo jim, tako kot v prvem razredu, posredovali preko e-pošte.

Ker so učenci v 2. razredu že nekoliko bolj samostojni (znajo brati navodila), smo se odločili za nekoliko drugačen pristop, saj smo želeli (vsaj nekaterim) učencem omogočiti, da v čim večji meri pouku na daljavo sledijo samostojno, brez nujne pomoči s strani staršev.

Pouk na daljavo smo izvedli preko naslednjih orodij:

- <u>Genially</u> [6] (Učenci so s klikom na prejeto povezavo sledili posnetim navodilom. Med stranmi so se premikali s puščicami. Vse spodaj navedene aplikacije so bile del te povezave. Aplikacija omogoča snemanje zvoka učitelja, izdelavo preprostih kvizov in še marsikaj drugega).
- <u>Youtube</u> [3] (Učenci so poslušali angleške pesmi in navodila učitelja: ponavljanje besed, preprostih povedi).
- <u>Liveworksheets</u> [7] (Učenci so reševali pripravljene naloge na interaktivnih učnih listih, kjer so povezovali sličice z izgovorjenimi besedami in pridobili direktno povratno informacijo).

Tudi v 2. razredu mora biti pri pouku tujega jezika v ospredju učenčeva kratkotrajna pozornost. Izmenjavaje krajših aktivnosti smo kombinirali s konkretnim materialom (slike). Učenci naj bi izkusili, razumeli in uporabljali jezik v medsebojni komunikaciji. Zadnje je bilo v času pouka na daljavo nemogoče, saj z drugošolci nismo imeli organiziranega pouka preko videokonference. Tako kot v 1. razredu, je bila tudi tu otežena individualizacija in diferenciacija [8].

2.3 3. razred

V 3. razredu imajo učenci na urniku dve uri tedensko. V času pouka na daljavo so učenci eno uro opravili samostojno, po pripravljenih navodilih, drugo uro pa smo se z učenci videli preko videokonference.

Učenci v 3. razredu so že razmeroma samostojni, prav tako pa smo se od septembra pripravljali na pouk na daljavo in s tem tudi na uporabo spletne učilnice. Tako so učenci lahko bolj ali manj samostojno opravljali svoje naloge.

Pouk na daljavo smo izvedli preko naslednjih orodij:

- <u>Xooltime</u> [9] (Učenci so s klikom na predmet TJA (tuji jezik angleščina) prišli do sprotnih navodil in nalog. V spletno učilnico so oddajali fotografije opravljenih nalog).
- <u>Liveworksheets</u> [7] (Učenci so reševali različne učne liste za ponovitev in dobili direktno povratno informacijo. Učitelju so rešene naloge tudi posredovali da smo se naslednjo uro, ki je potekala v živo, o nalogah in težavah pogovorili).
- <u>Zoom</u> [10] (Preko spletne učilnice so učenci dobili povezavo na videokonferenco. Enkrat tedensko smo pregledali opravljeno delo, se pogovorili o težavah, ki so jih imeli, ponovili in utrjevali. Predelali smo novo snov ter poskrbeli da je bilo med videokonferencami vedno prisotno tudi gibanje).
- <u>Quizlet</u> [11] (Učenci so s pomočjo aplikacije ponavljali in utrjevali besedišče).

2.4 4. razred

V 4. razredu sta na urniku dve uri tedensko. Tudi v času pouka na daljavo so bili učenci aktivni dve šolski uri na teden. Prvo uro smo skupaj spoznavali novo snov, drugo uro pa so samostojno ali v manjših skupinah utrjevali znanje (s pomočjo učbenika in DZ ter drugih orodij). Prva ura v tednu je v celoti potekala preko videokonference, k drugi uri pa so se učenci priključili po potrebi.

Učenci v četrtem razredu so bili že zelo samostojni. Komunikacija z njimi je prav tako v celoti potekala preko spletne učilnice Xooltime.

Pouk na daljavo smo izvedli preko naslednjih orodij:

- Xooltime [9] (Učenci so samostojno spremljali navodila in obvestila. Prav tako so v sklopu spletne učilnice reševali preproste kvize in oddajali opravljene naloge).
- Učbeniška e-gradiva (My Sails 1) [12] (Učenci so s pomočjo e-gradiv poslušali posnetke besedil iz učbenika).
- Bookwidgets [13] (Učenci so imeli (v sklopu učbeniških e-gradiv) dostop do dodatnih nalog in testov. Reševali so različne interaktivne naloge za ponovitev in utrjevanje, test ob koncu vsake predelane enote pa so poslali učitelju, ki je podal povratno informacijo).
- Zoom [10] (Z učenci smo prvo uro predelali novo snov. Način dela smo poskušali čimbolj približati situaciji v šoli. Z učenci smo uporabljali »sobe« za delo po skupinah. Druga učna ura je bila namenjena samostojnemu delu. Učenci, ki so želeli, so se na začetku ure priključili videokonferenci. Razdelili so se v »sobe« in si med seboj pomagali, v primeru vprašanj pa so se obrnili na učitelja).

V učnem načrtu za angleščino je zapisano, da je »Pozornost treba posvečati govornim zmožnostim in dejavnostim…«, zato je bilo zelo pomembno, da smo v 4. (in tudi v 5. razredu) v času pouka na daljavo vključili več videokonferenc. Tako so učenci lahko sodelovali v pogovoru in razvijali svoje komunikacijske strategije [2].

2.5 5. razred

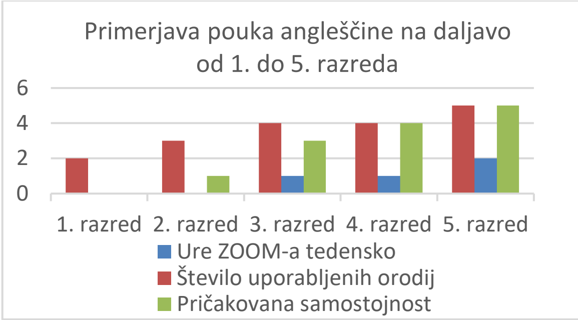
V 5. razredu imajo učenci na urniku tri ure tedensko, na daljavo pa smo se z učenci preko videokonference srečevali dvakrat tedensko.

Učenci so bili že popolnoma samostojni. Komunikacija z njimi je v celoti potekala preko spletne učilnice Xooltime.

Pouk na daljavo smo izvedli preko naslednjih orodij:

- Xooltime [9] (Učenci so poleg spremljanja obvestil v spletno učilnico oddajali opravljene naloge, reševali preproste kvize in vprašalnike, ustvarjali pa so tudi zapiske za posamezne učne ure in spremljali sprotno povratno informacijo učitelja na oddane naloge.)
- LearningApps [14] (Učenci so aplikacijo uporabljali kot dodatne naloge za utrjevanje besedišča).
- Quizlet [11] (Aplikacijo so uporabljali za utrjevanje besedišča).
- Padlet [15] (Učenci so se naučili samostojno objaviti besedilo, ki ga je učiteljica pregledala, popravila in poslala povratno informacijo).
- Zoom [10] (Z učenci smo preko orodja uporabljali »sobe« za delo po skupinah in kratke ankete. S pomočjo učbenika in delovnega zvezka smo predelali novo snov).

S pomočjo slike 1 vidimo, kako je potekal pouk (ure ZOOM-a tedensko), število uporabljenih različnih orodij (v 1. razredu najmanj, v 5. razredu največ) in pričakovano samostojnost (glede na izbiro in število uporabljenih orodij).



Slika 1: Kako je potekal pouk

3 UČNI NAČRTI ZA TUJI JEZIK IN IKT

Učni načrt za vsako obdobje posebej priporoča katera IKT znanja naj bi dosegli učenci. Poleg pridobivanja znanja in doseganja ciljev tujega jezika so učenci v času pouka na daljavo usvojili tudi nekaj teh znanj.

3.1 Neobvezni izbirni predmet v 1. razredu

Učni načrt za NIP v 1. razredu priporoča učenje varne uporabe informacijske in komunikacijske tehnologije, prav tako pa spoznavanje medijev za učenje in sprostitev [5]. Menim, da smo učencem ponudili dostop do aplikacij, ki omogočajo oboje (Youtube, Educaplay).

S pomočjo aplikacije Youtube smo poskrbeli za to, da smo učenem prikazali avtentične videoposnetke ter spodbujali besedno in glasovno ustvarjalnost [5].

3.2 Tuji jezik v 2. in 3. razredu

V 2. in 3. razredu naj bi učenci iskali in zbirali podatke, komunicirali in sodelovali na daljavo v okviru jezikovne zmožnosti ter se naučili varne rabe ter upoštevanja pravnih in etičnih načel uporabe IKT [8]. Zaradi načina dela, ki smo ga izbrali, so zgornje zmožnosti v večini razvijali le učenci 3. razreda, saj so bili učenci 2. razreda v veliki meri odvisni od pomoči staršev.

S pomočjo spletnih storitev za komuniciranje (ZOOM, 3. razred) smo spodbujali zmožnost sporazumevanja v tujem jeziku. Razvijali smo medkulturne zmožnosti (spoznavanje kulture, običajev, navad s pomočjo videoposnetkov, 2. in 3. razred) in objavljane izdelkov učencev (Xooltime, 3. razred) [8].

3.3 Angleščina (4. in 5. razred)

Učenci 4. in 5. razreda so zmožnost uporabe IKT-ja razvijali s komunikacijo v angleščini (komentarji v spletnem okolju Xooltime, ZOOM), pridobivali so gradivo o različnih temah, obravnavanim pri pouku (Xooltime), objavljali so svoje izdelke (Xooltime, oddaja nalog, izdelava zapiskov, Padlet), svoje izdelke so predstavili (nekateri učenci so za svoje predstavitve uporabili PowerPoint, posneli so glas ali ustvarili videoposnetek) [2].

4 DOKAZI O UČENJU IN POVRATNA INFORMACIJA

»Zbiranje dokazov omogoča učitelju vpogled v razumevanje in učenje učencev.« Ker pouk poteka na različne načine, so tudi pridobljeni dokazi o učenju različni. Razdelimo jih lahko v tri skupine:

- dokazi, ki izhajajo iz pogovorov med poukom
- dokazi, ki izhajajo iz opazovanj
- izdelki kot dokazi [16]

V šoli in pri pouku na daljavo je za uspešno učenje zelo pomembna tudi povratna informacija. Povratna informacija učencu pove:

- do katere stopnje znanja je prišel
- spodbudi ga k iskanju pomanjkljivosti
- ponudi mu možnost in pot za odpravljanje pomanjkljivosti

Kot učitelji moramo biti pozorni na to, kako povratno informacijo oblikujemo. Povratna informacija mora biti:

- pravočasna in primerno pogosta
- razumljiva, jasna
- konkretna, specifična in uporabna
- usmerjena v izboljšanje dosežka (izdelka) [16]

4.1 1. in 2. razred

V 1. razredu od učencev (in njihovih staršev) nismo zahtevali dokazov o učenju. Pouk neobveznega izbirnega predmeta tudi v šoli poteka preko igre, tako da bi dokaze o učenju najbolj zanesljivo zbirali z opazovanjem, kar pa je bilo na daljavo (z izbranim načinom dela) nemogoče. Posledično do vrnitve v šolo učencem ni bila nujena nobena povratna informacija o njihovem napredku. Povratna informacija torej ni bila pravočasna in primerno pogosta.

V 2. razredu smo od učencev občasno zahtevali fotografije zapisov v zvezek (ilustracije, miselni vzorci…), saj smo menili, da bi z drugimi načini pridobivanja dokazov o učenju dodatno obremenili tako starše kot učence. Dokaze smo torej zbirali s pomočjo izdelkov učencev. Povratna informacija ni bila nujena direktno učencem, pač pa njihovih staršem (komunikacija je potekala preko e-pošte). V tem primeru je bila povratna informacija s strani učitelja podana pravočasno (ne pa takoj po opravljenem delu) in primerno pogosto, usmerjena v izboljšanje izdelka, staršem pa smo zaupali, da so te informacije predali tudi svojim otrokom.

4.2 3., 4. in 5. razred

V 3. razredu smo od učencev zahtevali fotografije o opravljenem delu (zapis v zvezek, ilustracije, miselni vzorci…), prav tako pa smo dokaze zbirali preko videokonferenc. Poleg zbiranja dokazov z izdelki smo torej dokaze zbirali tudi preko opazovanj in preko pogovorov pri pouku. Pri tem bi poudarila, da je bilo zbiranje tovrstnih dokazov veliko težje kot pri pouku, saj v eni šolski uri na vrsto niso prišli vsi učenci. Posledično v eni šolski uri ni bilo mogoče podati konkretne in jasne povratne informacije vsem učencem. Situacija pa je bila bistveno boljša kot v 1. in 2. razredu. Učenci 3. razreda so povratno informacijo dobili takoj in so svoje napake lahko sproti popravili (npr. pri izgovorjavi). Povratna informacija učenem je bila v 3. razredu podana preko videokonference (tudi za izdelke, ki so jih oddajali v spletno učilnico).

Tudi v 4. in 5. razredu je bila situacija podobna tisti v 3. razredu. Dokaze o učenju smo učitelji lahko, poleg oddaje izdelkov, spremljali preko videokonference. S tem smo dobili veliko več raznovrstnih dokazov o učenju. Glede na to je bila tudi povratna informacija bistveno pogostejša (in seveda takojšnja). V danem trenutku je bila povratna informacija o sprotnem delu in opravljanju nalog konkretna in v tistem trenutku za učence uporabna. Pomanjkljivosti so se učenci zavedali takoj in jih lahko ustrezno odpravili. Povratna informacija je bila učencem podana na različne načine: preko videokonference, s pomočjo kvizov, kjer so učenci sami opazili svoje napake, preko komentarjev in vrednotenja v spletni učilnici in preko zapisov učitelja ob zaključku posameznih enot.

5 REZULTATI

5.1 Pregled uporabljenih orodij v posameznih razredih

Delo v vsakem razredu je bilo drugačno. Že s pogledom na to, kako samostojni so lahko učenci v posameznem razredu je nujno raznoliko delo. Menim, da je bila odločitev, da učencev 1. in 2. razreda ne vključimo v spletno učilnico, pravilna. Učenci samostojno še ne znajo dostopati do nalog, staršem pa bi bilo spoznavanje z okoljem spletne učilnice dodatno breme. Želela bi si le, da bi bila, vsaj v 2. razredu, kakšna videokonferenca, saj je na daljavo, brez stika težko ali skoraj nemogoče vedeti kako učenci napredujejo (sploh pri izgovorjavi).

V ostalih razredih so se kot zelo pomembne izkazale videokonference, saj je govor pri tujem jeziku zelo pomemben element. Učenci so prav tako lahko svoje dileme in težave naslovili direktno na učiteljico. Od 3. razreda naprej so učenci po korakih uporabljali spletno okolje Xooltime. V vseh razredih so bili učenci seznanjeni z delom v spletni učilnici še pred poukom na daljavo. Brez tega bi bilo delo zelo oteženo. Učenci v 3. razredu so spoznali le nekaj funkcij spletne učilnice, pri oddaji nalog pa so jim bili v podporo starši. V 4. in 5. razredu so učenci spoznali več funkcij, ki jih ponuja spletna učilnica (v 4. razredu so reševali preproste kvize in ankete, v 5. razredu pa so se spoznali še z ustvarjanjem zapiskov). V vsakem razredu se je tudi povišajo število različnih uporabljenih orodij.

5.2 Učni načrti za tuji jezik in IKT

Učenci so v vsakem razredu spoznali nekaj orodij. V vsakem razredu smo povečevali število spretnih orodij ter jih spodbujali k uporabi le teh. Učenci 4. in 5. razreda niso več le spremljali pouka preko teh orodij, pač pa so se tudi sami preizkusili v izdelavi predstavitev, samostojni oddaji in komunikaciji z učiteljem in podobno.

5.3 Dokazi o učenju in povratna informacija

Izkazalo se je, da je bilo v 1. in 2. razredu bistveno premalo (ali skoraj nič) zbiranja dokazov o učenju in podajanja kakovostnih povratnih informacij. To nas je čakalo ob vrnitvi v šolo, ko pa povratna informacija (sploh pri mlajših učencih) ni več tako zelo uporabna. Sploh pri mlajših mora biti povratna informacija takojšnja in konkretna.

V 3., 4. in 5. razredu je bilo več možnosti za zbiranje dokazov (predvsem zaradi večje samostojnosti učencev in videokonferenc). Povratna informacija je bila v vseh razredih podana bistveno bolj kvalitetno, prav tako pa je bila podana na različne načine. Učenci so bili v vsakem razredu bolj samostojni.

6 ZAKLJUČEK

Pomembno je, da se zavedamo, kako samostojni so učenci v določenem razredu. Glede na to prilagajamo svoje didaktične pristope in ustrezno izbiramo različna orodja.

Menim, da bi v zadostni meri tudi ob vrnitvi v šolo morali nadaljevati z uporabo IKT, saj s tem spodbujamo informacijsko pismenost učencev in jih dodatno motiviramo. Seveda pa morajo biti vse dejavnosti, tako na daljavo, kot v šoli, osmišljene in slediti ciljem ter namenom učenja.

Pozabiti ne smemo niti na kvalitetno povratno informacijo, kar se je, vsaj v nekaterih razredih, izkazalo kot problematično. V prihodnje bi bilo potrebno konkretno razmisliti o drugačnem načinu dela z najmlajšimi učenci in pretehtati pomembnost takojšnje povratne informacije zanje.

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Virtualna izvedba študije primera na Fakulteti za organizacijske vede Univerze v Mariboru

Virtual implementation of a case study at the Faculty of Organizational Sciences University of Maribor

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POVZETEK

Na Fakulteti za organizacijske vede Univerze v Mariboru se uporablja izobraževalna metoda študija primera izvedbi izobraževalnih dogodkov, ter pri nekaterih predavanjih in vajah v pedagoškem procesu. Zaradi epidemije, ki se je začela v mesecu marcu 2020, se je spremenila tudi izvedba dogodka študije primera. Študija primera je metoda, kjer udeleženci iščejo rešitve za nek izziv. Izziv poda podjetje ali organizacija, ki sodeluje pri dogodku. Izzivi so najpogosteje s področja marketinga, prodaje, organizacije dela, informatike, turizma in drugo. V začetku prispevka je pojasnjeno problemsko učenje in izobraževalna metoda študije primera. V prispevku so predstavljeni pozitivni elementi in prednosti omenjene metode. V nadaljevanju prispevka so pojasnjeni organizacijski koraki potrebni za izvedbo virtualnega dogodka. Zahteve za izvedbo virtualnega dogodka se razlikujejo od klasične dogodka študije primera. Predstavljene so izkušnje in predlogi za izvedbo virtualne metode študije primera. S prispevkom želimo pomagati vsem, ki bi želeli uporabljati študijo primera v izobraževalnem procesu, predvsem pri organizaciji virtualnega dogodka.

KLJUČNE BESEDE

E-izobraževanje, problemsko učenje, študija primera, virtualni dogodek

ABSTRACT

The Faculty of Organizational Sciences of the University of Maribor uses the educational method of case studies at educational events, as well as in some lectures and exercises in the pedagogical process. Due to the pandemic that started in March 2020, the implementation of the educational case study method has also changed. A case study is a method where high school or college students are looking for solutions to a challenge. The challenge is given by the company participating in the event. The challenges are most often in the field of marketing, sales, work organization, informatics, tourism and others. At the beginning of the article, problem-based learning and the educational case study method are explained. The article presents the positive elements and advantages of this method. In the continuation of the article, the organizational steps necessary for the implementation of a virtual event are explained. However, the requirements for performing a virtual event are different from a classic event. Experiences and proposals for the implementation of the virtual method of case study are presented. With this article, we want to help everyone who would like to use a case study in the educational process, especially in organizing a virtual event.

KEYWORDS

E-learning, problem-based learning, case study, virtual event

1 UVOD

Zasebno in poklicno življenje se je marca 2020 drastično spremenilo. V tem času je bila namreč v Sloveniji razglašena epidemija nalezljive bolezni SARS-CoV-2 (COVID-19). Prizadeta pa ni bila le Slovenija, temveč praktično ves svet in večina poklicnih področij. Izobraževanje pa je bilo eno izmed področij, kjer so posledice čutili prav vsi udeleženci. Organizacija United Nations [1] navaja, da je po svetu kriza prizadela 1,58 milijarde otrok in mladine (94 %) in to od predšolskih otrok do študentov v visokošolskem izobraževanju in to v 200 državah sveta. Evropska komisija [2] v svojem poročilu ugotavlja, da 95 % anketirancev meni, da kriza pomeni pozitivno spremembo pri rabi informacijske tehnologije v izobraževanju. Poleg tega omenja, da pred krizo skoraj 60 % anketirancev ni uporabljalo učenja preko spleta oz. na daljavo. Poročilo Evropske komisije tudi omenja, da 60 % vprašanih meni, da so zaradi povečane uporabe informacijske tehnologije med krizo izboljšali svoje sposobnosti njene uporabe in da 50 % vprašanih želi še nadgraditi svoje znanje s področja

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informacijske tehnologije. Številne izobraževalne organizacije so se zaradi posledic krize soočile s problemi kot so pomanjkljiva informacijska infrastruktura, nezadostne povezave do interneta, pomanjkljivo znanje računalništva in informatike učiteljev in profesorjev, slabo ali sploh nič implementirani sistemi za podporo učenja (LMS), videokonferenčni sistemi, neustrezna delovna okolja in drugo.

Na Fakulteti za organizacijske vede Univerze v Mariboru (FOV UM) smo se tako kot tudi večina izobraževalnih organizacij morali prilagoditi na spremenjene izobraževalne procese. Omejitev stikov s študenti, ohranjanje varnostne razdalje, delo od doma, povečan obseg dela z informacijsko tehnologijo so bili le nekateri izzivi. Za mnoge so bile spremembe zelo naporne in z delovnega stališča zahtevne. Spremenjeni so bili tudi drugi, že utečeni procesi in dogodki. Eden izmed dogodkov, ki se že vrsto let organizira in izvaja na FOV UM je dogodek študija primera. Študija primera je ena izmed izpeljank problemskega učenja, kjer imajo glavno vlogo študenti, ki s svojimi idejami rešujejo izziv, ki ga poda podjetje ali organizacija, ki sodeluje pri dogodku. Zaradi spremenjenih okoliščin so se dogodki študije primera morali organizirati in izvesti v virtualni obliki. Tako izvedeni dogodki so zahtevali širokopasovni dostop do svetovnega spleta, videokonferenčne sisteme (MS Teams), ustrezno informacijsko podporo in drugo. Zaradi lažjega razumevanja celotnega prispevka pa so v nadaljevanju predstavljena področja problemskega učenja, študija primera in virtualna izvedba študija primera, ki se izvaja na FOV UM.

2 PROBLEMSKO UČENJE

Ljudje se razlikujemo glede na številne značilnosti, navade, običaje in druge zadeve. Tako je tudi na področju izobraževanja. Nekdo se lažje uči zjutraj, nekdo zvečer. Obstajajo razlike med učnimi navadami, stili in strategijami uspešnega učenja. Številni se najlažje naučijo ali razumejo neko učno snov s pomočjo primerov ali z reševanjem dejanskega problema. Za problemsko učenje je značilno, da ima značilnosti, ki so podobne naravnemu učenju, ki izhaja iz reševanja problema, ki ga ima posameznik ali skupina. Problemsko učenje lahko v angleški literaturi najpogosteje zasledimo pod kratico PBL (problem-based learning). Na problemsko učenje lahko gledamo kot na zbirko didaktičnih elementov, kot so [3]:

- organiziranje problemskih situacij,
- formiranje problemov,
- zagotavljanje pogojev za delo,
- zagotavljanje primerne pomoči in
- utrjevanje problemskih znanj.

S takšnim načinom reševanja problemov se srečujemo že pred samim formalnim izobraževanjem, zato lahko problemsko učenje označimo kot pogonsko silo za učenje [4]. Zato ni presenetljivo, da je pedagoška metoda problemskega učenja vedno bolj uporabljena v izobraževalnih procesih. Metoda problemskega učenja je ena izmed najbolj inovativnih pedagoških metod, ki je bila kadarkoli implementirana v izobraževanje [5]. Edinstvenost problemskega učenja ima številne prednosti in pozitivne učinke na študente, ki jih pri drugih metodah manjka ali pa jih je bistveno premalo. Nekatere izmed teh prednosti so [6]:

Spodbujanje samostojnega učenje - to je pristop, ki je osredotočen na študente. Učenje je bazirano na podlagi podanega problem, ki študente spodbudi, da prevzamejo odgovornost za reševanje problema in s tem tudi za samostojno učenje. S tem so prisiljeni v raziskovanje in ustvarjalnost, hkrati pa razvijajo veščine, ki jim bodo koristile v odrasli dobi.

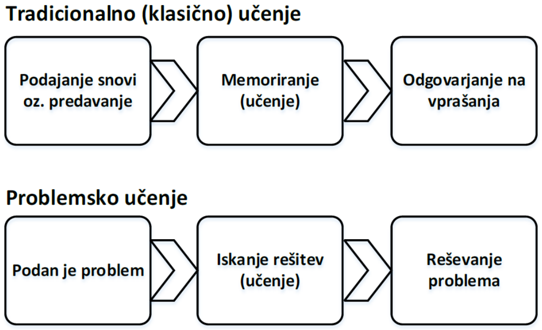
Visoka stopnja angažiranosti - namesto pasivnega spremljanja predavanj, poslušanja in zapisovanja so študenti primorani biti aktivni. S tem je njihova stopnja učenja bolj intenzivna, osredotočenost večja in bistveno več je kritičnega razmišljanja.

Razvijanje uporabnih veščin - udeleženci takšnega načina izobraževanja razvijajo veščine, ki so širše uporabne. Veščine niso omejene samo na šolsko okolje temveč je bistvo, da se jih uporabi v resničnih problemskih situacijah, katerih značilnosti so skupinsko reševanje problemov, prevzemanje odgovornosti in drugo.

Krepitev notranje motivacije - rešitev težkih izobraževalnih skupinskih problemov daje veliko zadovoljstvo. S tem se veča samospoštovanje in osebno zadovoljstvo.

Ekipno delo - problemske situacije so strukturirane tako, da so časovno in težavnostno prezahtevne za posameznika. S tem so študenti prisiljeni v ekipno delo, kjer vsak prevzame določeno vlogo v ekipi. S tem se razvija sposobnost sodelovanja, komuniciranja, poslušanja, delanja kompromisov, pogajanja in drugo.

Na Sliki 1 je prikazana primerjava med tradicionalnim (klasičnim) učenjem in problemskim učenjem. Pri tradicionalnem učenju ima študent pasivno vlogo, kjer je deležen podajanja neke snovi preko predavanj, ki jih izvede profesor. Sledi študij in memoriranje snovi. Omenjenim korakom sledi preverjanje osvojenega znanja oz. odgovarjanje na postavljena pisna ali ustna vprašanja. Pri problemskem učenju pa ima študent veliko bolj aktivno vlogo. Profesor ima vlogo vodnika ali usmerjevalca. V prvem koraku se študentom ali skupini predstavi problem. Za reševanje je namenjen določen čas, ki naj bi bil zadosti dolg, kar je odvisno od zahtevnosti podanega problema. Sledi iskanje rešitve. V fazi iskanja rešitev mora študent ali skupina preučiti določeno literaturo, brez katere bi težko ali nemogoče našli rešitev. Sledi iskanje rešitev. Rešitev je za razliko od klasičnega načina izobraževanja lahko več. Takšen način dela, izobraževanja in razmišljanja je podobno naravnemu procesu reševanja problemov. Študent nima občutka, da se prisiljeno uči oz. pregleduje gradivo, kar študentu ali skupini daje občutek kontrole nad dogajanjem.



Slika 1: Primerjava klasičnega in problemskega učenja [7].

Problemsko učenje se nenehno razvija in z razširjenostjo informacijske tehnologije še pridobiva na veljavi. Poleg tega se pojavljajo nove različice in oblike problemskega učenja in ena izmed alternativ je tudi študija primera.

3 ŠTUDIJA PRIMERA

Za študijo primera (angl. case study) velja, da je ena izmed izpeljank problemskega učenja [8]. Značilnost metode študije primera je, da so glavni akterji dijaki ali študenti, ki iščejo rešitve za postavljen problem. Trajanje študije primera je lahko različno dolgo. Najbolj znane obliko se enodnevne, nekajdnevne ali celo več mesečne. Rešitev problema mora biti najdena v danih časovnih omejitvah, kar postavlja udeležence pod določen pritisk in stres, kar je značilno tudi za delo v realnem okolju. Druge značilnosti študije primera so ekipno delo, kjer vsak član prevzame določeno nalogo. Študije primere naj bodo zasnovane tako, da lahko udeleženci s pomočjo pridobljenega znanja, podatkov in informacij predstavijo čim več svojih idej [9]. Študije primera se lahko deli glede na vrsto in različne kriterije kot so [8]:

- narava posameznega primera (posameznik, družba, organizacija, postopkov, kulturnih aktivnosti, …);
- število primerov, ki jih proučujemo (en primer ali več primerov);
- sestavljena ali enostavna analiza: enostavna enota (majhno podjetje) in sestavljena enota (večja organizacija, veliko podjetje, mesto, …);
- vrsta empiričnega gradiva: primarno (gradivo dobimo le z opazovanjem ali spraševanjem), sekundarno (gradivo so dokumenti) in kombinirano.

Študije primera lahko delimo tudi glede na področja oz. tematike, kjer se proučujejo [10]:

- osebe - osredotočenost na določenega posameznika.
- skupine - osredotočenost na določeno skupino ljudi.
- lokacije - osredotočenost na določen kraj.
- organizacije ali podjetja - osredotočenost na podjetje ali organizacijo in njihov problem
- dogodki - osredotočenost na dogodek, bodisi kulturni ali družbeni in njegov vpliv.

V nadaljevanju je predstavljena študija primera, ki se jo izvaja na Fakulteti za organizacijske vede Univerze v Mariboru ter njena virtualna izvedba.

4 ŠTUDIJA PRIMERA NA FAKULTETI ZA ORGANIZACIJSKE VEDE UNIVERZE V MARIBORU

Sodelovanje pri dogodku študija primera ima številne prednosti tako za udeležence (dijake ali študente), fakulteto in podjetje oz. organizacijo, ki sodeluje na dogodku. Prednosti, ki jih prinaša študija primera za študente so: razvijanje sposobnosti dela v ekipi, omogočen je stik s potencialnimi delodajalci, razvoj specifičnih kompetenc, razvijanje analitičnega in kritičnega razmišljanja, mreženje in drugo. Prednosti za partnerko podjetje ali organizacijo, ki sodeluje v okviru nekega dogodka študije primera so: nabor najboljših kadrov, promocija podjetja, blagovne znamke ali storitve/izdelka, pridobivanje novih rešitev ali idej za nek problem in drugo. Za fakulteto pa so prednosti sledeče: povezovanje z gospodarstvom, večanje ugleda fakultete, krepitev znanja o organizaciji dogodkov, prednosti pri akreditaciji študijskih programov in drugo.

V okviru preteklih dogodkov so s fakulteto sodelovala številna ugledna podjetja in organizacije kot so (navedeno po abecednem vrstnem redu): Autocommerce d. o. o., B&B izobraževanje in usposabljanje d. o. o., DA Automobiles, DHL Global Forwarding Logistika d. o. o., Društvo DOVES-FEE Slovenia (Program Ekošola), Elan d. o. o., Erste Card d. o. o. (Diners Club), Fraport Aviation Academy, Fraport Slovenija d. o. o., GA+kuhinje (Aparati d. o. o.), GS1 Slovenija, Iskratel d. o. o., Janus Trade d.o.o. (Samsung), Kompas Magistrat d. o. o., Kovačnica Kranj – MOK, Mercator d. d., Styria digital marketplaces d. o. o. (Bolha.com), Valtex & Co. d. o. o. in Zavod za turizem in kulturo Kranj (ZTKK).

V okviru dogodkov študije primera FOV UM organizira tri različne dogodke in sicer:

Decembrska šola in tekmovanje v študiji primera za študente. Dogodek je namenjen študentom FOV UM. Namen dogodka je, da študenti poglobljeno spoznajo kaj je študija primera. V sklopu izobraževanja spoznajo kako naj predstavijo svojo rešitev, kakšne so zakonitosti dobrih predstavitev, kako oblikovati in pripraviti numerične podatke, kako iskati podatke po spletu, kako sodelovati v ekipi in drugo. Drugi del dogodka je namenjen tekmovanju oz. predstavitvi študentkih rešitev. Prvo in drugo uvrščena ekipa se kot predstavnici fakultete udeležita mednarodnega tekmovanja v študiji primera, ki poteka v okviru Mednarodne konference o razvoju organizacijskih znanosti. Kot je razvidno iz imena dogodka se dogajanje izvaja v mesecu decembru.

Mednarodno tekmovanje v študiji primera za študente, ki poteka v okviru Mednarodne konference o razvoju organizacijskih znanosti. Dogodek poteka najpogosteje konec meseca marca. Poleg najboljših dveh ekip FOV UM se tekmovanja udeležijo tudi ekipe iz drugih fakultet, ki najpogosteje prihajajo iz držav bližnje okolice (Hrvaška, Srbija, Avstrija, …). Tekmovanje se izvaja v angleškem jeziku in je bistveno bolj zahtevno tekmovanje v mesecu decembru.

Študija primera - Izobraževanje in tekmovanje za dijake. Omenjen dogodek je najpogosteje organiziran v mesecu januarju, saj imajo takrat dijaki največ prostega časa. Najpogosteje se dogodka udeležijo ekipe in njihovi spremljevalci iz srednjih šol gorenjske regije, Ljubljane in njene okolice. V okviru izobraževanja dobijo dijaki podobna znanja kot študenti na decembrskem izobraževanju. Izobraževanje in tekmovanje poteka v slovenskem jeziku. Težavnost izziva namenjenega reševanju pa je prilagojena dijakom in je v večini primerov lažja kot pri študentih.

5 VIRTUALNA IZVEDBA ŠTUDIJA PRIMERA

Virtualna izvedba študije primera je zahtevala drugačno organizacijo in izvedbo kot običajno. V glavnem se študija primera deli na dva glavna dela in sicer na izobraževanje udeležencev (študentov in dijakov) in samo tekmovanje. Izobraževanje se organizira za dva dogodka in sicer za Decembrsko šolo in tekmovanje v študiji primera za študente, ter za dogodek Študija primera - Izobraževanje in tekmovanje za dijake. Tekmovanje pa je izvedeno za vse tri dogodke.

Za potrebe organizacije dogodka je bila oblikovana delovna skupina in širši organizacijski odbor na FOV UM. Poleg tega pri organizaciji dogodka sodelujejo tudi prodekan/ica za študentska vprašanja, prodekanica za izobraževalno dejavnost, predstavniki Kariernega centra in drugi. Večina usklajevanj in organizacije pri virtualnem dogodku poteka s pomočjo informacijsko-komunikacijske tehnologije. Tu lahko izpostavimo elektronsko pošto, videokonferenčne sisteme (MS Teams) in telefone. Pred samo izvedbo dogodka se omenjeni člani delovne skupine in organizacijskega odbora uskladijo glede same izvedbe, datumov in časovnice virtualnega dogodka, priprave promocije, usklajevanj podpornih služb (npr.: Center za informatiko in informacijske tehnologije) in drugih nujnih zadev. Veliko dela in usklajevanja zahteva oblikovanje izziva, ki poteka s partnerskim podjetjem ali organizacijo. Dogaja se, da nekatera podjetja nimajo istih videokonferenčnih sistemov in da je potrebno veliko časovnega usklajevanja. Oblikovanje izziva za udeležence poteka skupaj s podjetjem ali organizacijo najpogosteje preko videokonferenčnega sistema (MS Teams). Za takšno delo se oblikuje posebna soba v okviru MS Teams-ov, ki mora biti strogo varovana, saj bi bilo skrajno neprijetno, da bi katera izmed ekip predčasno prišla do izziva. S tem bi bilo tekmovanje nepošteno in neetično.

Vzporedno z organizacijo izobraževanja poteka tudi zbiranje prijav ekip. Število ekip, ki sodelujejo na izobraževanju in tekmovanju je najpogosteje omenjeno na osem. Takšno število ekip še omogoča časovno vzdržnost tekmovanja. Večje števili ekip pa bi tekmovanje naredilo preveč dolgo in s tem tudi dolgočasno za vse udeležence. Po oblikovanju in uskladitvi izziva sledi določitev tematik, ki bodo na izobraževanju. Teme predavanj so najpogosteje s področji komunikacijskih veščin, timskega dela, oblikovanja zanimivih predstavitev in drugo. Predavanja izvedejo profesorji na FOV UM in zunanji sodelavci. Na samem izobraževanju pa se predstavijo tudi pravila tekmovanja in izžreba vrstni red predstavitev ekip. Izobraževanje poteka preko MS Team-sov v okviru časovnice, ki je bila predhodno posredovana ekipam. V okviru izobraževanj lahko člani ekip postavljajo vprašanja predavateljem. Na koncu vseh predavanj sledi predstavitev izziva, ki ga predstavi predstavnik podjetja. Tudi tu lahko udeleženci postavljajo vprašanja, kjer se razjasnijo še zadnje malenkosti povezane z izzivom. Pri virtualnem dogodku je opaziti, da je vprašanj veliko več kot pri klasični izvedi dogodka. Razlog lahko iščemo v tem, da so udeleženci manj javno izpostavljeni kot v razredu ali predavalnici.

Po predstavitvi izziva imajo ekipe čas za iskanje rešitev. Člani posamezne ekipe si razdelijo delo in vsak izmed njih prevzame določeno vlogo v ekipi. Večino časa so v stiku s pomočjo informacijsko-komunikacijske tehnologije, kjer prevladujejo elektronska pošta, videokonferenčni sistemi (MS Teams, Zoom, Skype in drugo), telefoni in drugo. Usklajevanje rešitve je tako bistveno bolj zahtevno kot pri klasičnem sodelovanju v neki ekipi. Virtualno delo ima svoje pomanjkljivosti. Udeleženci nimajo enakih pogojev za delo, obstajajo in pojavljaj se tehnične motnje ter motnje v samem delovnem okolju in drugo.

Dan tekmovanje in vrstni red predstavitev ekip je bil predhodno določen. Pred samim tekmovanjem se v okviru MS Teams-ov ponovno predstavi izziv, kajti na tekmovanju so prisotni tudi drugi udeleženci, kot so gledalci ali spremljevalci (pri dijakih). Po uvodnem nagovoru vseh prisotnih v kanalu MS Team-sov se začnejo virtualne predstavitve. Vsaka ekipa ima na voljo določen čas za predstavitev. Študentske predstavitve trajajo do 15 minut, dijaške pa 10 minut. Po predstavitvi lahko ocenjevalna komisija postavlja vprašanja za pojasnitev morebitnih nejasnosti. Ocenjevalna komisija je sestavljena iz enega ali dveh predstavnikov podjetja ali organizacije, predstavnika FOV UM in v nekaterih primerih tudi iz predstavnikov študentov. Omenjena komisija ima za komunikacijo na voljo rezerviran kanal v okviru MS Team-sov, ki je viden samo njim. Za operativno usklajevanje pa je komisija dosegljiva tudi preko elektronske pošte in mobilnih telefonov. Komisija ocenjuje rešitve ekip po štirih karakteristikah, ki so:

- izvedljivost predlagane rešitve,
- samo razumevanje problema,
- struktura in kakovost predstavitve in
- odgovori na zastavljena vprašanja komisije.

Udeleženci najpogosteje pripravijo svoje predstavitve v programu MS PowerPoint, ki jih nato delijo s pomočjo MS Teams-ov. Ni redko, da pri tem nastanejo težave. Vsi člani ekipe nimajo istega znanja in veščin s področja informatike, ki jih zahtevajo videokonferenčni sistemi. V takšnih primerih je potrebna pomoč s strani tehničnega osebja FOV UM. Druga pogosta težava, ki nastane pri prezentaciji rešitev je povezana s tehničnem delovanjem oz. povezave do svetovnega spleta posameznega udeleženca. Udeleženci imajo različne ponudnike spletnih storitev in različno obremenjene spletne povezave. Težav, ki so s tem povezane so krajše ali daljše prekinitve signala in s tem tudi same prezentacije. Za čim bolj nemoten potek virtualnega dogodka je s strani delovne skupine FOV UM organiziran test oz. preizkus, ki je namenjen posamezni ekipi. S tem se izognemo številnim težavam in tehničnim zapletom, ki bi se lahko utegnile pojaviti med samim tekmovanjem.

Po zaključku tekmovanja se ocenjevalna komisija umakne iz kanala, kjer je potekalo tekmovanje, ter se priključi kanalu v MS Team-sih, ki je namenjeno izključno komisiji in ožjemu organizacijskemu odboru. Ocenjevalna komisija se tako lahko v miru posvetuje o dosežkih posameznih ekip in drugih zadevah, ki se upoštevajo pri določitev vrstnega reda ekip. Po določenem času se ocenjevalna komisija zopet pridruži skupinskemu tekmovalnemu kanalu v MS Teams-ih. Sledi razglasitev treh zmagovalnih ekip, ki jih najgosteje napove predstavnik podjetja ali organizacije, ki je partner tekmovanja. Vsaki ekipi so predstavljeni tudi nekateri pozitivni in negativni elementi iz njihove predstavitve. To daje celotnemu tekmovanju tudi pedagoško komponento in priložnosti za učenje. Sledi nagovor ob zaključku dogodka in povabilo za ponovno udeležbo prihodnje leto.

Pri promociji in dokumentiranju celotnega dogodka je potrebno upoštevati tudi določena pravila in zakonske omejitve, ki se najpogosteje navezujejo na Splošno uredbo o varstvu podatkov - GDPR [11]. Uredba nalaga določena pravila, ki se navezujejo na fotografiranje, snemanje, objave in delo s podatki udeležencev in drugo.

6 ZAKLJUČEK

V prispevku je predstavljena organizacija in izvedba virtualnega dogodka študije primera na FOV UM. Vpliv epidemije je spremenil velik del izobraževalnih procesov in dogodek študije primera pri tem ni bil izjema. Za potrebe organizacije in izvedbe je bilo potrebno spremeniti številne postopke in procese pri dogodku študije primera. Posledično se je dogodek začel izvajati v virtualni obliki. Najbolj pomembni elementi za izvedbo dogodka so videokonferenčni sistemi (MS Teams), širokopasovne spletne povezave in druge informacijsko-komunikacijske tehnologije. Zaradi sprememb in povečane uporabe novih tehnologij so se pojavile številne težave, tako na strani organizatorjev dogodka kot tudi na strani udeležencev (študenti in dijaki).

Za zmanjševanje tveganj in zmanjševanje tehničnih težav pri organizaciji virtualnih dogodkov predlagamo aktivno spremljanje priporočil za izvajanje izobraževanj v spremenjenih razmerah (npr. epidemija). Zanimivo bo iskati tudi nove oblike izobraževanj. V prihodnosti lahko pričakujemo pojav hibridnega izobraževanja, ki bo vsaj malo nadoknadil potrebno po socialnem stiku med študenti, ki je bil v času epidemije bistveno zmanjšan. Nikakor ne smemo zanemariti vpliv tehnologije, ki bo v prihodnosti vedno večji. Zato se priporoča sledenje trendom na področju informacijsko-komunikacijskih tehnologiji na področju e-izobraževanju. Dodatno priporočamo pripravo scenarijev za hibridno in popolno virtualno izvedbo dogodkov. S tem zmanjšamo verjetnost in potrebo po hitrem prilagajanju, ki so posledica negotovih razmer.

Spremenjene razmere v izobraževanju bodo prinesle tudi hitrejše premike na področju digitalizacije izobraževanja. Pri tem velja upoštevati določene smernice in trende. V prihodnosti lahko pričakujemo številne poskuse v smeri digitalizacije izobraževanja in nadaljevanje digitalizacije obstoječih procesov. S prispevkom smo želeli deliti znanje in izkušnje s področja študije primera, predvsem njene virtualne izvedbe. Deljenje izkušenj lahko koristi drugim izobraževalnim organizacijam pri vpeljavi ali dodatnem razvoju omenjene pedagoške metode ali drugih metod v izobraževalni proces. Prispevek lahko olajša ali prepreči težave ali napake, ki se lahko pojavijo pri virtualni izvedbi študije primera.

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Uporaba sodobnih tehnologij in metod strojnega učenja v mladinskem nogometu

Use of modern technologies and machine-learning methods in youth football

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POVZETEK

Razvoj nadarjenih posameznikov v nogometnih šolah in akademijah je strukturiran proces, ki predstavlja pomemben temelj tako na športnem kot na finančnem področju v nogometnem klubu. Z vse večjimi finančnimi vložki v nogomet je proces prepoznavanja ključnih atributov mladincev pri prehodu v članske selekcije vse pomembnejši, hkrati pa tak proces predstavlja izziv in potrebo po spremembah pri mnogih nogometnih klubih. Z razvojem tehnologije in umetne inteligence se finančno zmogljivejši klubi vse pogosteje odločajo za sodobnejše pristope prepoznavanja talentov že v zelo zgodnjih najstniških letih, kar jim ponuja konkurenčno prednost na trgu nogometnih igralcev. Tehnologija je bistveno pripomogla tudi pri ocenjevanju tveganja poškodb nogometašev, kar predstavlja zelo pomemben vidik v nogometnem klubu. V prispevku bomo pregledali prakse uporabe tehnologije in sodobnih pristopov uporabe podatkovne analitike za namen prepoznavanja ključnih atributov nadarjenih mladincev. Natančneje se bomo osredotočili na primere prepoznavanja ključnih atributov preko uporabe naprav za sledenje gibanja igralcev (GPS) ter razvoja modelov preko uporabe podatkovnega rudarjenja z namenom prepoznavanja poškodb pri mladih nogometaših. Namen prispevka je pregled literature na področju povezovanja tehnologije in mladinskega nogometa, ki predstavlja prvi korak pri načrtovanju in izvedbi doktorske raziskave.

KLJUČNE BESEDE

Razvoj talentov, Podatkovno rudarjenje, Digitalne tehnologije, GPS

ABSTRACT

Talent development process in football academies is a structured process that represents an important pillar on all levels in a football club. Investments in football have pushed the clubs to spend more resources on recognizing and developing football talents within their youth academies. With development of digital technologies and artificial intelligence, more clubs are able to perform detailed analysis of their youth development programme which gives them a significant competitive advantage in a football market. Development of technology has also improved the injury risk assessment which plays a cruicial role in every club. In the article, we focus on good practices of technology use and modern statistical approaches in talent development process. We closely examine key attributes in talent development process and risk assessment through the use of GPS devices and data-mining process. The purpose of this paper is to review the literature in the field of linking technology and youth football, which is the first step in planning and conducting the doctoral research.

KEYWORDS

Talent development, Data mining, Digital technologies, GPS

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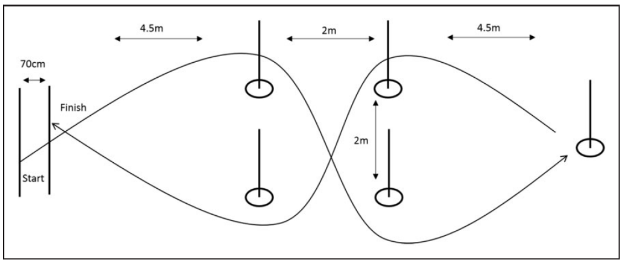
1 UVOD

Evropsko nogometno okolje postaja vse bolj zanimivo za investitorje iz bogatih držav Azije, Bližnjega vzhoda in Rusije. Najatraktivnejši nogometni klubi za tuje investicije so klubi iz peterice največji lig na svetu, in sicer iz angleške, francoske, italijanske, nemške in španske lige [1]. To je posledica števila sledilcev in navijačev po celem svetu [2]. Finančne zmožnosti velikih klubov jim omogočajo nakupe v že uveljavljene igralce, medtem ko klubi z omejenimi finančnimi zmožnostmi iščejo svoje priložnosti v prodaji le-teh igralcev. [3] ugotavljata, da klubi, ki imajo več tujcev, dajejo manj igralnega časa svojim mladincem. Ker je večina klubov odvisna od prodaje igralcev, se vse več časa in sredstev namenja razumevanju procesa razvoja mladincev. Kot že [4] ugotavljajo, so morfološke, motorične in funkcionalne značilnost pomembne pri razvrščanju otrok v športne panoge. Z ustreznim razvrščanjem otrok se le-te lažje motivira k udejstvovanju v športu. Z razvojem tehnologije in sodobnih metod podatkovne analitike klubi poskušajo sistematično slediti začrtanim smernicam razvoja mladincev, z namenom, da dosežejo želeni cilj in maksimizirajo vrednost posameznega talenta. Uporaba sodobnih tehnologij ne predstavlja zgolj konkurenčne prednosti, temveč nujnost, da klub optimizira svoje delovanje tako na športnem kot finančnem področju. Sodobne tehnološke naprave nogometnemu klubu ne koristijo samo pri prepoznavanju talentov, marveč se uporabljajo tudi pri vadbi, rehabilitaciji ter preprečevanju poškodb [5].

Visokozmogljive tehnološke naprave pri proučevanju nogometa znanstveniki delijo v dve skupini, in sicer na tiste, ki spremljajo igralce preko nosljivih tehnologij ter na že vgrajene naprave na nogometnih stadionih. Med prvimi so najbolj pogosto uporabljene Global Positioning System (GPS) naprave, ki merijo pozicijo igralca v vsaki sekundi. Poleg omenjenih naprav se pogosto uporabljajo še naprave za lokalno sledenje v prostoru (angl. Local Positioning Measurement System), ki merijo posamezne gibe ter pospešek igralca, naprave za spremljanje srčnega utripa (angl. Heart Rate Monitor) ter meriliniki pospeška (angl. Accelerometer) za sledenje fizičnim aktivnostim in naporom. Natančnost podatkov preko GPS sistemov zagotavljajo giroskopi, digitalni kompasi in mikroelektromehanični sistemi. Med že vgrajene tehnologije na stadionih uvrščamo predvsem sisteme večih kamer (Multi-Camera System), ki merijo zgolj fizične sposobnosti igralcev [6]. Razvoj tehnologije omogoča vse boljši vpogled tudi v nekoliko težje merljive zmožnosti posameznikov. V to kategorijo sodijo t.i. »eye-tracking« naprave, ki spremljajo fokus očesa pri igralcu. Primer vidnega zaznavanja so med drugim raziskovali [7] ter [8]. Zgolj zbiranje podatkov preko modernih tehnologij ne prinese želenih rezultatov. Podatke je potrebno razumeti, jih primerno umestiti v problem in obdelati, da se iz njih nekaj naučimo. Preveč podatkov, v kolikor jih ne znamo primerno obdelati, lahko predstavljajo večjo težavo kot korist [9]. Z razvojem tehnologije se razvijajo tudi pristopi obdelovanja podatkov, saj so vse zmogljivejši računalniki sposobni obdelati velike količine podatkov, ki jih ljudje sami ne zmoremo. S pomočjo strojnega učenja se ne obdelujejo le trenutni podatki, temveč se vse več podatkov uporablja za razvoj napovednih modelov, ki lahko z veliko verjetnostjo napovedo rezultate na osnovi prejšnjih podatkov.

2 PREGLED LITERATURE

Razvoj talentov v nogometu lahko opišemo kot mrežo koherentnih sil, ki izoblikujejo mladinca v profesionalnega nogometaša. [10] so za testiranje agilnosti uporabili foto celice (Newtest Oy, Finska) pri dveh skupinah mladincev v starostni kategoriji U-15 (t.j. mladinci, ki še niso dopolnili 15. leta starosti). Pri obeh testih so igralci začeli s testom 70 centimetrov za foto celicami, ki so sprožile merilnik časa za čim natančnješe merjenje. Foto celice prenašajo infrardeče žarke iz oddajnika v reflektor ter nazaj. Ko nastane sprememba v svetlobi, se merilnik sproži. Test agilnosti je predstavljen na sliki 1.



Slika 1: Test agilnosti
Vir: [10]

Posameznik mora pri testu agilnosti čim hitreje preteči razdaljo od začetne točke ter okrog postavljenih preprek do končne točke. S pomočjo testa agilnosti so raziskovalci ugotovili, da med obema opazovanima skupinama mladincev obstaja statistično značilna razlika.

Nadaljnjo raziskavo na področju razumevanja atributov so naredili [11], ki je vključevala 44 mladincev v starostnih kategorijah U-15 in U-17 za specifičen klub iz Portugalske. V raziskavi so se avtorji osredotočili na pozicioniranje in dinamiko igre. Obe starostni skupini so testirali s pomočjo 5-Hz GPS-a (SPI-ProX, GP Sports, Canberra, Avstralija) z namenom pridobivanja dinamičnih podatkov pozicioniranja. Testiranje je potekalo skozi dve prijateljski tekmi, prvo na ravni selekcije U-15 in drugo na ravni selekcije U-17. Namen testiranja je bil dobiti podatke o poziciji posamenzikov na igrišču v določenem momentu. S pomočjo GPS-a so vsi igralci imeli določene koordinate (dolžina, širina), s čemer so razsikovalci določili preprostost podajanja (glede na oddaljenost soigralcev). Na osnovi rezultatov testiranj so raziskovalci zaključili, da obstajajo razlike med obema starostnima skupinama, kar je najverjetneje posledica treningov pozicioniranja in vključevanja v člansko ekipo pri skupini U-17.

Reilly in sodelavci [12] so za ocenjevanje vzorcev gibanja in srčnega utripa pri 65 mladincih v starostni kategoriji U-15 uporabili 4-Hz GPS (VX Sport, Visuallex Sport International Ltd., Wellington, Nova Zelandija). Podatki so se zbirali za 6 tekem dolžine 60 minut. Preko GPS naprave so pridobili podatke še za skupno pretečeno dolžino, visoko intenziven tek (hitrost teka višja od 17 kilometrov/uro), šprint (hitrost teka višja od 22 kilometrov/uro) in skupno število šprintov. Skozi meritve so spoznali, da v prvih 15 minutah po začetku drugega polčasa skupna pretečena razdalja ekipe pade. Rezultati so podobni kot v študijah [13], [14] ter [15]. Intenzivni in naporni treningi, številne prijateljske in ligaške tekme neredko privedejo do poškodb pri mladincih. Zaradi kompleksnosti in številčnosti poškodb ni lahko napovedati. Ocenjevanje zgolj ene ali dveh spremenljivk se pri napovedovanju poškodb v praksi ni izkazalo kot uspešno. S pomočjo sodobnih znanstvenih pristopov, kot je npr. strojno učenje, ki omogoča analizo mnogih spremenljivk, se ocena tveganja poškodb izboljšuje in klubi vse lažje identificirajo prve znake morebitnih poškodb. [16] so ocenjevali tveganje za nastanek poškodb pri mladincih v starostnih kategorijah med U-10 in U-15, in sicer v belgijski mladinski ligi. S pomočjo algoritmov strojnega učenja so na osnovi pripravljalnega obdobja ocenili verjetnost poškodb za 734 mladincev tekom ligaške sezone. V teku sezone se je poškodovalo 368 igralcev (bodisi akutno, bodisi zaradi prekomernih naporov). Na osnovi modela iz pripravljalnega obdobja, so avtorji pravilno napovedali 85 % poškodb. Še več, s pomočjo modela so z 78 % natančnostjo napovedali ali gre za akutno ali neakutno poškodbo. Podobno faktorsko analizo napovedovanja poškodb pri mladincih v starostnih kategorijah med U-10 in U-18 so [17] naredili v angleškem državnem prvenstvu, kjer so rezultati imeli manjšo napovedno vrednost kot pri [16].

3 ZAKLJUČEK

Nogometni klubi so vse bolj primorani slediti zadnjim trednom na tehnološkem področju, v kolikor želijo ostati konkurenčni. Sodobni pristopi v povezavi s tehnološkim napredkom predstavljajo konkurenčno prednost pri razvoju in tranziciji mladincev v profesionalni nogomet. Prav tako je vse pomembneje investirati v kadre, ki znajo primerno obdelati podatke in kvantitativne analize ustrezno prenesti v prakso. Z uporabo sodobnih tehnologij na področju mladinskega nogometa se vse lažje razlikuje med tistimi z večjim potencialom in tistimi, ki le-teh ne dohajajo. Uporaba GPS sistemov in drugih naprav za pridobivanje dinamičnih podatkov tekom nogometne igre je vse pomembnejše pri ocenjevanju razvoja talentov, hkrati pa v povezavi s sodobnimi statistično naprednejšimi metodami predstavlja pomembno prednost pri ocenjevanju tveganja poškodb. Četudi se vse več uspešnih športnih klubov odloča za uporabo modernih tehnologij predvsem za maksmiziranje dobička in iskanje novih poti pri ustvarjanju »supertalentov«, pa mnogi posamezniki ne dosežejo svojega maksimalnega potenciala. Klubi se zaenkrat še ne odločajo za celovit pristop razumevanja tranzicije mladincev v članske selekcije, zato se izgubljenega potenciala ne zavedajo v celoti. V jugovzhodni Evropi (kamor spada tudi Slovenija), metod podatkovnega rudarjenja pri razumevanju in ovrednotenju razvoja mladincev praktično ni zaznati, so pa klubi pripravljeni sodelovati in kažejo naklonjenost modernim pristopom. Kratkoročni cilj je ustvariti celovit model razvoja talentov, ki bo služil kot podpora trenerjem, menedžerjem in drugim nosilcem razvoja mladincev pri razumevanju tranzicije igralcev v starejše selekcije. Z razvojem takšnega modela bi nogometni klubi bolje razumeli proces tranzicije iz večih vidikov, in sicer iz fizičnega, psihičnega, tehničnega in taktičnega vidika. Temu primerno bi prilagodili treninge, hkrati pa bi trenerji lažje in bolje motivirali svoje selekcije. Na ta način bi se deloma izognili izgubljenim priložnostim in odpadanju mladincev iz nogometnih šol in akademij. Razvoj modela za pomoč klubom pri razumevanju tranzicije mladincev v članske vrste predstavlja ključni cilj doktorske raziskave, ki je temelj za uspešno dokončan doktorski študij.

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Spremljanje napredka in dajanje povratne informacije v času dela na daljavo

Monitoring progress and giving feedback while working remotely

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POVZETEK

V prispevku so predstavljene nekatere težave glede spremljanja dela in napredka učenca v času dela na daljavo ter načini spoprijemanja z njimi. Opisana so orodja, s pomočjo katerih učitelj lahko dobi povratno informacijo glede usvojene snovi in posamezni koraki pri nastajanju besedila za govorno predstavitev pri obveznem izbirnem predmetu nemški jezik v 9. razredu osnovne šole. V času dela na daljavo je pouk potekal s pomočjo informacijsko-komunikacijske tehnologije. Učenci so pri delu uporabljali videokonferenčno orodje Zoom, Arnesove spletne učilnice in nekatera druga orodja. Povratno informacijo glede znanja učencev so učitelji pridobivali na različne načine. V članku je predstavljeno kako s pomočjo kvizov v Arnesovi spletni učilnici in preverjanja znanja z Microsoft Forms dobimo povratno informacijo ter kako jo s pomočjo nalog v Arnesovi spletni učilnici podamo. Za pridobitev realne slike znanja otrok so ti kvize reševali v času videokonferenčnih srečanj, kasneje pa imeli možnost svoje naloge ponovno pregledati in rešiti. Ob prihodu v šolo smo ugotovili, da kljub mnogim možnostim, ki so učencem bile na voljo, znanje usvojeno v času dela na daljavo pogosto ni bilo utrjeno. Tako je nekatere snovi bilo potrebno ponovno predelati in utrditi v šoli.

Pri obveznem izbirnem predmetu so učenci v času dela na daljavo spoznavali nemško govoreča območja. V prispevku je predstavljen potek dela in vloga informacijsko-komunikacijske tehnologije pri tem.

KLJUČNE BESEDE

Tuji jezik, vrednotenje znanja, preverjanje

ABSTRACT

The article presents some problems regarding the monitoring of student work and progress during distance education and ways to deal with them. The tools with which the teacher can get feedback on the acquired material and individual steps in the creation of a text for a speech presentation in the compulsory elective subject German language in the 9th grade of primary school are described. During the distance work, the lessons were conducted with the help of information and communication technology. Students used the Zoom video conferencing tool, Arnes online classrooms, and some other tools at work. Feedback on students' knowledge was obtained by teachers in various ways. The article presents how we get feedback with the help of quizzes in the Arnes online classroom and knowledge testing with Microsoft Forms, and how we give it with the help of tasks in the Arnes online classroom. In order to gain a realistic picture of children's knowledge, these quizzes were solved during videoconferencing meetings, and later they had the opportunity to review the answers and try again. Upon arrival at the school, we found that despite the many opportunities available to students, the knowledge acquired while working remotely was often not consolidated. Thus, some materials had to be reworked and consolidated in school.
In the compulsory elective course, students learned about German-speaking areas while working remotely. The paper presents the course of work and the role of information and communication technology in this.

KEYWORDS

Foreign language, knowledge evaluation, assessment

1 UVOD

V novembru 2020 smo ponovno pričeli z delom na daljavo. Ker smo tokrat lahko črpali iz pridobljenih izkušenj, smo učence v prvem mesecu pouka v živo opremili z znanjem glede ravnanja z orodji potrebnimi pri delu na daljavo. Učenci so se v prvih tednih pouka vpisali v spletne učilnice in ponovili kje in kako najdejo gradiva ter oddajo nalogo. Seznanili so se z ostalimi gradivi, ki jih bodo tekom šolskega leta potrebovali in kako dostopati do e-gradiv posameznih učbeniških kompletov. Hkrati smo na šoli oblikovali načrt dela in s tem seznanili tako učence, kot tudi starše.

Ob pričetku dela na daljavo je šola poskrbela, da je vsem učencem na voljo ustrezna oprema in lahko sodelujejo pri pouku. Kmalu po prvih videokonferencah so se pojavila prva vprašanja glede pridobivanja ocen. Učitelji so vprašanja, skrbi in pobude naslavljali na Zavod za šolstvo, o tem je bilo govora na študijskih skupinah in na šolskih aktivih. Ker smo tokrat že imeli nekaj izkušenj, smo pred pričetkom pouka o teh težavah govorili in temu primerno načrtovali delo v razredu. Ob prehodu na delo na daljavo smo prilagodili metode in oblike dela, ter tudi vsebine.

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2 SPREMLJANJE NAPREDKA

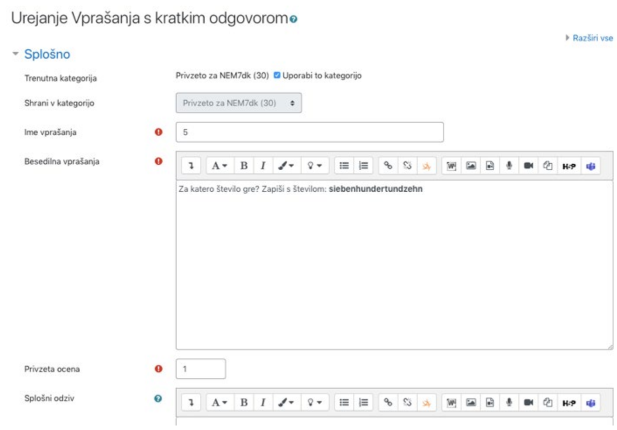
V prvih tednih dela na daljavo so učenci navodila za delo in razlago nove snovi prejemali v času videokonferenc in preko spletne učilnice. Na šoli uporabljamo Arnes Učilnice (Moodle) [1] in videokonferenčno orodje Arnes Zoom [2]. Dokazila o opravljenih nalogah so oddajali kot naloge v spletni učilnici ali izjemoma po elektronski pošti. Naloge sem sproti pregledovala in povratno informacijo zapisala individualno kot odziv na nalogo. Pri tem sem hitro opazila, da marsikateri učenec povratne informacije ne prebere in napak ne popravi. Na naslednji videokonferenci smo ponovno pogledali postopek oddaje naloge. V videokonferenčnem orodju Zoom sem omogočila deljenje zaslona in prosila, da prostovoljec pokaže, da je nalogo oddal in povratno informacijo deli z ostalimi. Učenka je poiskala oddano nalogo in pokazala kje najdemo odziv na opravljeno nalogo ter zastavimo vprašanja, v kolikor odziv ni razumljiv in je potrebna dodatna razlaga. Nekateri učenci so naloge popravili in ponovno oddali, drugi tega niso storili.

Po nekaj tednih takšnega dela sem ugotovila, da motivacija za delo pada. Učenci so v času videokonference sodelovali le, če so bili poklicani, sama pa nisem imela več vpogleda v to, ali večina učencev razlagi res sledi ali raje molči in se ne želi izpostavljati. Ponudila sem jim dodatno uro za razlago, vendar se je učenci niso udeleževali. Nekateri se tudi tedenskih ur izbirnega predmeta niso udeleževali redno, zato sem sklenila, da razumevanje snovi preverim s pomočjo kviza.

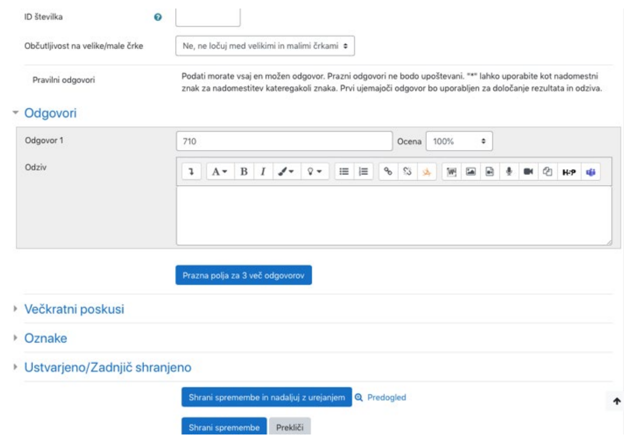
Sprva sem kviz ustvarila v Arnesovi spletni učilnici. Kviz je potrebno dodati in ga urediti. Orodje ponuja nabor različnih tipov vprašanj (drži/ne drži, izbirni tip vprašanja, povleci in spusti, esej, izberi manjkajoče besede, razvrščanje itn.). Kviz je vseboval različne tipe vprašanj, ki so si sledili od lažjega do težjega. Učenci so morali prepoznati nemški prevod besede, nato prevode zapisati sami in na koncu dopolniti poved z že danimi možnostmi. Zahtevnejših nalog, ki bi preverjale znanje višjih taksonomskih stopenj, pri preverjanju nisem vključevala. Poudarek je bil na razumevanju osnov in ustrezni povratni informaciji glede učenčevega znanja. Poleg tega v času, ko je motivacija za delo že tako bila nizka, učencev nisem želela še dodatno obremeniti.

Prednosti kviza v Arnesovi Učilnici so, da se učenci v učilnice prijavljajo z dodeljenim uporabniškim imenom in učitelj vidi, kateri učenci so kviz že rešili, kolikokrat so ga reševali, dan reševanja in koliko časa so za to potrebovali. Po oddanih odgovorih učenec in učitelj vidita, kateri odgovori so pravilni in kateri napačni. Učitelj tako vidi, pri katerih nalogah so učenci uspešni in katere snovi je potrebno ponovno razložiti ali ponoviti. Možnosti pri pripravljanju kviza je veliko, kar prikazujeta sliki 1 in 2. Učitelj ustvari nalogo oz. vprašanje, določi pravilne in nepravilne odgovore, oceno, doda odzive in izbere število poskusov. Učitelj izbere tudi občutljivost na velike in male črke, kar je pomembno pri preverjanju pravilnega zapisa. Zaradi vseh teh možnosti pa je priprava takega kviza precej zamudna, kviz pa je možno uporabiti za eno skupino učencev.

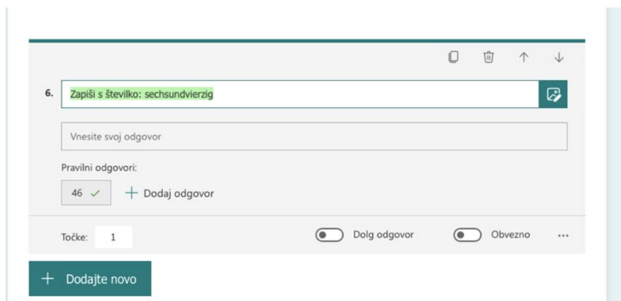
Kasneje sem za ustvarjanje kvizov začela uporabljati orodje Microsoft Forms [3]. V primerjavi s kvizi v Arnesovi Učilnici pri tem orodju govorimo o ustvarjanju novega obrazca oz. preizkusa znanja. Orodje ponuja manj tipov vprašanj (izbira, besedilo). Dodatnih odzivov ali namigov ni možno dodajati, zaradi tega pa ustvarjanje preizkusa ni časovno tako zamudno. Urejanje je prikazano s pomočjo slike 3. Preizkus je možno podvojiti in spreminjati, lahko ga kopiramo in damo v souporabo drugim. Po opravljenem preizkusu učenec in učitelj vidita odgovore, učitelj ima vpogled v to, kaj učenci že znajo in kaj je potrebno še ponoviti. Preveri lahko čas reševanja in natisne povzetek oz. rezultate preverjanja. V primeru, da želi preizkus ponovno uporabiti, lahko odgovore tudi izbriše.



Slika 1: Urejanje vprašanja v Arnesovi spletni učilnici -1. del



Slika 2: Urejanje vprašanja v Arnesovi spletni učilnici – 2. del



Slika 3: Urejanje vprašanja z orodjem Microsoft Forms

Če primerjamo obe orodji, lahko rečemo, da z njima lahko pridobimo informacijo o znanju v času dela na daljavo. Medtem, ko se v Arnesovo Učilnico učenci prijavijo z uporabniškim imenom in so imena posameznikov učitelju vidna, je v orodju Microsoft Forms potrebno nastaviti, ali kviz lahko rešujejo vsi z dostopom ali ljudje v organizaciji. V primeru, da potrebujemo splošno informacijo glede znanja, lahko učenci kviz rešujejo anonimno. Kadar pa želimo spremljati napredek posameznika, pa je potrebno v Forms-ih to tako tudi nastaviti. Prednost Microsoftovega orodja je preprosta uporaba, ki terja veliko manj časa, in možnost deljenja preverjanja znanja. Učitelji smo se lahko dogovorili, katere snovi bomo preverjali in si preizkuse delili, nato pa individualno prilagajali svoji skupini. Dodatna prednost je dostopnost, saj so do preizkusov učenci lahko dostopali preko povezave, ki sem jo pripela v času videokonference, medtem ko so kvize v Arnesovi spletni učilnici lahko reševali le ob prijavi v spletno učilnico.

Sprva sem kvize v spletno učilnico dodala kot nalogo, ki so jo morali opraviti tekom tedna. Ob koncu tedna sem opazila, da naloge niso opravili vsi. Po razgovoru z učenci sem ugotovila, da so se nekateri bali, da pri reševanju kviza, ki je zajemal snovi, ki smo jih delali pred in v času dela na daljavo, ne bodo uspešni in bo to kasneje vplivalo na oceno. V prihodnje sem učence pred preverjanjem znanja opozorila na to, katere snovi se bodo v prihodnjem tednu preverjale, kratke kvize, s pomočjo katerih sem dobila povratno informacijo glede njihovega znanja pa so reševali v času videokonference. Tudi tokrat kviza kljub pobudam in sprotnemu spremljanju niso rešili vsi učenci. Opazila pa sem, da so učenci pri obveznem predmetu kvize reševali uspešneje in v večjem številu kot pri obveznem izbirnem predmetu. Informacije, ki sem jih s pomočjo kvizov in preizkusov dobila, so mi služile predvsem kot pomoč pri načrtovanju naslednjih ur. Vseeno pa smo ob povratku v šolo pomembnejše teme ponovili, saj se je izkazalo, da kljub ponavljanju s pomočjo kvizov in preverjanj, znanje pri mnogih učencih ni bilo utrjeno.

V Pravilniku o preverjanju in ocenjevanju znanja ter napredovanju učencev v osnovni šoli (2013) je v 3. členu zapisano, da je ocenjevanje znanja »ugotavljanje in vrednotenje, v kolikšni meri učenec dosega v učnem načrtu določene cilje oziroma standarde znanja. Učitelj ocenjevanje znanja opravi po obravnavi učnih vsebin in po opravljenem preverjanju znanja iz teh vsebin.« [4] Ocenjujejo se lahko »učenčevi ustni odgovori ter pisni, likovni, tehnični, praktični in drugi izdelki, projektno delo in nastopi učencev.« [4] Z učenci smo s pomočjo kviza in preverjanja znanje sicer preverili, a preko teh orodij učencev nisem ocenjevala. Zaradi morebitnih zapletov s povezavo in občasnih nedelujočih kamer ni bilo možno vsem učencem zagotoviti istih oz. primerljivih razmer za delo, zato se takšne oblike ocenjevanja nisem lotila. Ko delu na daljavo ni bilo videti konca, sem se odločila, da bodo učenci devetega razreda pri obveznem izbirnem predmetu nemščine namesto načrtovane prve ustne ocene, oceno pridobili z govornimi predstavitvami.

3 PRIPRAVA IZDELKA IN POVRATNA INFORMACIJA

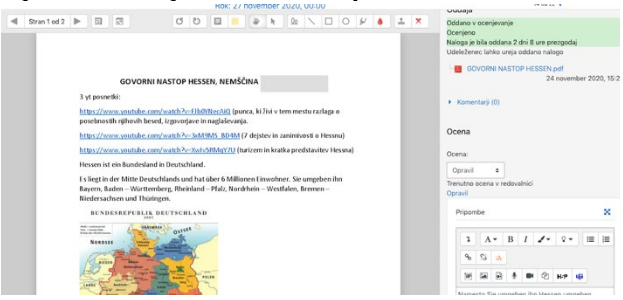
V devetem razredu govorimo o deželah nemškega govornega območja, zato učenci vsako leto na to temo pripravijo kratko govorno predstavitev. Dogovorili smo se, da bodo predstavitve opravili v času dela na daljavo in bodo ocenjene. Zastavljeni učni cilji se navezujejo na operativne učne cilje po učnem načrtu za nemščino kot obvezni izbirni predmet [5]. Učenci ob pripravi in izvedbi predstavitve dokažejo, da:

- razumejo podrobnosti na določeno temo ali situacijo vezanega besedila, tudi če ta vsebuje neznane informacije, ki za razumevanje niso ključnega pomena;
- znajo samostojno poiskati informacije v besedilu, ki so potrebne za rešitev določenih nalog;
- razvijajo govorno sporočanje (predstavitev – predaja informacije o prej raziskani temi);
- znajo postavljati vprašanja, ki se nanašajo na temo in nanje odgovarjajo.

Navodila za delo so učenci prejeli vsak teden v spletni učilnici. Postopoma so oblikovali govorno predstavitev, sproti pa dobivali povratne informacije o že zapisanem besedilu.

3.1 Nastajanje govornih predstavitev

V prvem tednu so učenci dobili naslov govorne predstavitve. Pred začetkom dela so učenci v skupinah razmislili, katere informacije bi bile zanimive in katere ne. Našteli so teme, o katerih bi že znali nekaj samostojno povedati, poudarek je bil, da naj bo besedilo njihovo delo in ne kopija že zapisanega. Povedi so lahko preproste, uporabljajo naj znano besedišče. Učenci so začeli z zbiranjem informacij s pomočjo spletnih brskalnikov. Pri tem je bilo zaželeno, da informacije že v osnovi iščejo v nemškem jeziku in si po potrebi pomagajo s slovarji (npr. PONS, Google Translate). Tako so spoznavali avtentična gradiva. Pozorni so bili na izgovorjavo in si beležili informacije, ki so jih s pomočjo posnetkov dobili. Ogledali so si lahko turistične predstavitve, brošure in različne spletne strani. Večina učencev je izbrala posnetke na YouTubu. Informacije so zapisali in oddali v spletno učilnico, kar je prikazano na sliki 4. Po pregledu zapisov so dobili povratno informacijo.



Slika 4: Dokazila o delu in podajanje povratne informacije

V naslednjih tednih so delo nadaljevali tako, da so najprej pregledali povratno informacijo, morebitne napake popravili, nato nadaljevali z delom po navodilih. S pomočjo informacij s spleta so tvorili naslednje povedi. Pri tem so si lahko pomagali s slovarji, spletom in knjižnim gradivom. Ob delu so sproti navajali vire in dodajali slikovna gradiva.

Pri vsem tem so učenci morali biti vešči brskanja po spletu, uporabe spletnega slovarja, Word-a in spletne učilnice. Izkazalo se je, da kljub opozarjanju, naj si kot jezik v dokumentu nastavijo nemški jezik, mnogi učenci tega niso storili. Tako so predstavitve imele napake, ki bi jih z ustreznim računalniškim znanjem učenci lahko odpravili sami. Pri tem naj omenim, da jim postopek nastavitve jezika in možnosti popravljanja napačnih zapisov v Wordu pokažem vsako leto. Učenci so morali pregledati odzive na nalogo in popravke upoštevati. Pri drugi oddaji naloge je bilo jasno, kateri učenci povedi tvorijo samostojno ali s pomočjo slovarja, kateri pa kopirajo celotne stavke. Za nadaljnje delo je bilo pomembno, da učenci povedi tvorijo sami. Ti učenci so ustni del opravili brez težav, saj so povedi bile enostavnejše in lažje razumljive.

3.2 Kriteriji uspešnosti

Z učenci smo oblikovali kriterije za ocenjevanje. To smo storili na videosrečanju. Učenci so bili razdeljeni v naključne skupine, skupaj so morali oblikovati predlogo za kriterije ocenjevanja. To so zapisali v skupni dokument (One Drive) [6], predloge smo pregledali in jih skupaj preoblikovali. Učenci so predlagali, da se ocenjujejo govor, vsebina in Powepoint predstavitev. Ocenjujejo naj se torej vsebina (ali so zajete vse iztočnice in v kakšni meri so zajete), jezik (ali je besedišče bogato, pravopisno pravilno, ali so slovnične strukture pravilno uporabljene) in govor (ali učenec govori prosto, tekoče). Pri tem naj bi se upoštevala tudi pripravljena dodatna gradiva. O predlogih smo se pogovorili in pregledali kriterije, ki so ob tem nastali.

3.3 Izvedba in povratna informacija s strani sošolcev

Pred izvedbo govornih nastopov so učenci zapisano lahko popravili na osnovi povratne informacije učitelja, si ogledali kriterije, ki so bili naloženi tudi v spletni učilnici predmeta. Za izvedbo smo se dogovarjali v manjših skupinah. Učenci so si pri tem lahko odprli dokument s kriteriji in si sproti beležili opažanja o izvedbi govornega nastopa. Po vsaki končani predstavitvi so najprej učenci podali povratno informacijo s pomočjo kriterijev, nato učiteljica. Učenci so tudi sešteli točke in povedali, kakšno oceno bi dobil posameznik. Učiteljica je potem povedala še svoja opažanja in ocenila učenca.

Ob koncu vseh govornih predstavitev so učenci rešili še kviz na to temo. V preteklem šolskem letu smo govorne predstavitve izvedli na podoben način, vendar smo temu dodali še beleženje slišanih informacij. Učenci so tekom govornih nastopov morali razbrati osnovne informacije in jih vpisati v pripravljene brošure. Tega na daljavo zaradi izvedbe predstavitev v manjših skupinah nismo naredili.

Ob dejavnosti so učenci razvijali vse štiri spretnosti. Pri iskanju informacij so vadili bralno razumevanje, pri oblikovanju besedila pa pisno sporočanje. Pred in med predstavitvijo so vadili govorno sporočanje in slušno razumevanje. Slušno razumevanje so vadili že pri prvi aktivnosti, ko so iskali informacije in si posnetke ogledali v nemščini. Takrat so morali biti pozorni tudi na izgovorjavo posameznih besed.

4 ZAKLJUČEK

V času dela na daljavo je pouk potekal drugače. Temu je bilo potrebno prilagoditi tudi ocenjevanje. Iz izkušenj v preteklem letu sklepam, da je najprimernejša izmed načrtovanih tem in dejavnosti za ocenjevanje priprava in izvedba govorne predstavitve. Učenci so pri delu bili vodeni in redno dobivali povratne informacije na Zoom konferencah ali kot odziv nalogo v Arnesovi Učilnici. Te so pripomogle k temu, da so postali pozorni na svoje napake, jih odpravili ter se iz njih učili. S pomočjo informacijske-komunikacijske tehnologije so imeli dostop do avtentičnih gradiv, pri delu so uporabili slovarje, dobili so redne povratne informacije, na koncu so si s pomočjo kriterijev uspešnosti lahko pregledali, kaj jim manjka oz. na katerem področju še potrebujejo pomoč ali utrjevanje. Po končani govorni predstavitvi preko Zooma ali v živo so prejeli še povratne informacije s strani sošolcev oz. so jih sošolcem podali sami. S tem se je ocenjevanje zaključilo. Splošno znanje na to temo se je preverilo še s pomočjo kviza. Menim, da so govorne predstavitve bile pozitivna izkušnja in situaciji primeren način preverjanja znanja, pri katerem so se imeli možnost izkazati tudi učno šibkejši učenci.

Kot uporabni orodji za preverjanje znanja so se izkazali kvizi v Arnes Učilnici in preverjanje znanja v Microsoft Forms. Slednji je sicer uporabniku prijaznejši, a z manj možnostmi izbire. V kolikor bi Pravilnik o preverjanju in ocenjevanju znanja omogočal ocenjevanje po delih, bi bilo vredno razmisliti o rednem izvajanju kratkih preverjanj znanja. Ta so časovno manj potratna, dajejo pa, v kolikor se izvajajo pod enakimi pogoji, objektivno informacijo glede učenčevega znanja.

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Priprava na obštudijsko dejavnost »Organizacija in usposabljanje v potapljanju«

Preparation for the extracurricular activity "Organization and education in diving"

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POVZETEK

V prispevku predstavljamo priprave na Fakulteti za organizacijske vede Univerze v Mariboru na izbirno kreditno ovrednotene obštudijske dejavnosti za študente "Organizacija in usposabljanje v potapljanju" v študijskem letu 2022/2023. Predstavljamo vsebine tečaja potapljanja z avtonomno potapljaško opremo. S ciljem dobre priprave na izvajanje tečaja v praksi smo predstavili izkušnje pridobljene med lastnim potapljanjem in sodelovanjem pri izvedbi različnih tečajev potapljaškega društva Kisik v času od junija 2021 do septembra 2021. V zaključku predstavljamo kaj smo se iz videnega naučili in kako bomo poskušali podobne težave preprečiti pri izvedbi tečajev s študenti.

KLJUČNE BESEDE

Izbirni predmet, potapljanje, izobraževanje

ABSTRACT

This article presents preparations at the Faculty of Organizational Sciences University of Maribor for the elective credit-evaluated extracurricular activities for students "Organization and training in diving" in the academic year 2022/2023. We hereby present the contents of a diving course with autonomous diving equipment. With the aim of good preparation for the implementation of the course in practice, we present the experience gained during our own diving and participation in various courses of the diving association Kisik in the period from June 2021 to September 2021. In conclusion, we present what we have learned from what is presented and how we will try to prevent similar problems when conducting courses with students.

KEYWORDS

Elective course, diving, education

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1 UVOD

UM FOV smo v začetku leta 2021 na UM v potrditev vložili učni načrt za študijsko leto 2022-2023 za izbirno možnost kreditno ovrednotene obštudijske dejavnosti "Organizacija in usposabljanje v potapljanju". Kot morebitna izvajalca teoretičnih vsebin sva se prijavila avtorja tega prispevka, ki imava večletne izkušnje s potapljanjem. Postopek priprave in zahtevane pravne podlage ter predvideni pozitivni učinki so predstavljeni v prispevku [1] (Werber, 2021). V tem prispevku smo se osredotočili na praktične izkušnje, pridobljene med lastnim potapljanjem in med izvedbo različnih tečajev in organiziranih potopov potapljaškega društva Kisik na Blejskem jezeru ali morju v času med junijem in septembrom 2021, ki nam lahko pomagajo preprečiti podobne težave pri izvedbi tečaja s študenti. Iz pričevanega bo razvidno, da smo imeli napačen vpogled v izvedbe potapljaških tečajev saj je skoraj v vsaki skupini tečajnikov ali certificiranih potapljačev prihajalo do manjših ali večjih težav med izvedbo potapljanja.

2 PREGLED LITERATURE

Obštudijska dejavnost je na Univerzi v Mariboru opredeljena na 48 strani v 215. členu Statuta UM [2]. Obštudijska dejavnost lahko izvira iz področja kulture, športa in drugih obštudijskih dejavnostih. Podrobnejši opis obštudijskih dejavnosti je na UM opredeljen v Pravilniku o kreditno ovrednoteni obštudijskih dejavnosti na Univerzi v Mariboru, št. 012/2019/1[3]. Na UM FOV smo se odločili, da med več možnimi izberemo izobraževanje po sistemu PADI (Professional Association of Diving Instructors), ki ima dolgoletno tradicijo iz leta 1966, je mednarodno priznan, je med najbolj razširjenimi med največ nudenimi potapljaškimi centri za rekreativno potapljanje in mu tudi druge univerze in fakultete po svetu priznavajo ovrednotenje po kreditnih točkah glede na stopnjo izobraževanja [4]. Glede na stopnje izobraževanja PADI deli izobraževanja na naslednje nivoje, kot je prikazano na sliki 1.

Iz slike 1 je razvidno, da je za mlade in otroke na razpolago PADI Seal team, ki je razdeljen na Bubblemaker in Discover Scuba diving ter Skin diving in omejen s starostjo 8 let. Pri vseh teh stopnjah je obvezna prisotnost in vodenje inštruktorja. Prvi nivo certificiranega potapljača predstavlja stopnja OWD (Open water diver), ki je omejena do globine 18m in omogoča samostojno potapljanje v parih v spremstvu inštruktorja ali Divemastra. V našem primeru bomo izvajali usposabljanja za to stopnjo. Kot nadaljevanje sledi izobraževanje za Adventure diver

(Deap diver in Wreck diver) in AOWD (Advanced open water diver), ki ima omejitev do globine 30m razen, če znotraj tega pridobimo certifikat za specialnosti, ki dovoljujejo potope do 40m. Naslednja stopnja je Rescue diver, ki pomaga pri reševanju in nato Master scuba diver, ki je le naziv za usposobljenost rekreativnega potapljača, ki pa ne sme sodelovati ali izvajati usposabljanja. Prvi nivo s področja profesionalnega usposabljanja je Dive master, kar predstavlja tudi poklic, a je omejen na manj zahtevne naloge in v večji meri le pomaga Open water scuba instruktorju.

Slika 1: Shema izobraževanja po sistemu PADI

Rekreativni potapljači, ki se želijo potapljati globje kot 40m morajo opraviti usposabljanja PADI za Tec diving (tehnično potapljanje)[5], pri katerih se uporablja obogaten zrak s kisikom (Nitrox) ali Trimix (helij, kisik in dušik), ki omogoča časovno daljše in globje potope, a zahteva varnostne postanke, dodatno tehnično opremo in dodatne vire zraka na posameznih predvidenih globinah za dekompresijo.

Kot je razvidno iz slike 1 ima PADI-jev izobraževalni sistem zelo dodelano in razvejano strukturo učenja. Ves sistem je podprt tudi z ISO standardi. Vsak tečaj je podrobno opisan v priročnikih (npr. PADI Divemaster manual [7]) in se ga posodablja glede na spremembe v tehnični opremi.

3 METODOLOGIJA DELA

Kot metode dela smo uporabili študijo literature, študije primerov in primerjave rezultatov z zapisi v Divemaster priročniku v katerem so našteti različni primeri težav s katerimi se lahko srečamo med izvajanjem izobraževanja in potopov. Zbrani primeri so se zgodili v času od junija 2021 do septembra 2021 med izobraževanji ali organiziranimi potopi. Primerjava je narejena s ciljem, da ugotovimo potencialne nevarnosti in se čim bolje pripravimo za izvedbo obštudijske dejavnosti »Organizacija in usposabljanje v potapljanju« s študenti UM FOV v študijskem letu 2022/2023.

4 REZULTATI

Na tem mestu so predstavljeni primeri, v katerih smo bili fizično prisotni in so potrebovali naši intervencijo s ciljem zagotoviti varnost in zdravje tečajnikov. Tečajniki so bili od starosti 8- 55 let različnih predznanj in stopenj usposobljenosti.

4.1 Neuspelo uravnavanje pritiska v ušesih

Skupina štirih tečajnikov je imela prvi dan praktičnih vaj in med prvim potopom smo opazili, da ima ena od tečajnic težave z izenačevanjem pritiska v ušesih. Kot posledica slednjega se ni uspela potopiti, ostali pa so čakali na dnu Blejskega jezera na globini 5m. S tečajnico je bilo potrebno izvesti ponoven poskus izenačevanja pritiska nad gladino, da smo zaznali napako pri tem postopku. Če bi se tečajnica spustila v globino brez izenačevanja bi začutila hudo bolečino in posledično poškodbo bobniča s krvavenjem,

Analiza: Obstaja več načinov izenačevanja pritiska v ušesih. Najenostavnejši je s pihanjem v nos pri čemer s prti stisnemo nosnice. Tečajnica je namesto v nos pihala v usta oziroma lica. To je izvedlo pritisk na ličnice namesto na ušesa.

Rešitev: Kandidatom je potrebno predstaviti vse možne načine izenačevanja pritiska v ušesih in z njimi po potrebi večkrat ponoviti to vajo v plitki vodi.

4.2 Prehiter dvig na površino

Prehiter dvig na površino je lahko za potapljača nevaren sorazmerno z globino in časom v katerem je bil na tej globini. Rezultira lahko v obliki dekompresijske bolezni, ki jo delimo na izločanje dušika v obliki mehurčkov v krvni sitem ter raztezanje pljuč kot posledica neustreznega izpusta zraka med dvigom. Da bi se preprečile take nesreče se vse vaje najprej izvajajo v plitvi vodi, ki ne presega višino potapljača (plitka voda ali bazen), kasneje pa na globini med 5-7 m.

Opis primera: skupina štirih potapljačev je izvajala ponovitev vaj iz plitke vode na globini 7m. Med vajo praznjenja maske (vodo iz maske izpodrinemo s pomočjo dovajanja zraka preko nosu), je tečajnica nenamerno namesto vpiha izvedla vdih preko nosu in tako vdihnila vodo. Sledil je kašelj, ki je izzval bruhanje, izpust regulatorja iz ust in hiter dvig na površino. Priporočeno je da se dvigujemo 18m na minuto [7] ali počasneje. Glede na globino in čas potopa ni bilo nevarnosti, da bi kandidatka dobila Dekompresijsko bolezen, a smo morali z njo pol ure ponavljati vaje v plitki vodi, da je premagala strah in si pridobila sposobnost kontroliranega izpiha čez nos.

Analiza: Do težave je prišlo, ker je tečajnica tečaj potapljanja zaradi omejitev v zvezi s korona virusom prekinila za nekaj mesecev in se tako drugega dne tečaja udeležila naknadno. Rešitev: Če je med vajami v nizki vodi in vajami v globoki vodi več dni ali mesecev, je nujno potrebno ponoviti vaje v plitki vodi. Na ta način tečajnik spet pridobi občutek in zmanjša strah zaradi neugodja, ko mu voda pride v nos in čez oči.

4.3 Pomanjkanje zraka

Ena od najbolj nevarnih situacij za potapljača je, da med potopom ostane brez zraka. Pravila sicer pravijo, da mora potapljač pred vstopom v vodo s so-potapljačem izvesti preverbo opreme, ki vsebuje tudi pregled funkcioniranja regulatorja in oktopusa (rezervni regulator). Ker je to najnevarnejši scenarij se vedno učimo postopke kako v takih primerih postopati in kako deliti zrak iz jeklenke s pomočjo oktopusa. V tem primeru je šlo za mešanico upoštevanja navodil, a ne v celoti. Sopotapljača sta po postopku pregledala drug drugega in na površini je bilo dihanje mogoče ne da bi na inštrumentih zaznali odstopanja. Ko pa se je potapljač spustil na 7m, mu delno odprta jeklenka ni dovajala dovolj zraka zato je težko dihal in na koncu bil prisiljen izplavati na površino.

Analiza: Na kopnem smo ugotovili, da je bila jeklenka le delno odprta, kar je podobno kot pri pipi z vodo, kjer voda sicer teče ampak v majhnem curku.

Rešitev: Opominjati potapljače na to možnost in ob prvem potopu na globino preveriti, če vsi lahko brez težav dihajo.

4.4 Izguba opreme

Tukaj smo doživeli štiri različne primere.

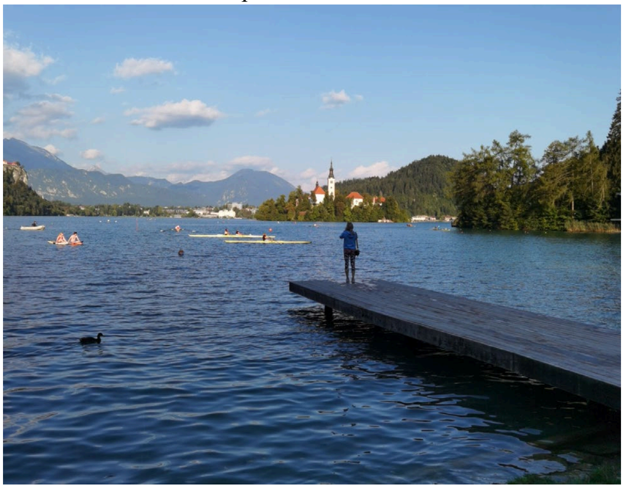
Prvi je bil s tečajnico srednjih let, ki je najprej sezula plavutke, potem v paniki izvrgla regulator in se pognala iz 3m na površino. Ker še ni obvladala kompenzatorja plovnosti je inštruktor napihnil njen jopič, da jo je dvignilo na površino.

Analiza: Tečajnica je slabo pritrdila izposojene plavuti.

Rešitev: Obvezno preveriti ali so tečajniki pravilno namestili in pritrdili opremo.

Drugi primer je bil pri izvedbi potopa očeta in sina, ki sta pravkar kupila novo opremo in sta oba že imela nekaj opravljenih potopov na Maldivih. Testirala sta nova jopiča z integriranimi utežmi (namesto, da so uteži na pasu, so v posebnih žepih jopiča). Potop je potekal po planu najprej v eno smer po 5m globine in nazaj na globini 3m na izhodiščno mesti v Veliki Zaki (Slika 2) na Blejskem jezeru. Med potjo nazaj je sina izvrglo na površino. Analiza: Ko smo prišli na kopno smo ugotovili, da je med potopom izgubil del uteži z ene strani. Očitno žep integriranih uteži dovoljuje, da se uteži v krogličasti obliki(vrečka s svinčenimi kroglicami) lahko izmuznejo.

Rešitev: V tem primeri je potrebno uporabiti eno večjo vrečko uteži ali pa klasične kvadrataste oblike.



Slika 2: Velika Zaka – Blejsko jezero

Tretji primer se je zgodil na potapljanju na morju v predelu Savudrije na Hrvaškem. Spustili smo se do 15m in med luknjami v skalnatem pobočju fotografirali morske živali (Slika 3). Da se ne dvigne pesek se včasih potapljač postavi na glavo in tako izvaja fotografiranje. V tem primeru je bila uporabljena suha obleka, ki je še bolj občutljiva na vertikalen položaj saj se zrak v obleki premakne v noge potapljača in ga začne vleči proti površini. Potapljač je imel opravljen tečaj iz uporabe suhe potapljaške obleke in več potopov z njo. Poskusil se je rešiti s prevali naprej z popolnim izpustom zraka iz jopiča, a ni pomagalo, nekje na 4m globine ga je potisnilo na površino. To sicer ni bilo nevarno, a ustvari vseeno neprijeten občutek.

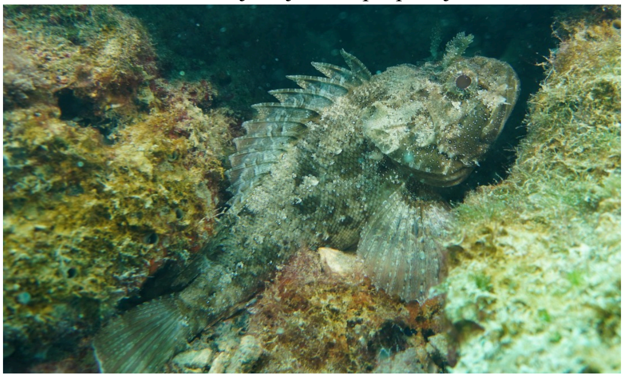
Analiza: na površini smo ugotovili, da so dodatne uteži iz žepa na nogah izpadle iz žepa, ko se je potapljač postavil vertikalno na glavo.

Rešitev: Uteži je potrebno pritrditi v žep s pritrdilnimi vrvicami namenjenimi drugim vsebinam.

Četrti primer se je zgodil po vaji izstrelitve boje v globoki vodi. Praviloma se najprej boja s sponko loči od jopiča, nato se sponka pripne na vrv, boja se razvije in napolni z zrakom, drug potapljač pa med dviganjem drži kolut z vrvico. Po tem postopku se varno dvigne na površino in bojo pospravi v prvotno obliko.

Analiza: Med zvijanjem boje je tečajnik podal sponko kolegu, ki je držal kolut in sponka je padla 7 metrov niže v blatni del jezera. V teh primerih se ne more ugotoviti kje je predmet pristal, saj se skrije v blatni del dna.

Rešitev: Označevalno bojo naj vedno pospravlja le ena oseba.



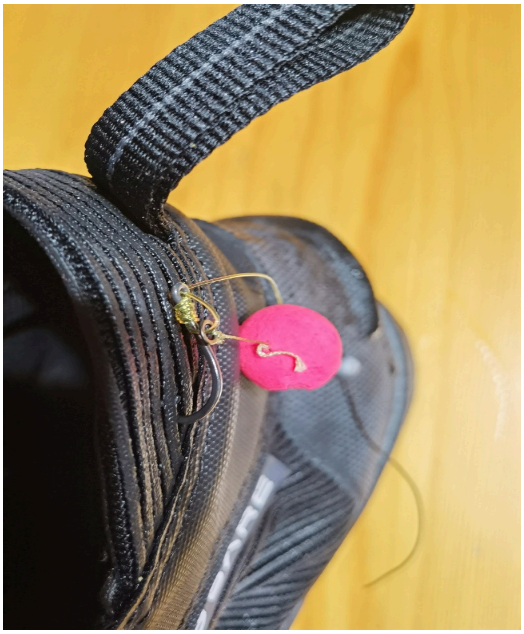
Slika 3: Škarpena – Savudrija, Hrvaška

4.5 Ribič, ribič me je ujel

Blejsko jezero je precej poseljeno z ribami, prednjačijo somi, ščuke in krapi. Občasno se dogaja, da ribiči lovijo v bližini kopalnega dela v Veliki Zaki, kjer izvajamo potope. Konec avgusta smo izvajali »Discovery dive« poskusni potop z enim kandidatom. To je potop pred tečajem, ki se izvaja zato, da stranke ugotovijo ali jim potapljanje ustreza in se kasneje vključijo v certificiran tečaj OWD. Značilnost poskusnega potopa je, da se izvede le nekaj najnujnejših vaj praznjenja maske in dihanja z regulatorjem ter izenačevanja pritiska v ušesih. Med potopom se tečajnika drži zadaj za jeklenko in na mesto njega uravnava plovnost s pomočjo regulatorja na jopiču. Potop se je izvajal po načrtovani poti na globini 5m. Med povratkom smo opazili mesto z belimi kroglicami (vaba za ribe), ki jih ribič vrže v vodo na mesto kjer pričakuje ribe. Nekaj metrov za tem je potapljač na nogah začutili upor, kot da bi nekaj zadrževalo gibanje. Tudi dodatno gibanje ni spustilo omejeno gibanje. Potapljač je pokazal tečajniku naj počaka, instruktor je nadzoroval tečajnika, medtem je potapljač uporabil nož in prerezal zadevo, ki je preprečevala nadaljnje potapljanje.

Analiza: Na kopnem smo ugotovili, da se potapljač ni ujel v odvržen ribiška vrvica – laks, ampak ga je dejansko nehote ujel ribič (Slika 4).

Rešitev: Čim opazimo na obrežju ribiče moramo pot potopov spremeniti na drugo stran, saj lahko ribič odvrže trnek vrč deset metrov vstran.



Slika 4: Ribiški trnek v potapljaškem čevlju

4.6 Slabo pritrjena jeklenka

Ena od prvih nalog potapljača je, da sam sestavi svojo opremo. Med drugim se na jopič pritrdi jeklenka v odvisnosti od sistema z dvema ali tremi pasovi. Pritrdilni pasovi so narejeni iz mešanice materialov, ki se v vodi delno raztegnejo, zato je potrebno pri pritrjevanju jeklenk še posebej preveriti trdnost. To naredimo tako, da jopič primemo za držalo in večkrat potresemo in opazujemo ali se jeklenka premika. Iz preventivnih razlogov se zato uporabljata dva ali trije pritrdilni sistemi s sponkami. V tem primeru je na kopnem vse delovalo v redu, med potopom pa je jeklenka zlezla navzdol in jo je držal le zgornji pomožni trak. Ker je to ena od vaj, ki jo potapljači opravljamo, je sopotapljač pod vodo zategnil nosilni trak jeklenke in smo lahko s potopom nadaljevali.

Analiza: Nosilni trak se je v vodi raztegnil do take mere, da ni bilo več potrebnega oprijema.

Rešitev: Opozarjati potapljače na to možnost. Obvezna izvedba kontrole med potapljačema pred potopom. Uporaba nosilnih trakov in sponk take vrste, ki zmanjšujejo to možnost.

4.7 Električni čoln

Načeloma na Blejskem jezeru ni čolnov z izvenkrmnim motorjem, potapljače opozarjamo na plavalce, pletnarje, kanuje, kajake in supe. Med tem, ko se motor na notranje izgorevanje pod vodo sliši na več deset metrov, se električni izvenkrmni motor s propelerjem sploh ne zazna. Med izvedbo ponedeljkovih osvežilnih potopov je skupina petih potapljačev opravila planiran večerni potop z ogledom rib (Slika 5) pod lesenim pomolom za kopalce. V tistem delu je globina vode med 1,5m in 3m. Ko smo se izpod podesta premikali proti drugemu delu pomola je nad nas zapeljal čoln z električnim izvenkrmnim motorjem, ki je pomagal med treningom veslačev. Na srečo smo ga vizualno opazili in se odmaknili na globino. Ker je bila ta skupina sestavljena iz certificiranih potapljačev, ki obvladujejo nevtralno plovnost med potopom, ni prišlo do nesreče.

Analiza: Čoln je očitno pobral ali dostavil neko osebo na kopno med tem, ko smo mi izvajali potop. Pri mestu vstopa in izstopa smo imeli postavljeno opozorilno bojo, medtem ko se med potopom ne označuje kje so potapljači.

Rešitev: V času, ko so na gladini čolni z izvenkrmnimi motorji spremenimo smer potopa na del jezera kjer ni nevarnosti za morebitno srečanje.

Slika 5: Som iz Blejskega jezera

4.8 Neustrezna oprema

Potapljanje zahteva kar nekaj kosov tehnične opreme, od obleke, čevljev, rokavic, kapuce, maske, dihalke, jopiča plovnosti, jeklenke, pasa z utežmi ali integriranih uteži. Na začetku se vsa oprema sposodi pri izvajalcu tečaja in se jo pred tem na kopnem tudi poskusno obleče in preizkusi. Pokazalo se je, da v nekaterih primerih to ni dovolj.

Po priporočilih PADI Divemaster priročnika [7] se masko izbere tako, da vsak poskusi nekaj mask in tista, ki se mu najbolj prilega se izbere kot prava. V našem primeru je tečajnik imel konstantno uhajanje vode iz zgornje strani maske kar je povzročalo zalivanje maske z vodo. To se je dogajalo kljub temu, da je maska na kopnem prilegala in tesnila.

Analiza: Tečajnik je imel posebno zaobljeno čelo, ki je omogočalo tesnjenje, kadar je bila maska najnižje možno nad ustnicami. Čim se je maska premaknila pod nos je maska puščala.

Rešitev: Vizualno oceni obraz in čelo tečajnika. V takih primerih je dobro imeti rezervno masko z manjšo površino med spodnjim in zgornjim robom maske.

4.9 Neupoštevanje navodil inštruktorja

Potapljanje je lep šport in dokler ne gre kaj narobe je vsem lepo in po malem adrenalinsko. Da se prepreči nesreče se ves čas usposabljan poudarja pomembnost upoštevanja pravil potapljanja in navodil inštruktorja. Kot omenjeno že prej je prvi nivo certificiranega usposabljanja OWD že dovolj, da so potapljači sami odgovorni za svoje početje in zato pred potopi podpišejo obrazec, kjer se s tem strinjajo. Kljub temu se najdejo osebe, ki nevarnostim navkljub ne upoštevajo teh navodil.

V bistvu sta se oba primera zgodila na istem potopu v Kostreni na Hrvaškem, ki je bil sestavni del AOWD, torej nadaljevalnega tečaja, kjer se lahko potapljač potopi do 30m. Med tečajniki je bil tudi mladoletni fant, ki se že nekaj časa potaplja, saj je njegov oče tudi potapljač s stopnjo Rescue diver – Potapljač reševalec. Zaradi njegove omejitve globine na 20m se je morala cela skupina prilagoditi temu. Že med spustom na nekje 10m globine je tečajnik plaval sem in tja in kazal prekomerno energijo. Spustili smo se do skalnatega previsa, ki se spušča daleč pod 20m globine. Pravilo je, da se potapljači v skupin ne potapljajo globje od inštruktorja. Seveda v tem primeru to ni bilo tako. Mladenič se je spuščal kar nekaj metrov pod mejo in šele na opozorila inštruktorja postavil v pravo višino. Zaradi črednega nagona so se nižje spustili tudi dve starejši potapljačici, ki nista kazali velikega zanimanja med uvodnim poročanjem in priporočilih inštruktorja. Na srečo noben od udeležencev ni imel posledic.

Analiza: Zaradi večje globine so tem, ki so se potapljali nižje bolj spraznile jeklenke, zato smo morali predhodno prekiniti potop, da smo še v mejah normale izvedli priporočljiv varnostni postanek za tri minute na petih metrih globine.

Rešitev: Pred potopom tudi z izkušenimi potapljači ponoviti pravila potapljanja on previsih.

4.10 Napačen vzgib za opravljanje tečaja

Tečaj OWD zahteva kar nekaj spretnosti in psihofizičnih sposobnosti udeležencev. Vsaj na začetku je za tečajnike to stresno saj se znajdejo v povsem drugačnih pogojih kot na kopnem. Na tem mestu predstavljamo dva primera, ko je napačen vzgib za opravljanje tečaja botroval prekinitvi tečaja oziroma spoznavnega potopa.

Prvi primer se je zgodil v avgustu, ko sta se na poskusni potop prijavila oče in njegova 8 letna hčerka. Na začetku sta bila ba navdušena, pomagali smo jima pri oblačenju in opremi in ju postavili v nizko vodo. Pri punčki smo vedno držali njeno jeklenko, ker sama še ni obvladala kontroliranega plavanja. Med tem, ko rid raslih že med poskusnim potopom opravimo nekaj nujnih vaj, jih v programu Bublemaker za otroke ne, saj so za to še premladi in ni dovolj planiranega časa, da bi se to izvedlo. Otroku se razloži kako zadeva deluje, kako se izenači pritisk v ušesih in znake s katerimi se pokaže, da je vse v redu ali da nekaj ni v redu. Prvi poskusi plavanja pod vodo z regulatorjem so bili s punčko uspešni, nato je čakala, da oče opravi zahtevane vaje. Še preden smo se dejansko odpravili na poskusni potop je punčka zahtevala, da gre iz vode in da ne bo nadaljevala.

Analiza: Deklica je šla na potop na željo očeta. Med pripravo smo se več ukvarjali z očetom kot z deklico, zato ji je postalo dolgočasno. Deklica je kazala znake strahu, torej to ni delala iz veselja, kot ostali otroci, ki se prijavijo po lastni želji.

Rešitev: Ločiti usposabljanje za otroka in odraslega tako, da vsak inštruktor ali Divemaster delata s svojim kandidatom. Pred potopom se pri otroku preveri ali je njegova želja, da gre na potop.

Drugi primer je je zgodil kmalu za tem, tokrat trije prijatelji jamarji in en gasilec opravljajo OWD tečaj. Že pri vajah na suhem med sestavljanjem opreme se je pri enem od jamarjev opazilo, da mu sestavljanje ne gre najbolje in da ni naštudiral teoretične osnove. Sledil je prvi dan praktičnih vaj v nizki vodi. Kandidat je imel velike težave s praznjenjem maske in vajami kjer je moral uporabljati regulator. Nenavadno je bilo tudi to, da ga je bilo strah vstopiti v vodo iz pomola nekje 50cm na gladino (Sloka 6). Večkrat je tudi omenjal, da on nekaterih vaj pač nebi dela, ker mu ne ustrezajo. Kljub posebnim naporom, da je opravil vse vaje prvega dne, ga drugi dan ni bilo na tečaj.

Analiza: Ugotovili smo, da se je na tečaj prijavil zaradi stave s kolegi jamarji.

Rešitev: Pri vsakem tečajnika preveriti razlog prijave na tečaj in jih opozoriti, da tečaj zahteva kar nekaj psihofizičnega truda.

Slika 6: Vstop v vodo iz pomola

4.11 Primerjava izkušenj z opisanimi primeri v PADI Divemaster priročniku

Kot omenjeno pred tem ima PADI sistem poudarek na kakovosti, pri svojem delu uporabljajo ustrezne ISO standarde in imajo dolgo obdobje delovanja v katerem se sproti učijo in prilagajajo. V priročniku [7] na strani 69 je opisanih okoli 100 primerov težav, ki jih imajo potapljači med izvajanje 24 vaj iz potapljanj. Pred vsakim poglavjem so opisani podobni primeri težav iz realnih primerov, kot smo jih doživeli tudi mi sami, s tem, da so se v priročniku nekateri končali tragično. Kljub vsemu pa nikoli ne bomo pripravljeni na vse situacije, ki nas čakajo. Samo dobra pripravljenost in strokovna podkovanost bo preprečila ali vsaj zmanjšala morebitne težave in posledice. In kot nas uči priročnik, v primeru težav se najprej za trenutek ustavi, oceni situacijo, poišči več rešitev, izberi najustreznejšo in po tem ovrednoti to rešitev.

Iz pričujočega je razvidno, da obštudijska dejavnost »Organizacija in usposabljanje iz potapljanja« zahteva dobro pripravljenost vseh sodelujočih in obvezno sodelovanje z certificiranimi inštruktorji v bližnjih potapljaških centrih.

5 ZAKLJUČEK

V prispevku smo predstavili nekaj izkušenj pridobljenih med izvajanjem različnih stopenj izobraževanj iz potapljanja po sistemu PADI na Blejskem jezeru in nekaj iz potopov na morju. Iz predstavljenega je razvidno, da potapljanje zahteva resen pristop in vnaprejšnje predvidevanje. Z vsakim odstopanjem od pravil se povečuje verjetnost za ogrožanje zdravja ali celo življenja potapljačev. Primerjava s primeri iz PADI Divemaster priročnika je pokazala, da so naše izkušnje v mejah običajnega in da smo ustrezno ukrepali, saj ni bil nihče poškodovan. Izkušnje nam bodo služile pri izvajanju tečajev potapljanja s študenti. Potrebna bo posebna pozornost na napake, ki so značilne za mlade in adrenalinske tečajnike.

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Šolanje na daljavo v digitalnem okolju

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POVZETEK

V letu 2020 smo na naši šoli prvič prišli v položaj, ko smo zaradi ukrepov za preprečevanje širjenja okužbe z novim koronavirusom morali prekiniti normalen potek šolanja. To je pomenilo zaprtje šol in začetek poučevanja na daljavo. Zato smo morali pripraviti in sprejeti več prilagoditev, ki so bile potrebne zaradi drugačnega načina poučevanja. V zelo kratkem času smo se morali prilagoditi novim razmeram. Glede na to, da naša šola vzgaja in izobražuje učence s posebnimi potrebami so nas nove okoliščine še dodatno silile k razmisleku, na kakšen način prilagoditi vsebine, oblike in metode dela. Google znotraj paketa Workspace for Education ponuja nabor sodobnih spletnih orodij, ki uporabnikom ponuja veliko prostora za kreativnost in sodelovanje, hkrati pa ne zahteva daljšega uvajanja, saj se storitev izkaže kot uporabniku prijazna. Prispevek predstavi pripravo in uporabo nekaterih aplikacij pri načrtovanju in izvedbi pouka v digitalnem okolju. Podrobneje so predstavljene tiste aplikacije, ki so se pokazale kot primerne za naše potrebe.

KLJUČNE BESEDE

Google Workspace for Education, spletno okolje, spletna mesta, obrazci, spletna komunikacija

ABSTRACT

In 2020, we witnessed for the first time a situation where, due to measures to prevent the spread of new coronavirus, we had to postpone the normal course of schooling. Schools closed down and all teaching became remote. We therefore had to prepare several changes to support new ways of learning. We had to adapt to the new situation in a very short time. Given that our school educates students with special needs, new circumstances forced us even further to consider how to approach the content, forms and methods of work. Within the Workspace for Education packages Google offers modern online tools that give users plenty of room for creativity and collaboration. Their implementation is quick and user-friendly. The paper presents the set up and use of certain applications in the planning and implementation of lessons in the digital environment. Those applications that turned out to be more useful for our requirements are presented in more detail.

KEYWORDS

Google Workspace for Education, web environment, websites, forms, online communication

1 UVOD

Danes je zelo veliko spletnih orodij, ki omogočajo tudi delo na daljavo. Učitelji pri svojem delu uporabljamo različna IKT orodja. Doslej smo šolske spletne učilnice za učence imeli postavljene znotraj Arnesovih spletnih učilnic, učitelji pa smo gradiva shranjevali lokalno na računalnikih, oziroma v oblačne storitve, kot so Google Drive ali Oblak 365, v primeru, da so bili dokumenti namenjeni skupni rabi. Odločili smo se, da v skladu s priporočili in usmeritvami, ki smo jih prejeli s strani Zavoda RS za šolstvo [1] in na podlagi primerov dobre prakse, skupaj izberemo in pripravimo novo sodobno spletno okolje za potrebe šolanja na daljavo.

2 PRIPRAVA SPLETNEGA OKOLJA

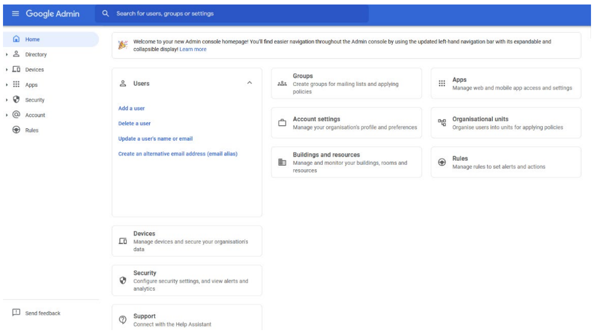
Pri odločitvi glede izbire spletnega okolja, ki bi čim bolj olajšalo prenos znanja na daljavo smo na šoli zasledovali sledeče kriterije [2]:

- Funkcionalnost oziroma uporabnost spletnih strani – je lastnost spletne strani, da izpolni potrebe, zahteve in želje uporabnika z vidika koristnosti in uporabnosti. Stopnja uporabnosti strani je odvisna predvsem od vsebine ter kako učinkovito lahko njeni uporabniki uporabljajo njene funkcije.
- Oblikovna podoba strani – vsebuje nabor različnih elementov kot so možnosti dodajanja grafičnih elementov, barv, ozadij, gumbov, ikon, besedil, tipografij, fotografij, ipd.
- Interaktivnost spletne strani – postavlja obiskovalca v aktivno vlogo. S pomočjo različnih aplikacij in obrazcev lahko učinkovito preverjamo zastavljene cilje in ustvarimo dvosmerno komunikacijo z udeleženci.
- Navigacijski sistem – je namenjen hitremu, preglednemu in enostavnemu dostopu do informacij. Bistvenega pomena je, da se uporabnik na spletnih straneh zna samostojno in hitro orientirati.

Na podlagi analize stanja smo se odločili, da novo spletno okolje zgradimo s pomočjo storitve Google Workspace for Education. Za osnovno okolje smo izbrali aplikacijo Google Sites. Aplikacija uporabnikom omogoča ustvarjanje in urejanje spletnih mest na spletu, hkrati pa sodelovanje z drugimi uporabniki v realnem času [3].

Google račun nam z istim uporabniškim imenom in geslom omogoča dostop do večine Googlovih izdelkov. Za dostop do paketa Google Workspace for Education je za šole potrebna registracija [4]. Šola z uspešno registracijo pridobi svojo lastno domeno. Po uspešni registraciji pridobi oseba z dodeljenimi ustreznimi pravicami dostop do upravnega središča (Slika 1) in s tem možnost urejanja določenih sistemskih nastavitev. V razdelku - skrbnik dostopamo do naslednjih podrazdelkov:

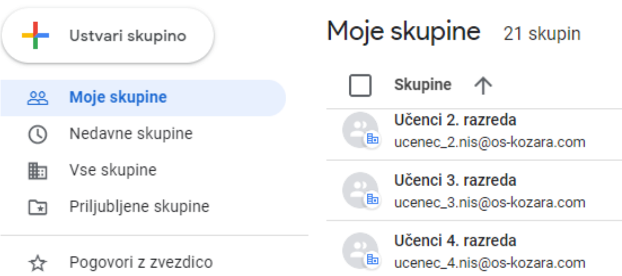
- Imenik (directory) – na tem mestu lahko dodajamo ali brišemo uporabnike, urejamo njihove e-naslove, gesla za dostop, jih razvrščamo v skupine, spreminjamo dostopne pravice na različnih nivojih ter spremljamo njihovo aktivnost po skupinah.
- Naprave (devices) – na tem mestu lahko pridobimo informacije o vpisanih uporabnikih, času zadnjega vpisa ter katero vrsto naprave in operacijski sistem pri tem uporabniki uporabljamo.
- Aplikacije (apps) – storitev vključuje velik nabor spletnih aplikacij, kot so npr. Gmail, Drive, Docs, Calendar, Sheets, Slides, Chat, Forms, Sites, Meet, itd., ki jih lahko na tem mestu upravljamo.
- Varnost (security) – urejamo lahko nekatere varnostne nastavitve.
- Račun (account) – po potrebi lahko poljubno spremenimo spletne naslove za dostop do nekaterih spletnih aplikacij.



Slika 1: Upravno središče

2.1 Organizacija skupin

V podrazdelku – imenik, skrbnik organizacije najprej ustvari skupine uporabnikov (Slika 2). Na naši šoli smo delo organizirali tako, da so bile skupine ustvarjene po oddelkih, dostop pa imajo samo člani. Učenci so bili uvrščeni v ustrezno skupino, glede na oddelek, ki ga obiskujejo, učitelji pa v tisto skupino - oddelek, kjer poučujejo. Učencem so bile dodeljene pravice bralca, učiteljem pa pravice urejevalca.



Slika 2: Organizacija skupin

3 UPORABA SPLETNIH ORODIJ

3.1 Spletna mesta

Google Sites je strukturirano orodje za ustvarjanje wiki in spletnih strani [3]. Do storitve lahko dostopamo z enkratno prijavo v Google račun, ki predstavlja enkratno avtentikacijo.

Na OŠ Kozara Nova Gorica je skrbnik organizacije najprej na šolski spletni strani ustvaril povezavo do začetnega spletnega mesta (Slika 3). Na tem mestu je lahko vsak uporabnik opravil prijavo v Google račun in poiskal ustrezno povezavo do spletnega mesta.

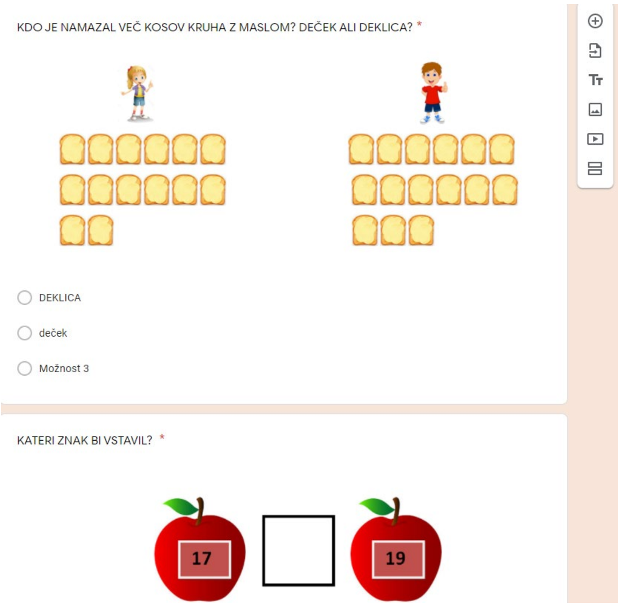
Slika 3: Začetno spletno mesto

Ustvarimo lahko večje število spletnih mest, ki jih smiselno hierarhično uredimo. Vsakemu spletnemu mestu lahko dodajamo podstrani in na ta način organiziramo delo po tednih oziroma dnevih. V razdelku spletna mesta najprej izberemo možnost – začetek novega spletnega mesta. V novem zavihku lahko poljubno poimenujemo novo spletno mesto, dodajamo podstrani ter spreminjamo grafično podobo celotne strani z izborom različnih tem in gradnikov. Poleg tega imamo integrirano možnost vstavljanja datotek oziroma spletnih povezav. Udeleženca lahko pritegnemo z vstavljanjem lastnih multimedijskih vsebin, spreminjamo velikost, barvo in obliko pisave, učne vsebine prikažemo s pomočjo pripravljenih dokumentov, predstavitev in grafikonov. Znanje lahko preverjamo ob pomoči izdelanih obrazcev ali s povezavo do drugih spletnih aplikacij, če želimo doseči večjo interaktivnost (Slika 4).

Slika 4: Spletno mesto 5. razreda

3.2 Obrazci

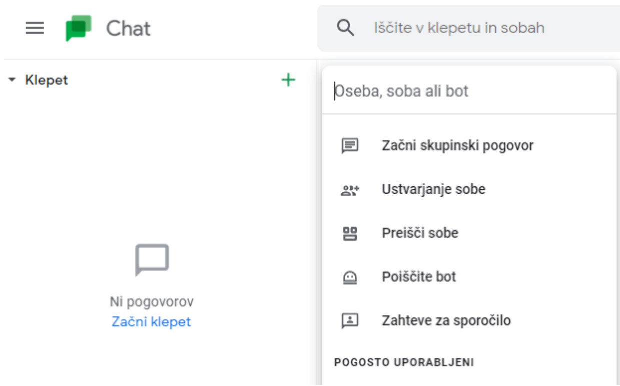
Google Forms predstavlja učinkovito orodje za zbiranje informacij v obliki različnih vprašalnikov oziroma kvizov. V razdelku obrazci izberemo možnost - začni nov obrazec. Nato v nastavitvah določimo vrsto obrazca. Če izberemo možnost kvizi, lahko odgovore na vprašanja tudi točkujemo. Obrazcem lahko s spreminjanjem teme določimo tudi grafično podobo, Izbiramo lahko med različnimi tipi vprašanj, kot so vprašanja z izbirnimi odgovori, vprašanja odprtega tipa, ali npr. v obliki linearnih lestvic. Po želji lahko dodajamo poljubne slike ali videoposnetke z YouTuba. Končni izgled kviza lahko sproti preverjamo s klikom na možnost – predogled (Slika 5). Obrazec lahko učencem posredujemo na različne načine. Prvi način je, da uporabimo njihove e-naslove, kjer imamo možnost pošiljanja po skupinah. Vprašalnik lahko posredujemo tudi s kopiranjem URL povezave, oziroma vstavimo na spletno mesto v obliki HTML kode. V zavihku - odzivi lahko pregledujemo odgovore učencev, po posameznih učencih, vprašanjih ali skupno.



Slika 5: Matematični kviz izdelan s pomočjo Google Forms

3.3 Spletna komunikacija

Vsak uporabnik šolskega računa ob prijavi pridobi tudi svoj šolski elektronski naslov za uporabo elektronske pošte Gmail. Pošto se lahko prejema in pošilja tako iz računalnikov, kot tudi iz mobilnih naprav. Spletno komunikacijo prav tako omogočata aplikaciji Google Chat (Slika 6) in Google Meet. Slednji v obliki videokonferenc.



Slika 6: Aplikacija Google Chat

3.4 Prednosti uporabe spletnih aplikacij v Google Workspace for Education

Prednost uporabe Google Workspace for Education je enotna prijava z enim uporabniškim imenom in geslom za uporabo vseh storitev. Z aplikacijo Google Sites lahko učitelji na preprost način dodajamo, urejamo in prilagajamo digitalne vsebine. Pri tem nam je na voljo veliko orodij, ki so že integrirana v samo storitev, kar zelo poenostavi delo ter pušča uporabniku veliko prostora za individualnost. Prav tako je sam uporabniški vmesnik zelo pregleden in enostaven za uporabo, storitev pa deluje preko spleta, ne glede na lokacijo uporabnika. Z aplikacijo Google Forms učitelji pridobimo in zbiramo različne potrebne informacije, ki nam lahko služijo pri evalviranju dosedanjega ter načrtovanju nadaljnega dela. Uporabniki s storitvijo pridobimo tudi možnost uporabe sodobne elektronske komunikacije, kot je uporaba elektronske pošte Gmail s šolsko domeno in drugih orodij za spletno komuniciranje.

4 ZAKLJUČEK

V šolskem letu 2019/2020 smo na šoli v času šolanja na daljavo prvič preizkusili delovanje storitve Google Workspace for Education. Znotraj ponujenih orodij smo skrbno izbrali tiste, v katerih smo prepoznali dodano vrednost za naše delo. Zaradi pozitivnega odziva pri uporabnikih smo zato v šolskem letu 2020/2021 ustvarili dodatno spletno okolje za primer izvajanja hibridnega modela šolanja, ki predvideva delno izvajanje pouka v šoli, delno na daljavo.

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Delavnica URBANITE 2021
URBANITE Workshop 2021

Uredniki / Editors

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8. oktober 2021 / 8 October 2021
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PREDGOVOR

Delavnica URBANITE bo forum za predstavitev najsodobnejših mobilnostnih rešitev v urbanem okolju s poudarkom na prebojnih tehnologijah, kot so umetna inteligenca, sistemi za podporo odločanju, analitika velikih podatkov in napovedni algoritmi, ki se uporabljajo pri analizi podatkov o mobilnosti, napovedovanju dogodkov in podpori javnim upravam pri sprejemanju strateških odločitev.

Delavnica je aktivnost projekta URBANITE. Vabimo prispevke akademskega sveta, industrije in oblikovalcev strategij na področju mobilnosti in pametnih mest.

Delavnica se bo osredotočila na naslednje teme v okviru mobilnosti v pametnih mestih:

- Umetna inteligenca
- Inteligentni sistemi
- Strojno učenje
- Podatkovno rudarjenje
- Sistemi za podporo odločanju
- Analitika velikih podatkov
- Dejavnosti soustvarjanja
- Socialni vidiki
- Urbana preobrazba

FOREWORD

The URBANITE Workshop will be a forum for presenting the state-of-the-art solutions for the urban mobility with the focus on disruptive technologies such as artificial intelligence, decision support systems, big data analytics and predictive algorithms, which are applied in mobility data analysis, eventualities prediction, and supporting public administrations in making policy-related decisions.

The workshop is an activity of the URBANITE project. We welcome papers from the academia, the industry, and the policy makers in the mobility and smart cities fields.

The workshop will focus on the following topics within the scope of mobility within smart cities:

- Artificial intelligence
- Intelligent systems
- Machine learning
- Data mining
- Decision support systems
- Big data analytics
- Co-creation activities
- Social-related aspects
- Urban transformation

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How Disruptive Technologies can Strengthen Urban Mobility Transformation. The Experience of URBANITE H2020 Project

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ABSTRACT

URBANITE (Supporting the decision-making in URBAN transformation with the use of dIsruptive TEchnologies) is an H2020 project (started in April 2020) investigating the impact, trust and attitudes of civil servants, citizens and other stakeholders concerning the introduction and adoption of disruptive technologies (e.g. AI, Decision Support Systems, big data analytics) in decision-making processes related to the planning and management of urban mobility. The project experiments and validates its approaches and tools in the context of four real use cases in the cities of Amsterdam (NL), Bilbao (ES), Helsinki (FI) and Messina (IT). This article summarises the main findings matured during the first half of the project in the four cities, their main mobility issues and how disruptive technologies can play a role in supporting the decision-making process to solve them. Despite the four cities face different kinds of mobility issues and are characterised by different levels of IT maturity, we identified a chain of three categories of technologies that can improve the efficiency and effectiveness of decision-making processes in all four cities: data access and harmonisation, data analysis and data visualisation.

KEYWORDS

Urban transformation, disruptive technologies, urban mobility, URBANITE project, decision making, data access, data analysis, data visualisation.

1 INTRODUCTION

Today's cities are facing a revolutionary era in urban mobility; this is due to different factors, among the others their continuous growth and the concentration of human activities. To prevent and solve problems related to mobility such as traffic congestion and air pollution (for instance due to $PM_{2.5}$) and its potential link with other risk factors (e.g. Covid-19 spread, as envisaged in recent studies [3], [4]), cities are in continuous search of adequate mobility solutions to satisfy the demand of the growing population, both living in or moving around the cities every day. As a result, decision-makers have to face more and more complex challenges when managing and planning mobility, combining new forms of mobility, that must coexist in the urban structure of modern cities, in compliance with the well-being of citizens and protection of the environment.

The concrete adoption of disruptive technologies in the decision-making processes can represent the pivoting point for a paradigm change in the management of mobility. Decision Support Systems, Artificial Intelligence, predictive algorithms, simulation models, Big Data analytics, etc. offer the opportunity to analyse the current mobility situation, identify present and future trends allowing to predict potential future mobility scenarios [6], [9].

Our investigation focuses on four European cities distributed in four different countries: Amsterdam, Bilbao, Helsinki, and Messina. Each of them offers a different perspective on urban mobility, in terms of characteristics, offered services and challenges. Section 2 presents the four cities, their general characteristics, the specific urban mobility issues they are currently facing, and which kind of disruptive technologies (e.g. artificial intelligence, decision support systems, big data analytics, predictive algorithms, simulation engines) can improve the decision-making processes and how. Final considerations and conclusions are reported in Section 3.

2 URBANITE CITIES

2.1 Amsterdam

Amsterdam, the capital of the Netherlands, in recent years has been growing rapidly in terms of inhabitants and visitors; this growth leads to increased mobility and traffic issues. The city has complex traffic streams with massive amounts of bicycles combined with cars and public transport; this drives the need for finding solutions that can conciliate the ever-growing use of bikes with the other means of transportation (from public transportation to private cars) resulting in more sustainable mobility for the whole city. Part of this view is a strategy tending to increase the appeal of bikes as the main mobility option [5]. This strategy goes through the improvement of the city network of bike lanes and of the overall cycling experience within the city, encouraging virtuous behaviours (e.g. respect of traffic lights) to avoid potential discomfort.

What Amsterdam is aiming for. To reach these objectives the city of Amsterdam would like to align the mobility policies to the real needs of bike mobility, realise a data-driven decision

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mechanism, strengthen the safety and comfort of cycling, and encourage citizens to make sustainable mobility choices.

The role of disruptive technologies in Amsterdam. From a broader perspective, a unique point to access data coming from different sources can support the decision-makers in the identification of the required information, reducing the time spent to search it and speeding up the decision-making process. Since different departments of the municipality (i.e. civil servants) are involved in decision-making, the possibility to easily share information among them (such as data, results of analysis/simulations, map layers, charts, graphs) would improve collaboration and overcome inefficient communication and silos, allowing at the same time the reduction of policy fragmentation and the subsequent uncertainties. From a more specific perspective, data analysis tools can support decision-makers in understanding different aspects of bike mobility (through the analysis of bike-related data) and in identifying dependencies among factors that could influence directly or indirectly bike mobility and its adoption. In this sense tools and models to simulate how decisions and policies can potentially impact on traffic and mobility would offer predictions and the possibility to compare different scenarios. This would allow decision-makers to make choices with minimal negative impact and to minimize related costs. Finally, effective visualisation of information is essential; a dashboard offering map layers, charts and graphs that summarise the status of bike mobility in the city would allow decision-makers to have, in a single view, the overall and relevant information they need to gain new insights about bike mobility in the city (e.g. type of road infrastructure/ bike paths, road safety level, traffic mix/sources, congested routes, cleaner routes in terms of air quality, greener routes, faster routes).

2.2 Bilbao

With an area of 41,60 km^2 and around 355,000 inhabitants, Bilbao is the heart of a metropolitan area that extends along the estuary of the Nervioén River with a population close to 1 million people. In the last 25 years, Bilbao has suffered an important urban transformation from an industrial economy to a city based on a service economy. This has helped to balance the city and provide a friendly environment for pedestrians with wider pavements, reduction of on-street car parking in the city centre, traffic light control system to cater for pedestrians and promenades for walking and cycling. Today, 65% of internal movements are produced on foot. In this context, the Sustainable Urban Mobility Plan (SUMP) [8] in Bilbao plays a significant role; its main objectives are:

- Reducing air and noise pollution.
- Improving safety by reducing accidents and fatalities.
- Guaranteeing universal accessibility.
- Improving energy and transport (passengers and goods) efficiency.
- Contributing to improve the attractiveness and environmental quality of the city.

Of particular interest is the "Pedestrian mobility strategy" aiming to promote non-motorized modes of transport (especially pedestrian displacement) since these best suit the sustainable mobility objectives. Part of this strategy is the transformation of Moyuéa plaza, for exclusive use of public transport, pedestrians, and cyclists, prohibiting private traffic.

What Bilbao is aiming for. To reach its objectives, the city of Bilbao aims to obtain a global vision of the city in terms of sustainable mobility, to take decisions based on updated data (predicting the impact resulting from applied measures), follow a more agile decision-making process (facilitating communication between stakeholders involved in the definition and development of the SUMP), translate measures impact into health and life quality indicators and access data coming from scattered sources that is automatically collected and integrated.

The role of disruptive technologies in Bilbao. In the context of Bilbao, it is essential that decision-makers can easily access the most updated data; in this sense tools that facilitate the connection of data sources and the data harmonisation (leveraging common and well-defined data models) would support decision-makers in their daily activities. Once data is collected, a data catalogue (as a unique point of access to the data) would offer the capabilities to search data considering different criteria; among them, the possibility to filter the available data by for example the "transport mode" would allow the decision-makers to reduce the time they spend to identify the data they need. Facilitated setup and execution of simulations (for instance, to forecast impact on traffic, mobility patterns or SUMP's KPIs resulting from a measure/policy applied) would support the decision-making process reducing the time spent in performing those simulations. Tools to create charts and graphs that summarise the status of mobility in the city from the sustainability point of view would allow the decision-maker to have, in a single view, the overall and relevant information to globally monitor the mobility in the city. On the other hand, the possibility to define and create customised KPIs and indicators would allow the decision-makers to fine-tune the dashboards with all the relevant information that they need to take into account in the planning of the mobility in the city. To this aim, checking if the data is updated would allow the creation of analyses and simulations based on correct information that represents the real status of the city, whereas pre-processing of collected data would reduce the time needed to setup the analysis and simulation for decision-making processes.

2.3 Helsinki

Helsinki, the capital of Finland, is a continuously evolving and developing city. In this sense a particular example is represented by the Jaétkaésaari area. The shore area of Jaétkaésaari, literally meaning "Dockers' Island", was previously used for industrial and harbour purposes; now it has gradually transformed itself into a residential area offering workplaces and services. At the same time, Jaétkaésaari is also a growing passenger and transport harbour due to its location (right adjacent to the centre of Helsinki). The harbour is the main connection between Helsinki and Tallinn, with growing mobility and opening of a new terminal in 2017. Annually 1 million private cars travel on the connection where a single main road leads in and out of Jaétkaésaari. This road feeds directly to the largest car commuting junction (70.000 cars daily) from the city centre to the western suburbs of Helsinki, creating interference. The Jaétkaésaari area is emblematic of the overall development Helsinki is facing, in particular, concerning mobility. In this context, to correctly cope with this evolution, the City of Helsinki's traffic planning and traffic management need up-to-date and high-quality traffic information to support data-driven decision making. In addition, proactive and forward-looking approach is needed as the population of the metropolitan area grows and traffic situation changes.

What Helsinki is aiming for. In this context, the City of Helsinki aims to check the status of traffic and its development, analyse how traffic could evolve, perform traffic forecasts, simulate traffic planning and land use, check the development and implementation of new infrastructures and policies, develop a master plan for city development (e.g. land use, mobility, housing). To reach these objectives it is essential to establish a unique view and understanding among traffic planning and urban planning, allowing the exchange of information among different departments (overcoming information silos). In doing so, the city of Helsinki faces some issues related to the availability of different map layers with different information representations moving from a department to another, the lack of people with competences for demanding analysis, the lack of time to get deep understanding of data and problems related to obtain raw data to be analysed with external tools.

The role of disruptive technologies in Helsinki. A data catalogue as unique point of access that brings under the same umbrella the data produced by different departments would simplify the discovery and access of needed data, avoiding complications caused by scattered repositories managed by different departments of the same organisation. The data catalogue could leverage tools for the integration with existing ICT software and applications. This would allow on the one hand, the automatic check of information (e.g. automatic detection of inconsistencies in the data, such as missing mandatory fields, infringement of time constraints about updates) and on the other hand, the automation of repetitive tasks (e.g. extract relevant information and provide it in a more usable manner). Leveraging the data made accessible it would be possible to define pre-packaged simulations that need only minor operations to be executed (e.g. few parameters and/or initial input data). This would simplify the use of this kind of technology by personnel without specific competencies and skills who would be able to set up an entire simulation from scratch, and reduce the time needed and the acceptance of this technology, since the personnel will not spend too much time to learn how to use it.

2.4 Messina

The metropolitan area of Messina is one of the most extended urban areas in the south of Italy and the first in Sicily and counts over 620.000 citizens. In the city of Messina alone, there are over 250.000 inhabitants and most of them are commuters between Sicily and Calabria regions. Geographical peculiarities (the geographical shape of the city of Messina is stretched for 32 km beside the Tirrenian sea, and tight between its hills and the sea) and its role of main connection point between Sicily and the Italian peninsula have a huge impact on mobility in the city of Messina. The local transport system of the city consists of sea transport (hydrofoil and ferry boats fleets) and land transport (buses, tramway and rail transports network), operated by public and private companies. One of the main issues that affects both kinds of services (sea and land transport) is the lack of interoperability among the different departments of the Municipality that are involved for different reasons in the management of the mobility.

What Messina is aiming for. Concerning mobility, the main challenge of the city of Messina for the upcoming years is twofold: on the one hand, to build mobility services able to fulfil the needs of citizens, dwellers, commuters and visitors, allowing them to move around and through the city seamlessly; on the other hand, the challenge consists in optimising the management and interaction among the different mobility and monitoring systems and services available in the urban area of the city of Messina reducing the waste of resources and costs for the Public Administration. A particular attention is paid on light mobility (e.g. extension of the cycle network with new bike-lanes and links between the centre and suburbs zones of the city to spread the use of bicycle mobility [2]) and pedestrians (definition of an integrated system of pedestrian areas and paths).

The role of disruptive technologies in Messina. The different Departments of the Municipality would benefit of a unique data-access point to their data, avoiding the complication generated by the need of accessing scattered data sources (for instance, in the case of data hosted and managed in different repositories for the different departments). This would simplify the discovery of and access to the data needed by the decision-makers. In this context, tools to facilitate the connection to data sources (also from third parties) are vital. Data is the fuel of any activity related to analysis, simulation and the more information is available (not only in terms of amount but also in terms of variety), the more accurate and precise can these analysis and simulations be. In this context, advanced smart devices and virtual devices [7] (abstracted component characterized by specific high-level functionalities) offer the chance to access the needed information with the most appropriate frequency and accuracy, avoiding information overload and allowing a more efficient computation. In the management of urban mobility, analysis and simulations would support decision-makers in the identification of potential solutions (such as multimodal paths and possible intervention to increase public safety) [1] and hidden problems (such as related to public transportation and for planning maintenance interventions of road and public transportation vehicles). Customisable dashboards to represent the information a decision-maker needs would allow to obtain a clearer view of the status of mobility, supporting the decision-making process in the most appropriate manner. Finally, the possibility to share information (such as data, results of analysis/simulations, map layers, charts, graphs) with people working in the same or a different department would improve the collaboration and the efficiency of the decision-making process, overcoming inefficient communication and information silos.

3 CONCLUSIONS

Despite their specific peculiarities such as organisational approaches and mobility needs to be satisfied, the cities of Amsterdam, Bilbao, Helsinki and Messina have some commonalities in terms of potential application of disruptive technologies that can help their decision-making processes. The main aspect that emerged is related to the need of data, as a vital element to perform any decision-making activity; in this sense it is important to underline that here the need is related to the easiness of accessing the data, that in most of the cases is scattered, or represented using different data structures with non-uniform standards. Uniform access to the data drives to another common point among the four cities, that is the exploitation of the possibilities offered by simulation tools, in particular to forecast and predict the impact of decisions taken on traffic and mobility (such as the building of a new road, the creation of a LTZ). This kind of technologies would allow the decision-makers to better design mobility solutions and policies, giving the possibility to tackle complex problems and to evaluate the implications of new policies. The third common point is the data visualisation. Accessed data and results obtained from simulations and data analysis must be visualised in an easy-to-understand manner, this includes not only the data visualisation per se, but also the possibility of creating customisable dashboards in which the decision makers can arrange the information they need and represent it according to their preferences. From the result here summarised, it is possible to clearly identify a chain of needs with their corresponding solutions. The first link of the chain is the need of **accessing data**. Here tools facilitating the connection to data sources and the integration with existing IT systems can offer a valuable solution to overcome information silos and to build a unique data-access point to available data, allowing also the harmonisation of the data thanks also to common and well-defined data models and highlight the relevant information reducing the time to find it. The second link of the chain is the **analysis of the data** made accessible through the previous step and the execution of simulation. Here it is important to highlight that beyond the possibility to perform analysis and simulation, availability of tools that simplify and reduce the time needed to set them up play a key role. In this sense, pre-packaged simulations ready to use, that guide the users in their setup, and tools, that allow the creation of customised KPIs and indicators, represent an advantage for the decision-makers. The third and final link of the chain is the **data visualisation**. Here, tools (e.g. Wizards) guiding the users in the creation of charts, graphs, map layers, etc. offer the opportunity to speed up the decision-making process by reducing the time of interpreting and understating the information. At the same time, the possibility to visualise different data in the same view through customisable dashboards offers the chance of obtaining a bird's-eye view on the information that is relevant for each decision-maker, according to their specific needs. Considering the reported results, a final consideration can be made; even if cities could be characterised by a different IT maturity level, the most suitable way to effectively improve mobility decision-making processes is not a single technology, but a combination of disruptive technologies, that glued together unlock their respective potentialities and benefits.

ACKNOWLEDGMENTS

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An Overview of Transport Modelling Approaches – A Use Case Study of Helsinki

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ABSTRACT

In this paper a general view to transport planning approaches have been articulated with a focus on the simulation models. To this end, different analytical methods have been investigated with regard to the scope of target policies, geographic scales, and modelling techniques. The paper also provides an overview to the transport planning approaches which are specifically applied in the City of Helsinki in close relation to the land use policies. Besides, further discussions have been included to shed light on the approach URBANITE project is seeking. Although there is still a need for overcoming the challenges regarding data-driven decision-making, we see a potential in the project's approach to foster the use of disruptive technologies for accelerating the uptake of the evidence-based policies.

KEYWORDS

Transport planning, scales of analytics, policy-making, transport modelling in the City of Helsinki, simulation

1 INTRODUCTION

Transport planning plays a major role in defining the way public resources such as funds and spaces are used. Transport plans are mainly applied to understand the strategic capacity and consequences of high-level democratic decisions. Hence, it is important to consider the political and societal preferences of relevant stakeholders including citizens [1]. This also explains the urge for developing transparent, open-source, and simplified solutions in order to evoke citizen engagement and public participation [2]. Moreover, the advantage of transport planning models most probably lays in the fact that the scope of identified solutions by these models are inherently geographic [3]. Geographic analysis and tools speed up the uptake of new technologies due to the power and potential to provide evidence for interventions in transport planning [4].

In the following, the different approaches to tackle transport problems based on analysis levels will be addressed. In section 3, a schematic framework for transport planning approaches is suggested with the focus on analytical and simulation techniques.

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Furthermore, the transport planning techniques applied specifically by the City of Helsinki is included here. Section 4 discusses URBANITE project's global view and argues the advantages and challenges ahead of mobility decision makers.

2 TRANSPORT PLANNING APPROACHES

There are different approaches to analyze characteristics of a transport network and to evaluate the outcomes of the strategic and/or ad-hoc interventions with the transport. Ni [5] considers the geographic scales of transport planning models and proposes a framework which can enable multiscale traffic modelling which can be seen in Figure 1. In another study, Vassili [6] compares the transport analysis tools based on the scope and complexity of research area and highlights the importance of distinguishing between Analysis, Modelling, and Simulation (AMS) tools. Some of the tools for each scale of geographic analysis are already suggested in Figure 1. In addition to the geographic scale, the purpose of policy making processes to tackle a specific problem is also an important criterion in defining the right approach. Larger geographic scale of analysis can be chosen to support policy making with less data granularity [7]. However, it is reasonable to opt for micro-scale analysis when dealing with ad-hoc interventions in a specific area. This, on the other hand, becomes demanding on obtaining more detailed and comprehensive data.

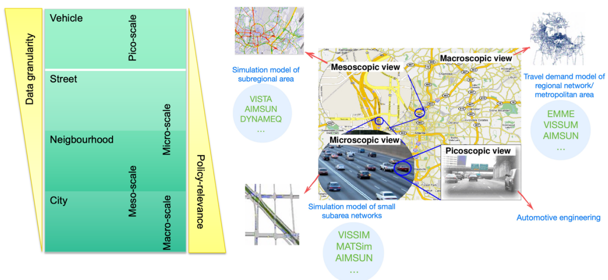

Figure 1. Scales of Transport Planning Approaches; Tools & Solutions

3 TRANSPORT PLANNING APPROACHES

De Dios Ortúzar and Willumsen [8] structured the transport planning approaches into five main stages as problem formulation, data collection, modelling and analysis, evaluation, and implementation of the solutions. In this paper, a new schematic framework is formulated based on Dios Ortúzar and

Willumsen's approach in Figure 2. The framework is modified in accordance with the approach of Helsinki Region Transport (HSL) and URBANITE's global view to provide a clear understanding of current applied techniques as well as a basis for the comparison of the two approaches.

Australian Road Research Board [9] categorizes the problem-solving techniques into analytical and simulation techniques. The research implicates that the analytical techniques are sort of closed form mathematical equations which provide statistical results such as forecasts and predictions. On the other hand, simulations are physical mathematical models, the results of which is to project objects moving around in a transport network. It is also possible to check the network state at different time stamps [9] & [10].

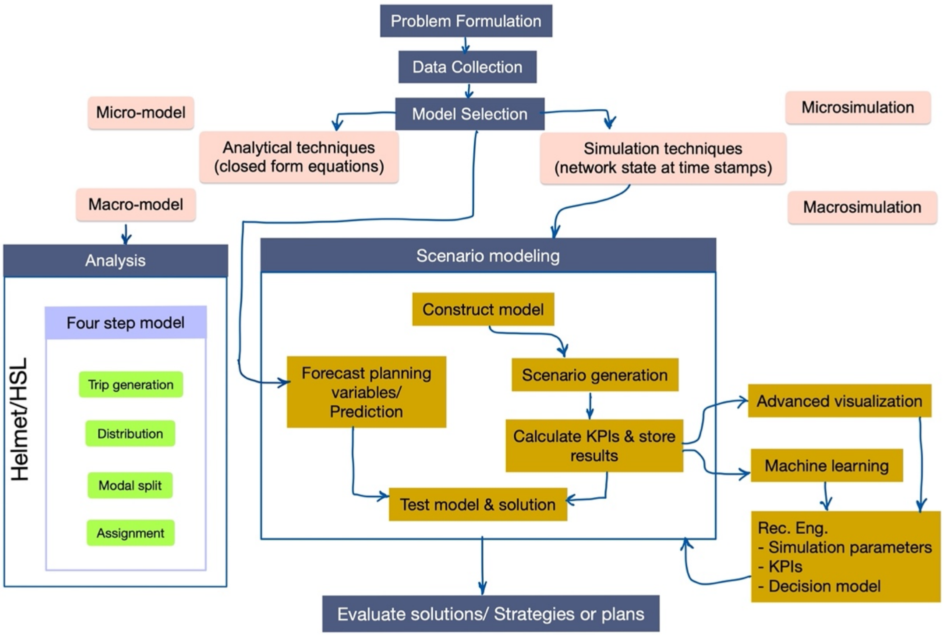

Figure 2. Proposed Schematic framework for Transport Planning[1]

4 TRANSPORT PLANNING – Use Case of Helsinki

The techniques used by the Helsinki Region Transport (HSL) follow an analytical approach to enable strategic transport and land use planning for the city. The model is called "HELMET" and is built with the help of proprietary tool EMME[2]. The statistical mathematical models in the field of transport models are usually referred as travel demand models when considered on a macro-level. These models have Four Step Transport Model (FSM) as the basis although they have evolved to more advanced levels to encompass the intelligence of models' agents [11]. The last version of HELMET model is therefore considering agent-based modelling (ABM) approach when it comes into trip chains analysis [12].

Helsinki Region Transport (HSL) developed its Sustainable Urban Mobility Plan (SUMP) for the City of Helsinki in 2015[3]. In particular, this plan focuses on 1) strengthening the strategic capacity and effectiveness, 2) integrating transport and land use, and 3) clarifying transport policy choices as well as the roles of different modes of transport.

According to the SUMP of Helsinki and on the basis of interviews performed with the City stakeholders, the interrelation between transport planning strategies as well as land use policies has been come into our focus frequently. Stover and Frank [13] suggested that development of transport and land use affect each other continuously in a cycle which is illustrated in Figure 3.

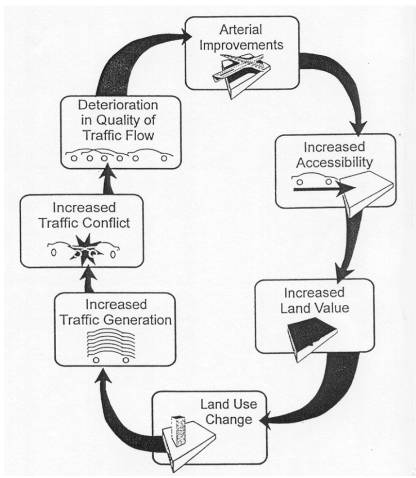

Figure 3. Transportation Land Use Cycle

[1] In blue: the main stages of transport planning processes; in yellow: URBANITE's global view
[2] https://www.inrosoftware.com/en/products/emme/
[3] http://www.bsr-sump.eu/good-example/helsinki-region-transport-system-plan-hlj-2015

Bearing this in mind, the proposed use case scenarios aim to find out the outcomes of the following decisions:

1. Intervention with the traffic network e.g., building a tunnel on the west harbor's junction to lead the main stream of heavy-duty vehicles caused by the arrival of ferries
2. Interventions with the land use in the area as it has been undergoing a lot of changes due to the constructions to turn the harbor into a dense residential area

The results of such analysis will help with understanding the causes of congestions and bottlenecks in the west harbor and serve as a tool for measuring the impacts of different policies on air quality and noise levels. Finally, the results will contribute to comprehending situational and statistical awareness which is one the main pillars of the City's Intelligent Transport System Development Programme 2030[4].

5 Discussions and Future Directions

URBANITE project aims to build microsimulation models which can help cities find out the outcomes of certain policies by applying new technologies and advanced techniques. Building transport models is demanding in terms of costs, time, data, and computation space requirements. However, URBANITE aims to take advantage of machine learning techniques as well of decision support systems to overcome these challenges. Hence, the models will be trained by the results obtained from simulations' input-output space exploration. Additionally, a recommendation engine will be built to provide decision makers with the relevant policies and KPIs tailored for their needs.

The approach facilitates data-driven decision making and will be fundamental in enabling real-time implementation and evaluation of solutions. Although there are still a lot of challenges regarding available data sources whether on the level of required infrastructure for gathering data or the quality of the available data. Recognition of the most relevant data sources and opening the data is a crucial step for the cities if they aim to realize evidence-based decision-making. The other challenge depends on the ability to include the benefits of all stakeholders esp. citizens in building technological solutions. In this regard, cities should come up with the ways to consider interests of all relevant beneficiaries and move towards participatory approaches.

ACKNOWLEDGMENTS

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URBANITE: Messina Use Case in Smart Mobility Scenario

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ABSTRACT

The urban transformation and the changes that the world is undergoing lead, today more than ever, to the need to make faster and more timely choices in the field of mobility management. Technology is therefore essential for providing decision support tools that help managers and politicians to better manage cities. The European project URBANITE (Supporting the decision-making in URBAN transformation with the use of disruptive Technologies) aims to put in place a sustainable mobility with the support of disruptive and innovative technologies for this sector. The proposed study describes the URBANITE project with reference to the technologies and the strategies implemented in the city of Messina. As a partner and pilot use case, in the municipality of Messina, software tools have been created starting from a series of local data regarding traffic and public transport tracking. These tools allow technicians to quickly view traffic status or bottlenecks for public transport on a map.

KEYWORDS

Urban Transformation, Disruptive technologies, Urban mobility, URBANITE project, Decision making, Data Access, Data Analysis, Data Visualisation.

1 INTRODUCTION

In the context of Smart Cities it is crucial to pay attention to issues relating to mobility. Today Smart Mobility allows people to optimize their travels by reducing the stress associated with them, while Sustainable Mobility helps to protect the environment by improving the quality of life in Smart Cities. Institutions around the world are implementing policies that allow to decrease CO2 emissions. The issues of mobility and its optimization are therefore protagonists in the identification of these policies. In particular, the European Commission encourages projects in the field of Smart Mobility and Sustainable Mobility with H2020, Horizon Europe and the Next Generation EU programs. The URBANITE project was financed within the H2020 funding program. Among the objectives of URBANITE the main one is to promote the use of disruptive technologies in the nascent Smart Cities in technological terms through the use and analysis of Big Data, AI algorithms, etc. An innovative element, however, is that related to the promotion of innovative tools for participatory decision-making processes such as the Laboratory Social Policy (SoPoLab). The aim of the project is to provide the Stakeholders of the project with a series of innovative technological tools in order to support the decision-making processes of managers of public administrations and companies. Within the project there are four pilot cities: Amsterdam, Bilbao, Messina and Helsinki. In each of the pilots, the needs are studied and analysis tools developed which will then be applied to each of them. As regards the city of Messina, analysis were conducted on traffic and its effects on local public transport. This work describes the reference scenario and the actions implemented for the municipality of Messina within the URBANITE project regarding the purely Information Computer Technology (ICT) aspect. In particular, in section 2 the state of the art of the technologies studied and applied to achieve the objectives is described. Section 3 introduces the reference scenario. In section 4 the tools implemented will be illustrated, while in section 5 the final considerations and future developments are reported.

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2 STATE OF THE ART

In [1] a case study concerning the home-office mobility of the University of Messina staff is discussed. The home-work commuting of public employees in the city of Messina is one of the main critical issues related to daily life. Traveling at particular times of the day causes both traffic congestion and pollution. Authors analyze different performance indicators to be used for the design and development of Smart Mobility services by adopting FIWARE technologies. After analyzing the travel habits of workers at the University of Messina, authors described how FIWARE can lead to an agile development of Smart Mobility services capable of minimizing traffic congestion, fuel consumption and CO2 emissions. In [2] authors describe the results of a Sustainable Mobility project in Messina. The presented application aims to encourage citizens to use low-impact vehicles instead of private cars. Through a partnership between different stakeholders a digital application to assign citizens electric bikes was developed, free of charge for a limited time period. Authors describe cyber security issues, both in terms of secure authentication for citizens that access the service and tracking of the whole assignment process. The flow is described from the user's request to the e-bike restitution. The adopted solution uses two-factor authentication (2FA) and Blockchain as the main technologies in the implementation phase. Innovative and advanced smart devices and virtual devices are described in [6]. Authors have designed, for one use case in the city of Messina, an abstracted component characterized by specific high-level functionalities. The system offers the chance to access the needed information with the most appropriate frequency and accuracy, avoiding information overload and allowing a more efficient computation. In this case it is important the access control and the security of the data. An interesting work for this purpose is described in [5]. In [3] authors show the use of customized generic Edge devices to carry out multiple activities at the same time, also focusing on how the proposed solution can lighten the work of cloud infrastructures. The presented concepts were implemented and tested in a real use case in the city of Messina by means Function as a Service (FaaS) paradigm. The proposed work allows users to perform multiple tasks on the same device. Applications such as vehicle counting, license plate recognition, object identification, etc. are proposed. In the considered use case two cameras were connected to a Raspberry PI 4 and the performance was compared. It is possible to connect different sensors to the proposed Edge devices and imagine each sensor as a different service. In [8] authors introduce a tool for studying mobility data. The basic principle is that technological innovation has led to the spread of various data tracking systems. The data are accumulated and can be used in various applications such as the analysis of mobility, urban planning and transport engineering. It is possible to use the data to extract information in matters relating to rough space-time trajectories, or by relying on statistical "laws" governing human movements [4]. However, authors do not neglect the attention to user privacy [7]. From the study and development comes an interesting Python library used in URBANITE for the analysis of mobility data in particular in Messina use case. From the state of the art it emerges that the city of Messina has been the subject of various scientific studies that have found practical application. Various national and European grants made it possible to achieve relevant innovations in the field of mobility. It is not clear how the data collected can be useful to administrators and managers in the decision making phase. This paper, therefore, want to synthesize and demonstrate how, thanks to URBANITE project, it is possible to put together what is already present in the systems of the city of Messina, creating the basis for the creation of new useful decision-making tools.

3 REFERENCE SCENARIO

The URBANITE project was created to provide communities with a long-term sustainable ecosystem model. Through a co-creation strategy we want to bring stakeholders (civil servants, citizens, etc.) closer to the use of disruptive technologies in the field of mobility. This model is supported with a data management platform and algorithms for data-driven decision making in the field of urban transformation. Furthermore, the model is validated by pilot mobility use cases in the context of the proliferation of sharing services. The URBANITE platform encapsulates the experiences of four pilot cities and acts as a junction point to create a unique analysis model for cities. Thanks to the platform it will be possible to have information regarding mobility that can be as a support in order to take serious technical and practical decisions.

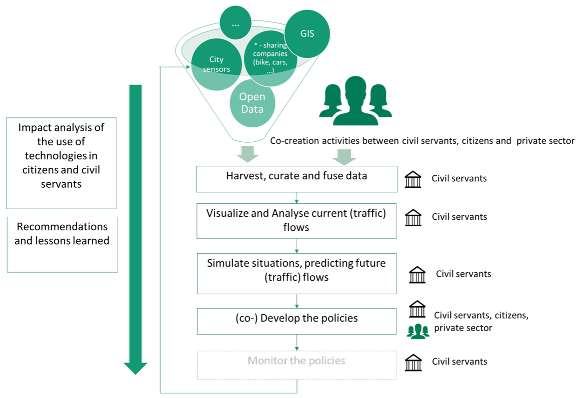

Figure 1: Urbanite Approach

In each pilot the data, useful for the mobility analysis, were analyzed and collected. The data considered funcional are collected on a single data storage. Thanks to different visualization and AI techniques/algorithms, the data were processed and made possible to create decision making tools that currently need validation (Figure 1). The use case regarding the city of Messina is described below.

3.1 Briefly on Messina Use Case

The metropolitan area of Messina is one of the most extended areas of the south of Italy, the first in Sicily and counts over 620.000 citizens. The city counts over 250.000 citizens and most of them are commuters between Sicily and Calabria. The local transport of the city of Messina consists of both sea transport (hydrofoil and ferry boats fleets) and land transport (buses, tramway and rail transports network). They are managed by public and private companies. The main issue that affects both kinds of services (sea and land transport) is the lack of facilities that can permit interoperability between different departments of the municipality and the communication with citizens and stakeholders. In order to overcome this problem, the Municipality of Messina is investing in intelligent infrastructures and services for the city and citizens. In particular, the main activities are focused on vehicle access detection in LTZ (Limited Traffic Zone) and pedestrian areas, centralised traffic management based on smart lights, traffic flows and analysis, incentives to use public transportation and video surveillance. URBANITE, for the city of Messina, is focusing on light and pedestrian mobility. Concerning the light mobility there are two main action lines:

(1) the extension of the cycle paths and the spread of bike mobility (but the main goal is to promote the use of bicycles and to offer better services to citizens)
(2) create new bike-lines and links between the centre and suburbs zones of the city.

Regarding pedestrian mobility, the objective is the definition of an integrated system of pedestrian areas and paths. Furthermore, from a wider perspective concerning public transportation, the city of Messina aims to extend the transport network in urban and extra-urban areas. The use case scenario in Messina (Figure 2) aims to evaluate the effects of the extensions of the public transportation services in terms of frequency, itineraries and stops on traffic and multi-modal transportation. In particular, a comparison of the impact on traffic between the different version of the public transportation network was performed. Moreover, the scenario includes an analysis of the suburban roads around the city of Messina (that represent an important connection with the surrounding towns) in terms of traffic congestion and connection with public transport network.

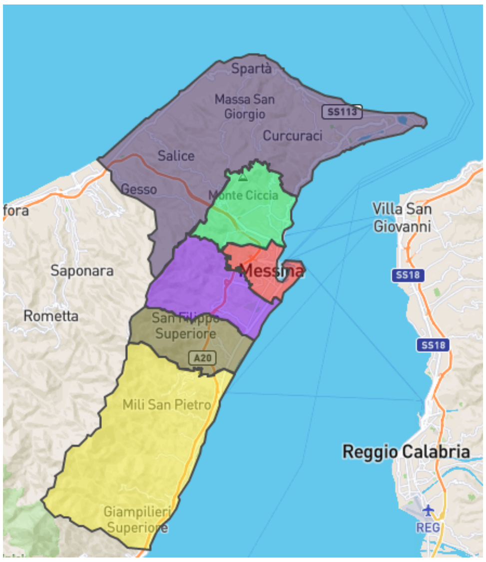

Figure 2: City of Messina

3.2 The URBANITE Architecture

The architecture created within URBANITE is made up of several abstract components that interact with each other. Thanks to the interaction between the different components, it is possible to provide all the tools necessary to achieve the objectives of the project. In Messina this architecture has been enriched by building new dedicated components, at the Edge level, which fully integrate with the existing Cloud ecosystem as shown in Figure 3, in which these components are highlighted.

In particular, for the Messina Edge Components, a local component called *Messina Data Storage* has been added. This component acts as a support for the parent component *Data Storage & Retrieval* (reported in URBANITE Cloud Components) through the *Data Harvester & Preparation* and is filled with data by the *Data Importer*. The *Data Processor* allows both to expose the data via Restful API and to process them ensuring correct formatting. Finally, within the *Urbanite UI*, three new specific components for the Messina use case have been built: *Messina Traffic Evolution*, *Messina Traffic Flows*, *Messina LPT Critical Areas*.

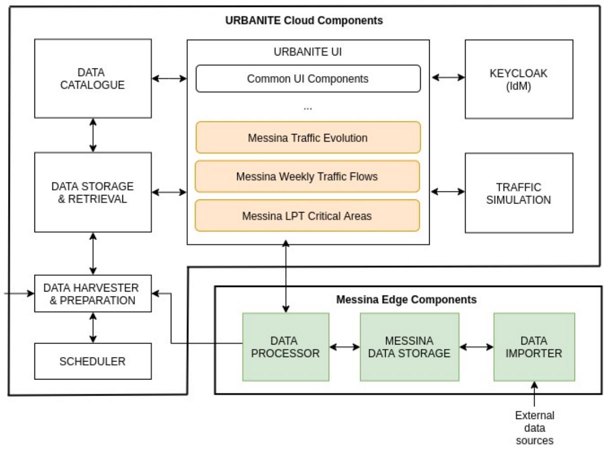

Figure 3: URBANITE Architecture - Messina

4 MESSINA IMPLEMENTATION

The use case scenarios described in Section 3 are accessible thanks to the functionalities provided by the URBANITE UI, the integrated URBANITE's framework at the UI level. The different analysis and visualizations provided aim to help the municipality's technicians in the extension of the current public transportation network. The tools allowing the users to interact with each visualization by filtering and querying the underlying data. Concerning the traffic congestion analysis for the municipality of Messina, Figure 4 depicts the temporal evolution of traffic flow on selected roads entering or leaving the city of Messina.

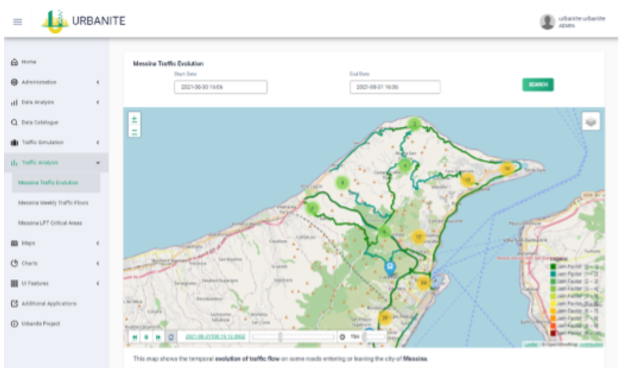

Figure 4: Messina Traffic Evolution

The traffic jam factor of each road, in a specific time of the day, is represented by the colour of the road itself, following the provided legend. Data used to this purpose are acquired and stored for real-time and historic analysis. Figure 5 illustrates the comparison analysis of the jam factors on two different roads of the city considering the time window of a week.

Figure 5: Messina Weekly Traffic Flows

The data source is the same of the previous analysis, but this time the purpose and the target users are people with a more technical background. For each road, if the road is bidirectional, the dashboard provides a chart for each direction using a different symbol for each one. The colors indicate the jam factor value. Finally, to identify areas of Messina where vehicles of public transportation are stationary for a certain time in a specific observation period, the heat-map analysis, depicted in Figure 6, is provided.

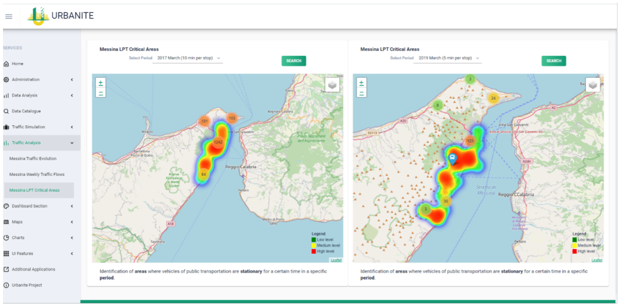

Figure 6: Messina LPT Critical Areas

To investigate if public transportation means use to be stationary in the same place for different time periods, the dashboard allows to compare two different time slots. In this case the data source is an historic database for the bus and tram position of the Local Transport Company. The data are elaborated with the scikit-mobility [8] Python library with the aim to obtain the heat-map visualization. In each described visualization, in order to have further information, the dashboard allows to visualize Points of Interest and Public Transport Stops on the map.

5 CONCLUSIONS

This paper describes the current state of the ICT systems put in place for the URBANITE project as regards the case of the Messina pilot. From the first results it is evident that, thanks to the use of data analysis and their appropriate visualization, it is possible to obtain information that is often difficult to understand. The visualization methods allow for immediate analysis and support decision-making policies. Thanks to the presented tools, in fact, it is possible to determine the effectiveness of the mobility policies used compared to the past, thanks to the historical harvested data, and possibly try to improve them. The next step will be to extend the functionalities. The scenario of each single pilot must be applied to all the case studies of the project. Moreover, it is necessary to improve smart algorithms in order to have responsive systems even in real-time. Finally, the system will make the APIs available for open-data, giving other scholars or stakeholders the possibility to carry out analysis or develop innovative solutions.

ACKNOWLEDGMENTS

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Data commons in smart mobility – the road ahead?

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ABSTRACT

Mobility data collection and governance are mainly dominated by larger technology companies that gather all the data. Therefore, they also have exclusive control over what happens with the data. This calls for alternative data governance models. A viable alternative, introduced in recent years, is the data commons model. With this model, people can share their data on their own terms, while maintaining a certain amount of privacy. This model has been used with health data and scientific data, however, no viable example of a mobility data commons has thus far been found. This paper explores how local governments can facilitate a mobility data commons. And: is the commons a beckoning road for all of us?

KEYWORDS

Data governance, disruptive technologies, mobility data management, digital literacy, data commons, policy making.

1 INTRODUCTION

In the last decades, the concept of a smart city has grown in popularity both as a research subject and in government policies. Cities all over the world have started using technology to look for solutions that enable transportation linkages, mixed land uses, and high-quality urban services with long-term positive effects on the economy and sustainability of the city [1].

Smart cities are built on data. And one area where the generation and analysis of data have steadily increased is the mobility sector. App-based mobility services, like bike-sharing, scooter-sharing, peer-to-peer carsharing, and ride-hailing gather enormous amounts of information about how, when, and where people travel. And not only sharing apps, also other apps like weather apps or wayfinding apps generate data. Plus not only 'smart solutions' generate data but also 'regular' cars and bikes are becoming more and more mobile sensors in the city landscape by offering, to name just a few examples, 'tracking services' in case of theft, and cameras helping people to park.

In this context the City of Amsterdam aims to be a smart and mobile city, offering a large supply of mobility options; affordable, reliable, and accessible to everyone. However, most mobility data are enclosed by private companies, while the data generated by these services can be of great public value. As the city of Amsterdam is also part of the 'cities coalition for digital rights' and aiming to be a number one city in the protection of its citizens digital rights, Amsterdam is looking for good examples in the governance of data and cocreation of public value together with citizens, local stakeholders and SMEs.

Considering the context, and considering the role of the municipality, this paper explores the following question: can or should a local government organize a data commons in order to enable parties to share data in a trusted, fair and economic way, while observing privacy and security concerns? This paper therefore shortly explores the 'why' and 'how' and evaluates the applicability of a data commons as a disruptive technology and framework. This paper is based on existing literature and interviews with experts from the municipality of Amsterdam and is structured as follows: section 2 will start with some background information to support the research question. In section 3 the concepts of a smart city and data commons are explored, and section 4 will present the conclusions.

2 BACKGROUND

In the last couple of years, data have become a valuable asset to our economy. Some have claimed that the world's most valuable resource is no longer oil, but data [23, 49, 53]. A new form of capitalism has arisen where wealth is generated based on the accumulation, extraction, processing, and use of data.

The term Big Data has been on the rise since the start of the new millennium. Enabled by new and innovative technologies, companies can gather and analyse data from their customers or users and use it to their advantage. Digital data and information have become a critical economic, political, and social resource and most of this data is in the hands of just a few companies such as Amazon, Google, Facebook, and Apple [41, 43]. With this data, these few companies can have huge control and influence over human behaviour and societies. As a response, politicians, human rights movements and people in general have raised concerns about the misuse of their data. For many, it is not clear how much data these companies collect and what they do with it. As a result, people opt to not share anything with anyone and have started hoarding their data. However, data can be of great value for everyone if used in the right way. In the near future for instance, Artificial Intelligence will have to use data to play a role in the delivery of services [36]. If this data stay in the hands of big tech companies, the positive effects may never reach citizens.

As a digital rights city, therefore, it is of importance to look for new technologies that enhance public value and public benefit at the same time [43]. Citizens should have the power to decide on who they want to share their data with, under which rules, for

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what purpose and in a transparent manner. Data are (too) often regarded as a resource to be extracted for private profits, and technical developments have enabled technology firms to capture data from and about those who have not consented or have no viable alternatives. The view on data therefore must change from an asset that can offer a competitive advantage, to one of public infrastructure to ensure common welfare, which can be exchanged equally.

For this research, a smart city is defined as "A well defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of wellbeing, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development". The city of Amsterdam has already become an example of how a smart city strategy can be implemented. With the above mentioned definition in mind, the main goal of smart cities is to improve the quality of life for its citizens in a sustainable way. At the same time, citizens also have the potential to be the main component of data acquisition. With the use of smartphones, the citizens can act as human sensors and help gather enormous amounts of data [29]. ICT can act as a platform to collect information and data to promote an improved understanding of how a smart city is functioning in terms of services, consumption, and lifestyle. Especially with mobility data, the input of citizens can be of great value [30].

While the potential of big data is explored on a daily basis in the development of new and possibly disruptive technologies, the potential societal disruption and ethical concerns attract less attention or even denial and/or apathy. This while multiple studies show that, with the creation of intelligent mobility systems in smart cities, the potential for intrusive surveillance is increased [31] and that the types of data used are privacy-sensitive [32]. Location history data, for instance, can act as an identifier of its users [33, 34]. Also bias in data can be a multiplier of societal injustice, as the Dutch 'toeslagenaffaire' [35] has shown, framing approximately 26.000 parents as possible fraudsters, based on their (second) nationality. Also multiple organizations may have multiple policies and rules regarding the protection of the data of their users. However, this is not always transparent - while it may lay in everyone's interest to share this data [36]. Therefore, one of the main challenges of the use of big data are privacy, transparency, and bias.

3 Data Commons

There are various definitions in use for commons and also for data commons. In general, the Nobel prize winning work on commons by Elinor Ostrom in 1990 is used as a reference for any such definition. Ostrom successfully described the commons as a governance model rather than open access to resources and introduced the commons as a framework to value various historical and contemporary social movements. In short one can define the commons as a commonly owned and managed (common pool) resource. More elaborate, Ostrom identified 8 design principles of stable common pool resource management in her groundbreaking work 'Governing the commons. The evolution of institutions for collective action.' [3, 6, 18, 19, 27].

3.1 Design principles data commons

Principles can be described as general rules and guidelines which a system architecture must follow to be as productive and cost effective as possible. Principles help guide the use and deployment of an architecture. Also principles may help identify concerns stakeholders might have that a system can address. Each principle should have a rationale and implication associated with it. This can help with promoting the acceptance and understanding of the principles [10, 25]. Here, we adapted and 'translated' 7 of Ostroms 8 design principles - in a first attempt - to rationales and implications for data commons [5].

(1) Define clear group boundaries:
  - *Rationale:* Who can use the data should be clearly defined and should be easily identifiable
  - *Implication:* An individual using the commons may require identifying information before allowing access to the commons. Additionally, the data sets should be easily identifiable. With this in place, poaching can be easily detected [23].

(2) Match rules governing the use of common goods to local needs and conditions:
  - *Rationale:* The rules of governing the data commons should be matched to the local needs of the users. Since no data commons and its environment are the same.
  - *Implication:* Setting up the rules and guidelines of the use of the commons should include the local users of the commons. Therefore, citizen participation is a crucial part of a successful commons.

(3) Ensure that those affected by the rules can participate in modifying the rules:
  - *Rationale:* Both the data producer and user should be able to benefit from the data commons and be protected.
  - *Implication:* All parties within a data commons should be able to change the conditions of the data commons, with agreement from all parties. The use and production in the data commons should always be in balance.

(4) Make sure the rule-making rights of community members are respected by outside authorities:
  - *Rationale:* The rules and regulations of the commons should be respected by the local authorities, must be recognized as legitimate by the authorities.
  - *Implication:* Local authorities shouldn't be able to change the rules without the consent of the parties involved.

(5) Develop a system, carried out by community members, for monitoring members' behaviour:
  - *Rationale:* Monitoring of the data commons is needed to ensure that the data is used fairly.
  - *Implication:* Unauthorized use of the data should be detected. In the case of a data commons, this could be a moderator, since the commons are not in a physical place. Ideally, this is done by the user community.

(6) Use graduated sanctions for rule violators:
  - *Rationale:* Users and producers in the data commons that violate its rules should not be banned directly.
  - *Implication:* A gradual system needs to be set up.

(7) Provide low-cost accessible means for dispute resolution:
  - *Rationale:* When issues within the commons come up, the dispute would has to be resolved in an informal, cheap, and straightforward manner. This way problems are resolved, rather than ignored
  - *Implication:* A process for conflict resolution should be created that is perceived as fair by all users of the data

commons. A mechanism for rule enforcement and for dealing with violators needs to be set up and discussed by all involved parties.

Concerns

The incorporation of the above-mentioned design principles can be a measure of success when organizing a data commons. But can they also be used to address the concerns the relevant stakeholders might have?

3.2 Citizen participation

Since citizen participation is a necessary step when organizing a datacommons and is essential for two design principles of a successful data commons, a major concern when it comes to a local government organizing or facilitating a datacommons is the participation of citizens. Is this a 'contradictio in terminis' or can and should the government act as a facilitator or incubator? Looking at the participation ladder by Arnstein [2] there is, indeed, a world to win, also calling for a different role of the government: a 'co-creating government' or 'co-city'.

Figure 1: Levels of participation

Transparency

Another important concern is transparency; in order to achieve a successful mobility data commons, the municipality needs to be transparent about every part of the data commons. To achieve full transparency, openness of all operations within the data commons is required, so that citizens if needed, can hold the consumers of the data accountable and are allowed to withdraw their consent [24]. However, measuring transparency within a data commons can be a tricky task. The question is not only how much information is available and under which terms, but is also a question of equality in the accessibility and usability of that information. Transparency is increased when the data within a data commons is given a proper context and, therefore, its users can use and understand the data without confusion. Transparency should cover all of these aspects of data access: physical access, intellectual access, and social access [13]. In the case of a data commons, physical access can refer to the ability to reach the content of the commons, social access is the ability to share the content of the commons and intellectual access is the ability to fully comprehend the content [7, 4], sometimes also referred to as 'digital literacy'. Not only in Amsterdam, but in more cities in the digital rights coalition, the Covid-19 pandemic and subsequent lockdowns showed that a lot of families don't have access to technology when public services like libraries and schools are closed. And how can Amsterdam residents take ownership over their data if they don't have access to technology, know where to access their data or how to object to their data being used? By introducing a 'digital agenda' [41] the city of Amsterdam is working on overcoming this divide and promoting and protecting digital rights, yet agency is complex and scattered. Also, the use of data and which algorithms are used should always be disclosed to the contributors of the data. Amsterdam has made a first step by introducing an 'Algorithm register' [16]. But can a commons be organized in such a way that no one has access to a contributor's data without their permission?

Monitoring and validating

This also raises the question if local governments can organise the monitoring of the use and validation of data. A solution could be implementing an interoperable context-aware meta-databased architecture [15]. This type of architecture is context-aware and allows permissions and policies to be attached to the data. Additionally, due to its flexibility, trust norms can be changed and can account for increased transparency and accountability. This is an architecture that associates data with user permissions and policies which enables any consumer to handle the data in a way that is consistent with a contributor's wishes [21]. This is a method that could increase accountability in a decentralized data ecosystem like a data commons. However, this method does thus far not provide a way for community members to contribute to monitoring the behavior within the community.

Concerns

Interoperability is a practical, yet very prominent concern when organizing data commons [7, 8] since a data commons is not only about access to data, it is also a platform for data experimentation and interaction. Technically, a data commons is a repository of personal manifests that describes the access and usage rights of all data generated by an individual within a digital service. Therefore, the data commons must regulate relationships between the organizations and individuals that use and share ownership of the data. This way, data commons help citizens having a say in what data they want to share and under which conditions. Also data commons could provide users easy access to their own data, information about who has access to their data and what they could do with this information. However, for this to be successful also trust needs to be built between the different parties participating in the commons. As our last concern we raise the question on the definition and the narrative. The commons, although part of an important and impactful historical movement, that, amongst others, created the guilds in the Middle Ages, the common land movement in the UK and, more recently, knowledge commons Wikipedia [11], mutuals like 'broodfondsen' in the Netherlands and citizen energy communities in most European countries, are not part of our current, dominant, narrative. Although he European Union and Dutch government have legal frameworks in place for several types of commons - in housing and energy for instance- no real understanding of the potential public value or even clear definition of a data commons currently exists.

4 CONCLUSION

For now, the larger technology companies dominate the data collection in the area of mobility. As a result, these companies have exclusive control over what happens with the data the citizens of a city generate. In this paper we described how this 'enclosure' of data by big tech builds a powerful value driven case for cocreating and/or facilitating commons in mobility data as a local government. Although a clear pathway on how to organize a mobility data commons is not yet available, the road ahead is one of cooperation, building trust between participants and experiment. By taking it one step at a time, setting clear boundaries and rules that are understood by partners involved and, obviously, involving citizens in every step. However, considering digital literacy and other possible constraints for citizen participation, careful thought on how to involve citizens -for a longer period- is paramount. One suggestion would be to just 'follow the music': there is a vibrant movement of active citizens communities and SMEs in town, how can the local government cooperate towards the creation of a data commons in mobility as a spill-over effect from these efforts? This way data commons can prove to be an alternative for apathy and distrust in big tech, contributing to a strong and growing narrative on local cooperation.

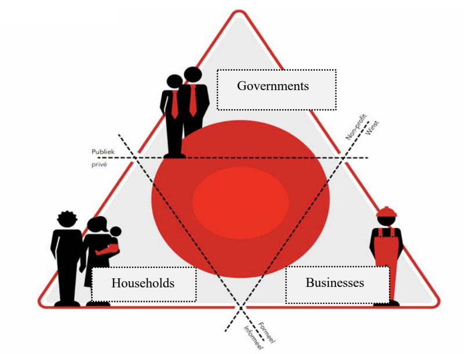

Figure 2: the third sector model [37]

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URBANITE Mobility Data Analysis Tools

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ABSTRACT

The decision-making process in the policy making should rely on data driven evidence, in most of the cases the raw data needs to be processed to transform it into actionable information. For this purpose, several tools have been developed within the URBANITE project to transform urban mobility data into usable information. Specifically: (1) traffic prediction models based on historical data, (2) Origin-Destination (OD) matrix estimation models and (3) a methodology to analyse the locations visited in several trajectories.

KEYWORDS

Traffic prediction, Origin-Destination Matrix Computation, Data Analysis, Artificial Intelligence.

1 INTRODUCTION

URBANITE project goal is to provide tools for the decision-making in the urban transformation field using disruptive technologies and a participatory approach. These tools should aid the process of taking decisions guiding it on data evidence. The main features of the URBANITE architecture include:

- **Modularity**, i.e., each component provides specific functionalities and exposes clear interfaces,
- **Adaptability** to heterogeneous city and region contexts and ICT maturity levels, from complete implementation to complementary add-on components.
- **Interoperability**, i.e., vertical, and horizontal interoperability among modules and with existing systems.

And using the European standards as much as possible.

The main elements that URBANITE offers are the following:

Social Policy Lab – an environment to promote digital co-creation with methodologies and methods to support the communication among public servants, private companies, and citizens. The aim of the Social Policy Lab is to develop joint ideas and to produce co-creation guidance for policies. **Data Management Platform** – to provide automatic support to the whole data processing chain and its life cycle, starting with the collection process all the way up to the use of the data. **Decision-Making Support System** – powerful tools which combine multiple data sources with advanced algorithms, a simulation engine, a recommendation, and visualisation system. These tools include predefined analysis pipelines to be used by non-technical users, intuitive and understandable visualisations, and setups to perform simulations of new mobility policies and situations that allow their evaluation. URBANITE is implemented in four different use cases: Amsterdam, Bilbao, Helsinki, and Messina.

The analysis tools that are presented in this communication belong to the Decision-Making Support System. More concretely they belong to the set of algorithms designed to obtain information from the historical data stored in the URBANITE Data Management Platform. The results obtained from these algorithms can be used to understand better what is the state of the mobility at a given time, or, alternatively, they can be used as input for simulations of new policies.

Among all the tools within the Decision-Making Support System three components are explained in this communication, namely: traffic prediction, OD matrix estimation, and trajectory location analysis. These components are discussed in the following sections, sections 2-4. This communication ends with some concluding remarks in section 5.

2 TRAFFIC PREDICTION

Road traffic forecasting has been a topic of study since the sixties [1] when time series analysis methods where mainly used [2][3][4]. In the last two decades, heuristic machine learning methods [5] started being used allowing to find more complex relations within the traffic data. Nowadays traffic prediction component has become one key tool for any ITS system. The component developed within the URBANITE project can forecast what is the traffic flow that a sensor within the city would measure for a given set of features.

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The set of features at the time of this communication include the day of the week and the time of the day but other ones are in the process of being incorporated. Some of these features include if the day of the forecast is a bank or school holiday, weather features (precipitation and temperature), the arrival of ferries to Helsinki port or sport events (soccer games) in Bilbao (using the method developed in [6]). Note that the approach within URBANITE is not to consider previous measurements as features since the data is not available in real time. Therefore, this approach can be considered as long-term prediction because the predicting horizon is only limited by the accessibility of external features (i.e., access to a weather prediction for example).

Figure 1: Integrated tool to perform traffic prediction showing the Helsinki use case.

The web portal to the integrated tool can be seen in Figure 1, the tool allows to train a new model, to perform a prediction and to visualize the results.

The process of performing the training implies that the user needs to choose the following:

- The regression model type, two options are available: random forest [7] and distribution inference [8] (only for features with discrete values).
- The number of features to consider: 1. considers only the day of the week, 2. also considers the time and so on.
- The time resolution, typically either 5 or 15 minutes. This is the aggregation period on which the individual counts of vehicles moving over the sensor are combined to produce a time series.
- The traffic sensor, this is chosen by selecting the available sensors within a map.
- The period of the training data, the period can be chosen from the available data within Data Management Platform, being able to change this period allows for instance to avoid choosing the anomalous period due to the restrictions due to COVID-19. In addition, a percentage of the training data can be reserved to test the goodness of the model, this percentage can also be specified.

Once a model is trained this can be used to perform a prediction, there are different ways to perform this, one way is to use the URBANITE web visualization tool to choose a given date and perform the prediction for either the following 24 hours or the following 7 days. Alternatively, specific set of features can be feed to the model using the REST Web service in JSON format to obtain a result at a given instant of time.

An example of the result can be seen in Figure 2 where in addition to the prediction (red line) the confidence interval is shown (orange band). The details of how to compute the confidence interval are explained in [9]. In the Figure the result of the prediction for a week is shown, where the peaks for the different days are clearly visible, including the difference in the pattern due to the weekend (fourth and fifth peaks in the series).

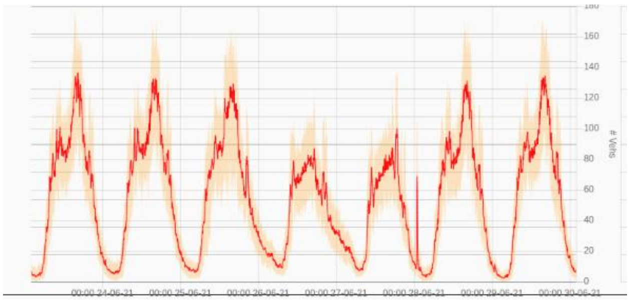

Figure 2: Detailed of the visualization for the result of the traffic flow prediction for 7 days including the confidence interval.

3 OD MATRIX ESTIMATION

The OD Matrix estimation works in a similar way than the prediction module. In this case we use data from bike rental city service, specifically we consider the origins and the destinations of each one of the rentals. These are both temporally and spatially aggregated by providing the time resolution (the same way as for the traffic prediction) and by providing a set of geographic areas where to aggregate the origins and the ends of each rental. These areas can be specified either via a GEOJSON or by specifying a set of points, the URBANITE web can be used to obtain the Voronoi areas [10] associated with those points and use those to perform the spatial aggregation.

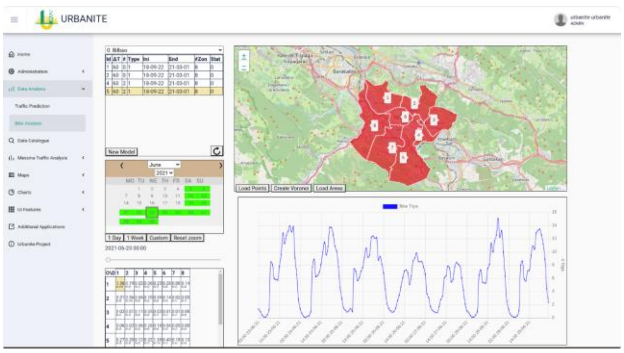

Figure 3: Integrated tool to perform OD matrix estimation for the Bilbao use case.

Training a model to perform OD matrix estimation implies choosing a regression model type, the number of features (in this case 0 can be chosen, which implies the use of only spatial information), the time resolution, and the period of training data.

The result of the estimation, at a specific instant of time, consists of a square matrix of size NxN where N is the number of different areas considered for the spatial aggregation. The web tool within URBANITE allows to compute and visualize these estimations for all the instants within a period (typically a day or a full week). In Figure 3 a detail of the web tool is shown where it can be seen the result at a given instant in the form of a matrix (lower left hand side) and the time evolution of one of the matrix components for a whole week (lower right hand side).

It is worth mentioning that this process to estimate OD matrixes, by means of the use of regression algorithms, have the capability to generalize the values measured obtaining results even in regions of the feature space where no values have been obtained yet.

4 TRAJECTORY LOCATION ANALYSIS

Finally, the last component that we explain in this communication consists in a tool able to analyze not only the origin and the destination of trajectories but also what happens in between. More specifically, and to fix ideas, we can think this tool's goal to be obtaining the points more popular to visit in a trajectory. The processing consists in two different phases: the cleaning phase, and the aggregation phase.

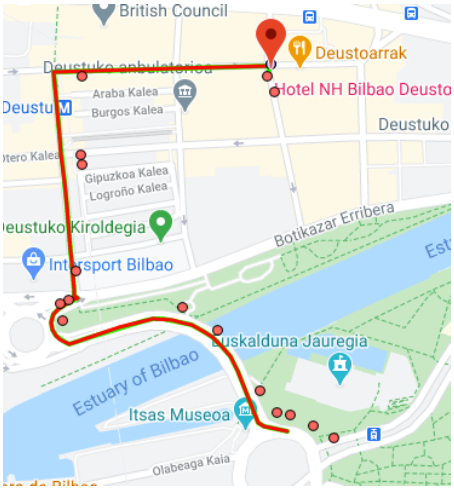

Figure 4: Result of the cleaning phase for a set of GPS points obtained from a single bike city rental in Bilbao.

The cleaning phase is a crucial phase when processing GPS data obtained from affordable, not very accurate sensors or in areas with tall buildings (urban environment) where the multi-path of the satellite signal can increase the noise of the measurements. The purpose of this phase is to align the obtained measurements with the navigational road network, i.e., the possible allowed positions for the vehicles. In URBANITE, Hidden Markov models [11] are used in this phase. Moreover, this process provides an additional result, which consists in the most likely points between measurements.

The second phase, the aggregation phase, compares the points obtained in the cleaning phase for all the trajectories. Probably the simplest of these aggregations is to compute the number of times a location is visited independently of the trajectory it belongs. The result of this process applied to the trajectories of the bike city service in Bilbao is shown in Figure 5.

Other types of aggregations can also be performed, as for example most likely points to be visited depending of the day of the week and the time of the day, the most popular chain of consecutive points visited, the longest route accomplished, etc.…

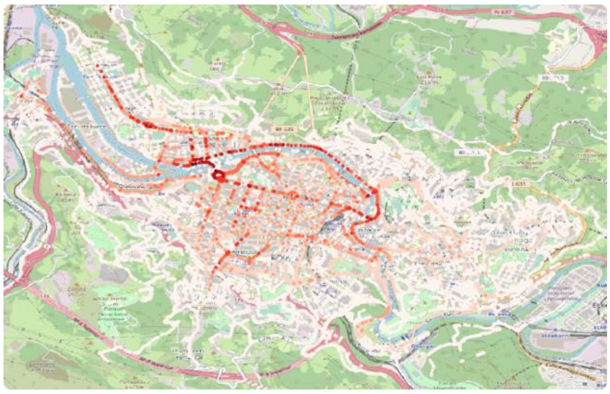

Figure 5: The most popular points corresponding to trajectory locations are labelled with darker color.

5 CONCLUSIONS

In this paper we have introduced three components developed within the URBANITE project to convert data into information. The first component is designed to obtain a prediction of the typical traffic flow at a particular sensor location given a set of features, the second component aims to produce OD matrixes from bicycle data and finally the last component consists in a methodology to analyse trajectory locations. These results have been achieved during funding project from the European Union's Horizon 2020 research and innovation programme under grant agreement #870338.

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Applicable European Regulations for Data-driven Policy-making

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ABSTRACT

Data-driven policy making aims to make optimal use of data and collaborate with citizens to co-create urban policies and, in general, to conduct a more reliable decision-making process. The European Commission considers data an essential resource for economic growth, competitiveness, innovation, and disposes as part of its strategy a set of regulations and guides, aiming to that more data becomes available for use while keeping the rights and trustworthy of the companies and individuals who generate and consume the data during the whole lifecycle. These regulations impact and open new challenges and opportunities when addressing the decision-making process in URBAN Transformation and specifically urban mobility as in the case of the URBANITE project.

KEYWORDS

Data, regulations, ethics, trustworthy, privacy, governance

1 INTRODUCTION

Urban mobility faces greater uncertainty and complexity in the long term generated by two main factors: the demand for growth in urban environments, the pressure for a more sustainable model of mobility in the face of the emergence of global warming. In general, we find that the social conscience is changing in favor of more equitable and sustainable ways, and the recovery of the space of the city for the people. On the other hand, the accelerated technological development in the transport modes and business models themselves, including innovations such as autonomous driving, micro-mobility, connected vehicles, electro-mobility, mobility as a service (MaaS), new vehicle ownership models, etc. mark specific challenges. in your deployment. These trends are changing the landscape of urban planning and mobility management in cities, incorporating new challenges. All of these require new advances in mobility planning processes and methods, with the aim of helping public administrations and policy makers to better understand this new context, supporting them in decision-making and policy definition. Policies should be discussed among the main actors in the new urban mobility scenario: citizens, service providers, public servants and political leaders.

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This scenario can be built on two pillars: 1) co-creation sessions and 2) empirical analysis on stakeholder trust, attitude, impact, benefits and risks in the use of disruptive technologies. Now, traditional technological solutions are no longer valid in this situation, and disruptive technologies such as big data analysis or artificial intelligence emerge as a promising support to those responsible for formulating new policies. Data-driven policy making aims to make optimal use of existing heterogenous data and collaborate with citizens to co-create policy. This opportunity entails specific challenges to favor the acceptance by users of the results obtained through the application of these technologies and, first, to collect the relevant data from the different local stakeholders. These are some of the objectives of the URBANITE project, to face challenges, attitudes, confidence and opportunities in the use of disruptive technologies in public services in the context of urban mobility.

URBANITE identifies several key results: a Social Policy Lab – an environment to promote digital co-creation and methodologies and methods to support the co-design and co-creation for policies, a Data Management Platform – To provide automatic support to the whole data processing chain and its life cycle, starting with the collection process up to its use and a Decision-Making Support System – Powerful tools which combine multiple data sources with advanced algorithms, simulation, recommendation, and visualisation.

The project identifies different stages from the perspective of data and more specifically, its availability, openness and privacy:

- 1st Stage- Setup of participation labs and initial gathering:
    - Open data currently available
    - including identification and recruitment of participants, the preparation of an informed consent procedure to implement for individual participation
    - The register and use of the virtual participation platform as a complement of previous sessions
- 2nd Stage. The potential use of existing non-open data, personal and non-personal on the cities to the objectives of the project.
- 3rd Stage. The transfer of collected data from 3rd parties, defining a transfer agreement among both parties (company and city use case)

2 RELATED EUROPEAN REGULATIONS

On the other hand, the European Commission considers data an essential resource for economic growth, competitiveness, innovation, defining an European strategy for data aiming to ensure Europe's global competitiveness, a data sovereignty, that more data becomes available for use, while keeping the rights of the companies and individuals who generate and consume the data during the whole lifecycle. As part of this support, the Commission has proposed some material as part of its data strategy, disposing several normative and guides to conduct a success and trustworthy data management.

2.1 Data Governance Act

This initiative refers to the management of personal as well as non-personal data, therefore being linked at the legislative level with the General Data Protection Regulation (GDPR)[1] and the Directive on privacy and electronic communications [2]. The European Commission has implemented a solid and trustworthy legal framework for the protection of data, in order to promote a single data market, for which it must guarantee that data from the public sector, companies and citizens can be available and used in the most efficient and responsible way possible, while companies and The Data Governance Act [3] is the first of a set of measures announced in the 2020 European data strategy, aims to promote the availability of data for its use, increasing trust between the parties and strengthening data collection mechanisms throughout the European Union. The DGA will also support the establishment and development of common European data spaces in strategic domains, involving both public and private actors.

The framework addresses the following scenarios:

- The transfer of public sector data for reuse, in cases where such data is subject to the rights of third parties. It establishes a mechanism for the reuse of certain categories of protected data from the public sector, which is subject to respect for the rights of third parties.
- The transfer of personal data with the help of intermediaries, whose work will consist of helping providers to exercise the rights conferred by the General Data Protection Regulation (GDPR). The objective is to strengthen trust in the exchange of personal and non-personal data, and reduce the costs of transactions linked to the exchange of data between providers and their consumers, with neutral facilitators,
- The transfer of data for altruistic purposes (making data available to the common good, on a voluntary basis, by individuals or companies). Establish a registration and consent in order to reduce costs and facilitate data portability.
- The exchange of data between companies in exchange for some type of remuneration.

2.2 ETHICS GUIDELINES FOR TRUSTWORTHY AI

Despite the fact that AI technologies are mature enough, their adoption by companies is very uneven, and in general, much lower than one would expect. There are obstacles that hinder the widespread extension of AI technologies, both cultural and technical. AI technologies will not spread massively until the scientific community is able to develop reliable technology from the user and from the different data providers. On the other hand, the use of these technologies involves risks that must be managed appropriately. To ensure that we are on the right track, it is necessary to abide by a human-centered approach to AI, without losing the goal of improving human well-being. The concept of trusted AI addresses reliance on technology as a first step. The new guidelines are aimed at all parties involved who develop, apply or use AI, encompassing companies, organizations, researchers, public services, institutions, individuals or other entities.

According to the regulations “Reliable AI has two components: 1) it must respect fundamental rights, current laws and essential principles and values, so as to guarantee an« ethical purpose », and 2) it must be reliable and technically sound , since a little technological mastery can cause involuntary damages, although the intentions are good ”.

Therefore, these Guidelines establish the framework of a reliable AI, guiding in three levels of abstraction, from the most abstract to the most concrete of aspects to be evaluated:

- Guarantee of the ethical purpose of AI, establishing fundamental rights, as well as the essential principles and values, which it must comply with.
- A series of guidelines, addressing both ethical purpose and technical soundness, listing the requirements for reliable AI, and providing a summary of technical and non-technical methods that can be used for their application.
- A concrete, but not exhaustive, list of aspects that must be evaluated in order to achieve reliable AI.

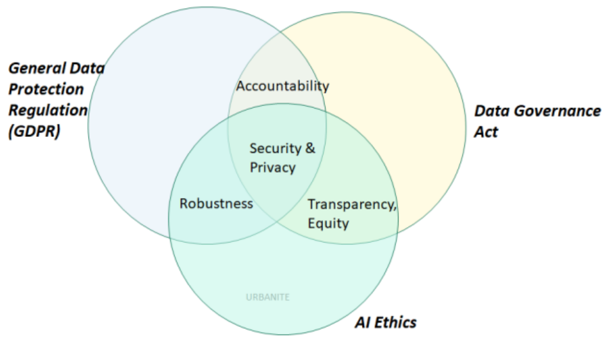

Figure 1: Relation and overlapping among regulations

According to these principles, the work package in charge of the definition, design and adaption of artificial intelligence and data analytics is ensuring that the applied methods meet the seven key requirements for Trustworthy AI:

1) human agency and oversight. URBANITE proposes a decision support methodology and supporting tool for policy creation, that combine and carefully balance different methods:
2) harvested historical data, GIS, expert knowledge, outputs of decision models, and others. The last word will remain in the hands of municipal experts, the platform being a tool to facilitate their decision. On the other hand, one of the pillars of the project is the implementation of a thoughtful space of discussion among the main actors of the new urban mobility scenario: citizens, service providers, public servants and policy makers.
3) technical robustness and safety. The work focused on the algorithms and simulations to be deployed, defines for as

objective metrics a pair of KPIs, refereed to the precision of predictions and the quality of recommended policies or procedures.

4) privacy and data governance, a fundamental right particularly affected by AI systems. Prevention of harm to privacy also necessitates adequate data governance that covers the quality and integrity of the data used. All the algorithms will work on the gathered data, just (pseudo) anonymised. If applied during the research stage on the algorithms, all the GRPR measures will be analysed and adopted to use personal data.
5) Transparency [7], the principle of explicability and encompasses transparency of elements relevant to an AI system: the data, the system and the business models: This implies traceability of decision along the whole cycle of data, from datasets, gathering, labelling and process, Explainability concerns will be considered for the methods applied, ensuring a better understanding of the underlying processes and related human decisions (e.g. xAI approach). In any case, the simulation and rules-based reasoning approaches, are well sited from the explainability point of view.
6) diversity, non-discrimination and fairness. URBANITE gather existing open data portals, geographical information systems (GIS), data coming from private data providers, the basis is any, comes in origin. SoPoLab sessions and use case evaluation support the feedback from stakeholders who may directly or indirectly be affected throughout its life cycle.
7) dedicated assessment of the algorithms during their design and use case deployment ensures the auditability.
8) environmental and societal well-being. In the last term, URBANITE provides a new decision-support system for Planning Sustainable Mobility and the early evaluation of urban policies. A Sustainable Urban Mobility Plans (SUMP), defines strategic plans based upon a long-term vision of transport and mobility, guaranteeing technical, economic, environmental and social sustainability.

3 ALGORITHMS ACTIONABILITY

Taking into account the previous regulations and based on previous experience in the context of Intelligent Transportation Systems [4], it is confirmed that aspects such as trust, precision and reliability, among other non-functional properties, are essential for predictive and analytical techniques to be practices in its use. We present the term Actionability, as the characteristic that any system based on data analysis or artificial intelligence must present to be implemented and used successfully in a real operating environment. This concept, in turn, identifies a series of desirable characteristics, which in URBANITE are contextualized in the field of urban mobility planning.

Data-based models are usually subject to uncertainty, involving non-deterministic stochastic processes, both in the learning, execution or training mechanisms / input data, and also present in the results. Once deployed, it is essential to provide an objective measure of the reliability and precision of the results, winning in terms of Trust. The need to explain and render the underlying analytical models interpretable is undoubtedly one of the research fields with the greatest impact, being considered under the concept of Explainable Artificial Intelligence [5][6] (xAI). This field of study comprises different techniques and methods, taking into account three fundamental factors: the nature of the model to be explained, from intrinsically transparent to completely opaque and unintelligible; the user of the algorithms; and finally, the way in which said explanation must be prepared and presented to the decision maker, which will depend on their degree of knowledge, as well as the intrinsic possibilities offered by the model to be explained in one way or another.

Adaptation is the reaction of a system, model or process to new circumstances, with the idea of maintaining its performance or reducing its loss, compared to the ideal conditions that were taken into account in its design and initial adjustment. The main problem in scenarios whose underlying phenomena change over time, without being addressed by the model itself, is that the conclusions, predictions or categorizations will not be reliable. This phenomenon is called concept drift [8][9].

Robustness refers to the ability of a system to maintain service when external incidents occur. In the case of urban planning, it will not be so critical, since the decisions to be made will not be made in real time; However, the data ingestion of the different data sets and available stores, if it must be operational, to minimize the loss of input data, in addition to being robust data algorithms in such loss situations, fluctuations in the frequency of the themselves, poor quality data, etc. In the URBANITE project, data quality is explicitly addressed through the implemented components associated with data preservation.

Stability means ensuring that there are no surprises for the user in terms of functionality. In general, the algorithms are worked in a specific geographic area and according to the available data sets. However, for their deployment in a real environment, it is necessary to project them to larger areas and volumes of data. This issue must be taken into account from the design stage of the algorithms, to optimize their algorithmic complexity, which represents the amount of resources (temporal, execution time and space, required memory) that an algorithm needs to solve a problem. This characteristic allows to determine the efficiency of this algorithm, not in terms of absolute measures but measures relative to the size of the problem. Currently, the availability of new technologies and paradigms of parallel and distributed processing of massive volumes of data, allows an escalation of the methods, obtaining adequate response times. However, its exploitation requires the adequate implementation and adaptation of the algorithms according to the architecture in which they will be deployed, as well as optimizing this deployment of analytical workloads in the different layers.

Another key feature is the compliance of the new methods with transportation engineering. Existing traffic and mobility engineering practices are well established, with a powerful knowledge base. A better understanding of the hybridization of data analysis and simulation methods, data-driven and model-driven approaches, by combining the strengths of each side, will help us improve the models by identifying more complex underlying assumptions. In general, the results are closely linked to the experiments carried out; transferability is a desirable characteristic for algorithms and any model, in order to present adequate performance and functionality in other contexts and starting data, different from those used in learning.

Finally, we cannot forget the contextual aspects identified by the EU for the definition of sustainable mobility policies, measures and solutions, as part of SUMP and any support tool, with the aim of contributing to urban regeneration, transport sustainability, social inclusion and social empowerment through active participation.

4 OPPORTUNITIES AND NEXT STEPS

Additionally, to the actionability requirements for our methods and algorithms, the new regulation and especially the Data Governance Act presents a set of topics or opportunities to explore from the different action lines. The following table presents some of them, according to the type of data to explore on the project: public, personal or altruistic data

Table 1: Challenges and Research Opportunities

	Public sector data for reuse	*Reuse of personal data*	*Altruistic purpouse*	*Data Sharing among business*
SoPoLab	Presentation of **Data Gobernance Act among local stakeholders**. **Engagement** of city departments, public transport service providers, collectives and final users on sharing data. **Identification of potential local "Data Sharing Providers"**.			
Data Management Platform	**Support of Data Gobernance functionalities** by the Urbanite Platform: - **Data exchange policies**. Establishment of policies regarding the exchange of data and events across the boundaries of an organization. - **Data ownership**. Opportunities or barriers to data and events between companies: IPRs, rights of access and exploitation, sensitivity, etc. - **Security and privacy**. Access and authentication, integrity, privacy. Etc.			
Decision support tools	**Explainable** IA-techniques. Other algorithms **avoiding the trasfer of raw data** between origin and the platform			

5 CONCLUSIONS

During the first period of the project, some relevant algorithms and data analysis have been identified based on the project's use cases. Having analyzed the different regulations around the exploitation, data management and artificial intelligence technologies, machine learning and advanced processing, the requirements that these new algorithms must present in the future have been identified. Finally, it introduces the concept of Actionability as a key property of any data-based modeling and treatment process to generate knowledge of practical value for decisioning. All these aspects open challenges and, also opportunities for URBANITE project.

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Supporting Decision-Making in the Urban Mobility Policy Making

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ABSTRACT

City mobility is changing rapidly due to population growth and disruptive technologies. To efficiently handle these changes, policymakers need advanced tools based on AI, including simulation, prediction, decision making, and visualization. In the URBANITE H2020 project, we are developing a decision support system (DSS) that is based on DEXi and enables the decision-makers to combine low-level mobility data obtained with simulation, into high-level attributes suitable for decision making and comparison of mobility scenarios. By providing the user preferences in advance, DSS can be also used in combination with machine-learning models to search for the best mobility policies automatically.

KEYWORDS

decision making, mobility, urban transformation

1 INTRODUCTION

The mobility in cities is changing rapidly. On one hand, the population in cities is growing which results in increased congestion and pollution. On the other hand, new and disrupting mobility modes are being introduced, such as vehicle sharing, hop on/off bikes, etc. The city policymakers thus face a very complex problem: how to improve mobility under growing congestion pressures, while considering new mobility modes [1]. Advanced tools that include artificial intelligence (AI) approaches can significantly help policymakers to select the most appropriate actions [4].

AI-based tools for city mobility typically include the city models and traffic simulation, which enables the users to simulate various traffic situations [3]. We are developing a system that will, besides city models and traffic simulation, include also a decision support system (DSS) [2] and a machine learning module. The decision support system will support the user, either human or algorithm, in selecting the best policy, while the machine learning module will aim at replacing human decision-makers with algorithmic ones. In this paper, we focus on the DSS of the URBANITE H2020 project [5].

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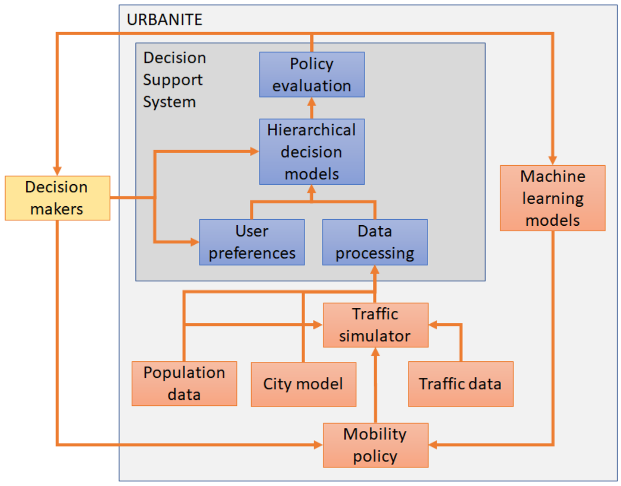

Figure 1: The architecture of the URBANITE system.

The developed DSS aims to enable the users to select the most appropriate policy actions based on data from simulations, population data, current and predicted traffic data, and user (citizen, decision-makers) preferences. By defining the user preferences in advance, it weights and hierarchically aggregates the basic data to obtain one or a few objectives, based on which the evaluated policies are compared and ranked. The policy ranking represents the key information for the final decision regarding which policy should be applied.

The rest of the paper is organized as follows. Section 2 presents the URBANITE system. The decision support system within URBANITE is described in Section 3. Finally, Section 4 concludes the paper with a summary and ideas for future work.

2 OVERVIEW OF THE URBANITE SYSTEM

The URBANITE system consists of several modules such as tools for the involvement of various types of stakeholders, including the general public. However, from the point of view of the presented decision support system, only the modules relevant for DSS are presented in Figure 1.

There are two main inputs to DSS. The first one consists of the expert knowledge, provided by the decision-makers. This knowledge is of key importance when building hierarchical decision models, as well as when defining user preferences (see Section 3 for details).

The second input consists of raw data including city models, population data, and evaluation results from the traffic simulator. Population data include the number of people in the urban area as well as their distribution between the districts. The city model consists of a map of roads, districts, public areas, etc. Finally, traffic simulation results are trip traces that include all the relevant data such as the (vehicle) positions, time, and pollution. These results are obtained by evaluating a mobility policy with the traffic simulator. To this end, the simulator processes the population data, the city model, and the past traffic data to emulate the characteristics of real-life traffic as much as possible.

The mobility policy consists of a set of actions to be applied within the urban area (such as closing a specific road for cars) and can be proposed either by decision-makers or by machine-learning models. Both take into account the policy evaluation, computed by the DSS. The main difference between the two approaches is the fact that decision-makers rely on expert knowledge and define the mobility policies by hand, while machine-learning models apply pattern-recognition approaches, process a possibly huge amount of data, and select mobility policies automatically.

Finally, the decision support system consists of several components that are described in Section 3.

3 DECISION SUPPORT SYSTEM (DSS)

Our DSS aims to evaluate mobility policies, i.e., for each policy produce one or a limited set of objectives that are easily interpretable and handled by the experts. Note that a baseline mobility policy is evaluated by the traffic simulator, but the evaluation provided by a standard simulator is very difficult to process by experts due to a large amount of data since the evaluation consists of traces of all the trips within the city. Therefore, the DSS aggregates evaluation data into meaningful high-level attributes to enable efficient and effective decision-making.

3.1 Components of the URBANITE DSS

The main component of the DSS is the hierarchical decision model (see Figure 1). A hierarchical decision model is defined by the experts/decision-makers based on their expert knowledge. It starts with the evaluation values, provided by the traffic simulator, and iteratively combines semantically similar attributes into higher-level attributes until only one attribute remains. This results in a tree structure in which the root represents the final evaluation of the policy. However, it is not required to always use the final evaluation during the decision-making process. In some cases, it is more appropriate to use several high-level attributes (e.g., pollution and congestion) to compare the policies in all the aspects that the decision-makers are interested in. In this case, the selected attributes are inner nodes of the tree structure.

To create the hierarchical decision model and to select the relevant attributes, user preferences have to be obtained. They are included in the module by experts/decision-makers. When creating the decision model, the preferences are used to weigh the attributes within the tree structure. More precisely, when combining attributes into a higher-level node/attribute within the tree structure, a utility function needs to be defined, which specifies how each combination of lower-level attributes transforms into the higher-level attribute. This is a preference-based process and typically involves combining qualitative attributes of various types.

Hierarchical decision models are not able to directly handle the city model data or the raw data obtained from the traffic simulator. Therefore, the baseline data need to be preprocessed and, if appropriate, aggregated. For example, if the city pollution is required as an input to the hierarchical decision model, it has to be calculated from all the trips within the city.

Finally, policy evaluation has to be executed. This is done by applying the preprocessed traffic simulator data within the hierarchical decision model. The resulting values of the high-level attributes, selected based on user preferences, are then sent to decision-makers or machine-learning models (see Figure 1). The hierarchical decision models, including their definition and execution, were implemented with DEXi [2].

3.2 Hierarchical Decision Model for Mobility Policy Evaluation

A new hierarchical decision model was developed by focusing on the needs and preferences of the URBANITE project [5], based on the user experience of four major EU cities. The model shown in Figure 2 was developed based on mobility policies that include building new roads, closing parts of the city like squares, setting up new lines of public transport including ferries, and other potential modifications of the city mobility. For a policy, three areas within the city were identified as relevant:

- Target area where the policy action is applied
- Nearby area that surrounds the target area and which is directly influenced by the applied policy
- The entire city

The attributes were divided into three categories:

- Road network
  These attributes measure the size of the city area where the policy action has a direct influence. They also consider the capacity of the affected roads and take into account both target and nearby areas.
- Population-related attributes including the type of the area and public transport data.
  Area type is defined with the position within the city (e.g., center, periphery), the district type (e.g. residential, commercial), and the population number. Public transport counts the available bus and underground stops, and the lanes of public transport. All these attributes are measured in both target and nearby areas.
- Policy impact
  It measures the change with respect to the baseline scenario when no policy action is applied. The following aspects are taken into account:
  - Change in air pollution
  - Change in the number of used private vehicles
  - Change in the number of used bicycles
  - Change in the number of used public transport
  - Change in the number of pedestrians
  In addition, it also takes into account congestion change. All the attributes are measured in both target and nearby areas, as well as in the entire city.

The developed model is intended to be used for both comparing the effects of applying a policy with the baseline as well as comparing the effects of various policies between themselves. As

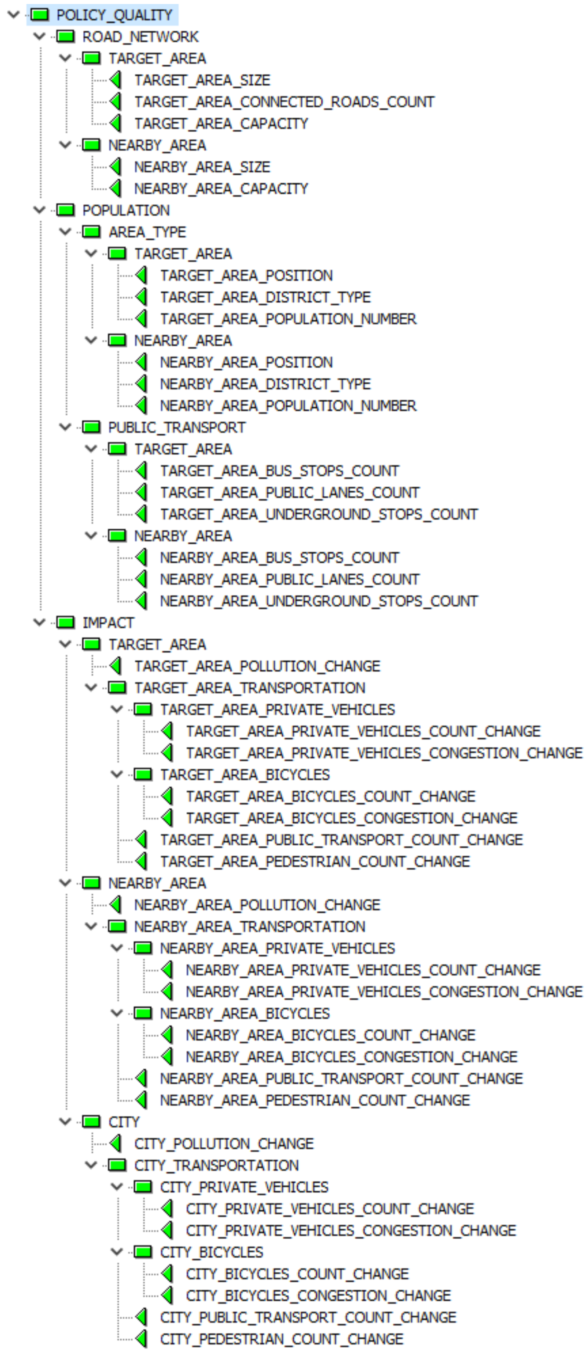

Figure 2: A hierarchical decision model for mobility policy evaluation.

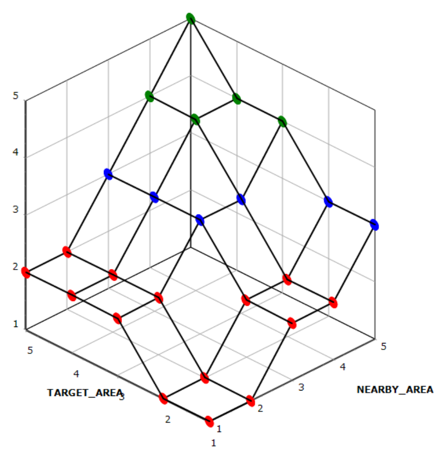

Figure 3: An example of the utility function for the selected attributes.

Option	WITHOUT_INTERVENTIONS	CLOSED_SQUARE
TARGET_AREA_SIZE	2	2
TARGET_AREA_CONNECTED_ROADS_COUNT	2	1
TARGET_AREA_CAPACITY	2	1
NEARBY_AREA_SIZE	2	2
NEARBY_AREA_CAPACITY	2	2
TARGET_AREA_POSITION	center	center
TARGET_AREA_DISTRICT_TYPE	residential	residential
TARGET_AREA_POPULATION_NUMBER	1	1
NEARBY_AREA_POSITION	center+districts	center+districts
NEARBY_AREA_DISTRICT_TYPE	residential	residential
NEARBY_AREA_POPULATION_NUMBER	2	2
TARGET_AREA_BUS_STOPS_COUNT	3-6	3-6
TARGET_AREA_PUBLIC_LANES_COUNT	3-6	3-6
TARGET_AREA_UNDERGROUND_STOPS_COUNT	1-2	1-2
NEARBY_AREA_BUS_STOPS_COUNT	7+	7+
NEARBY_AREA_PUBLIC_LANES_COUNT	7+	7+
NEARBY_AREA_UNDERGROUND_STOPS_COUNT	3-6	3-6
TARGET_AREA_POLLUTION_CHANGE	5% decrease - 5% increase	+20% decrease
TARGET_AREA_PRIVATE_VEHICLES_COUNT_CHANGE	5% decrease - 5% increase	+20% decrease
TARGET_AREA_PRIVATE_VEHICLES_CONGESTION_CHANGE	5% decrease - 5% increase	+20% decrease
TARGET_AREA_BICYCLES_COUNT_CHANGE	5% decrease - 5% increase	+20% increase
TARGET_AREA_BICYCLES_CONGESTION_CHANGE	5% decrease - 5% increase	+20% decrease
TARGET_AREA_PUBLIC_TRANSPORT_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
TARGET_AREA_PEDESTRIAN_COUNT_CHANGE	5% decrease - 5% increase	+20% increase
NEARBY_AREA_POLLUTION_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_PRIVATE_VEHICLES_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_PRIVATE_VEHICLES_CONGESTION_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_BICYCLES_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_BICYCLES_CONGESTION_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_PUBLIC_TRANSPORT_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
NEARBY_AREA_PEDESTRIAN_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
CITY_POLLUTION_CHANGE	5% decrease - 5% increase	5-20% decrease
CITY_PRIVATE_VEHICLES_COUNT_CHANGE	5% decrease - 5% increase	5-20% decrease
CITY_PRIVATE_VEHICLES_CONGESTION_CHANGE	5% decrease - 5% increase	5-20% increase
CITY_BICYCLES_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
CITY_BICYCLES_CONGESTION_CHANGE	5% decrease - 5% increase	5-20% increase
CITY_PUBLIC_TRANSPORT_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase
CITY_PEDESTRIAN_COUNT_CHANGE	5% decrease - 5% increase	5-20% increase

Figure 4: Definition of two test scenarios.

a consequence, some attributes focus on comparison with baseline, while others focus on differences among various policies.

Selection of the attributes and their organization into the tree structure is only the first step when building the hierarchical model. The second step consists of defining the functions that aggregate the lower-level attributes into higher-level ones, i.e., utility functions. All the attributes in the inner nodes of the tree were defined as categorical from 1 to 5, which facilitated the utility function definition. The default scale defined the higher the better, except for the pollution where the the-lower-the-better scale was applied. An example of the utility function is shown in Figure 3 that shows how the Target area attribute and the Nearby area attribute are combined into the Public transport attribute.

3.3 Evaluation of Mobility Policies

The hierarchical decision model, described in Section 3.2, was used to evaluate a test policy that prescribed that the main square of a test city should be closed. The effects of this policy were compared to the baseline, where no actions were taken.

First, both scenarios (no intervention and closed square) were simulated and the obtained results were preprocessed. Second, the data were inserted in DEXi as shown in Figure 4, where each column represents one scenario and colors represent the evaluation of single attributes (green: good, black: neutral, red:

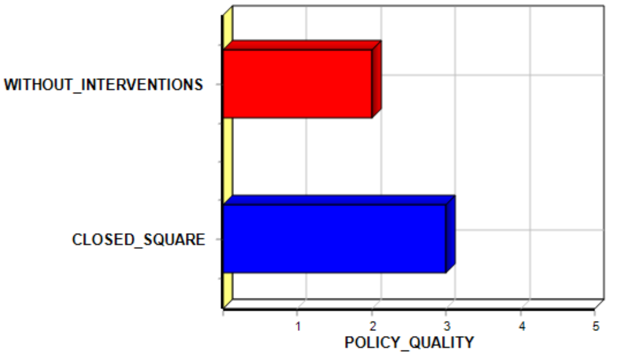

Figure 5: Comparison of the overall quality of the test scenarios.

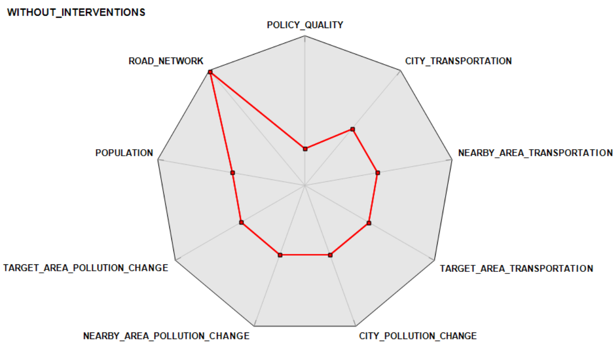

Figure 6: Evaluation of the scenario without interventions.

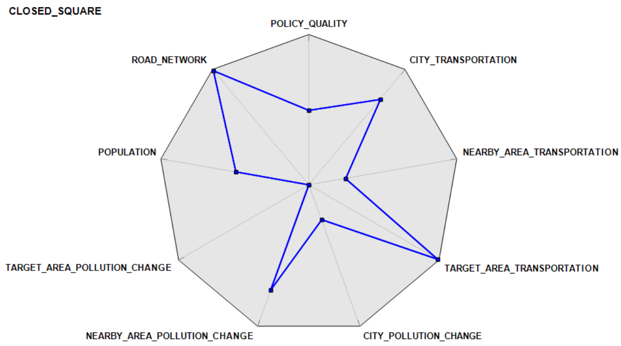

Figure 7: Evaluation of the scenario with closed square.

bad). This figure shows that the differences between the scenarios are in the target area roads and the impact attributes. The impact is negative only in a minority of attributes: in the nearby area and the congestion when observing the entire city (see the color change from black to red). On the other hand, there is a positive change in the majority of the impact attributes (black color to green).

The selected scenarios were evaluated both based on the overall quality and based on a set of the most relevant high-level attributes, i.e., inner nodes of the tree. The overall quality comparison is presented in Figure 5, while the comparison on the selected attributes can be found in Figures 6–7. These figures show that the overall quality of the closed-square scenario is higher in comparison to no interventions. As noted previously, for the pollution change in Figures 6–7, lower, i.e., near the center of the graph is better, while for other attributes, higher, i.e., near the edge of the graph is better. In these figures, we can observe a similar trend as in Figure 4. The difference is that in Figure 4 we compare the scenarios on basic attributes (leafs of the tree), while in Figures 6–7 we compare scenarios on the higher-level attributes (inner nodes of the tree). Finally, Figure 5 shows the comparison on the top-level attribute, i.e., the root of the tree.

4 CONCLUSION

Selection of the best mobility policy for a city is typically a complex task since the policy can influence a large variety of mobility aspects. In addition, simulation tools typically produce a large amount of data that needs to be appropriately preprocessed and aggregated. Consequently, a suitable approach for hierarchical aggregation of mobility attributes needs to be defined to get a low number of higher-level attributes that make the decision-making process feasible.

In this paper, we proposed to aggregate the mobility attributes with DEXi. DEXi applies hierarchical decision models that are defined based on expert/decision-maker knowledge. We developed a new hierarchical decision model that was then used for basic and multiobjective comparison of mobility scenarios.

This paper also presented a basic graphical interface for comparing the scenario outputs, while additional and more advanced GUIs are still under development. The evaluation of the developed decision model on a variety of mobility policies is ongoing and aims at determining whether the model is suitable for all the relevant scenarios. In case of discovered deficiencies, we will upgrade the model with additional attributes and/or attribute rearrangement.

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ABSTRACT

This paper describes the Data Management Platform developed in URBANITE H2020 project. This platform provides automatic mechanisms to harvest, curate, fuse and visualize existing open and proprietary data coming from different sources related to urban mobility and transportation (e.g. traffic data from cars, public transport, bikes or ferries; air quality and noise; events, parking, and so on).

KEYWORDS

Data harvesting, data curation, DCAT-AP metadata, data storage

1 INTRODUCTION

One of the main goals of the research carried out in URBANITE H2020 projects, is to provide algorithms, tools and models to support decision-making processes in the field of urban planning and mobility. This support is based on the analysis of the current situation based on harvested and fused data, on data simulations and the prediction of future situations when changing one or more variables. Hence, the availability of good quality data coming from heterogeneous data sources and its interoperability for data aggregation and fusion is highly important.

The Data Management Platform (DMP) provides the components for data acquisition, aggregation and storage. These components are:

- Data Harvesting, Preparation and Transformation covering the entire process of fetching, preparing, transforming, and exporting data for storage
- Data Anonymization to transform datasets in conformity with data protection requirements for further data analysis.
- Data Curation which deals with enrichment and annotation of data.
- Data Fusion and aggregation. Data aggregation is the process of gathering data and presenting it in a summarized format, e.g. to hide personal information or to provide information in a synthetic form. Data fusion is the process of integrating multiple data sources to produce more consistent, accurate, helpful information and sophisticated models than those provided by any individual data source.
- Data Storage & Retrieval providing the means to store and retrieve datasets, DCAT-AP compliant metadata, and related data.
- Data Catalogue offering the functionalities to discover and access the datasets collected and managed by the components of the URBANITE Ecosystem.

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2 DMP ARCHITECTURE

Figure 1 represents the component diagram of the Data Management Platform (blue rectangle) and its interaction with the other modules in the URBANITE Ecosystem.

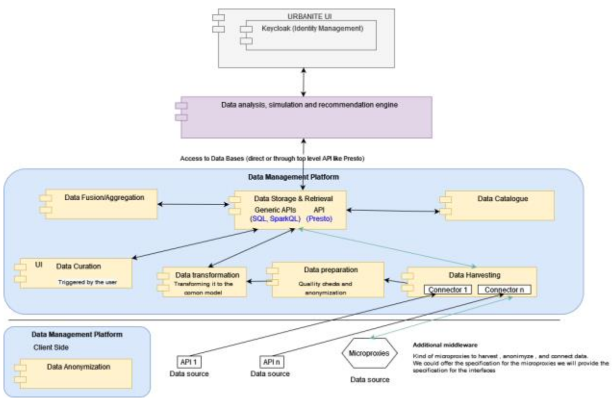

Figure 1. Component diagram of the DMP

3 IMPLEMENTATION

3.1 Data Harvesting, Preparation and Transformation

The process of fetching, preparing, transforming, and exporting data (from now on referred to as *harvesting*), i.e. providing a way to make heterogeneous data available in defined format and means of access, has been implemented following the form of a pipeline, as shown in Figure 2. This means that data is passed through the pipeline, and each component is agnostic of the other steps. This leads to lose coupling and improves flexibility allowing steps to be omitted if not necessary for a given data source. The pipeline has been implemented using the open source solution named Piveau Pipe Concept [1, 2].

Each of the components in the pipeline is implemented as a service that exposes a common RESTful interface. This way, services can be connected in a generic fashion to implement specific data processing chains. No central instance is responsible for orchestrating the services. A scheduler is in charge of launching the pipes and how services are connected together is specified in a JSON file known as the pipe descriptor.

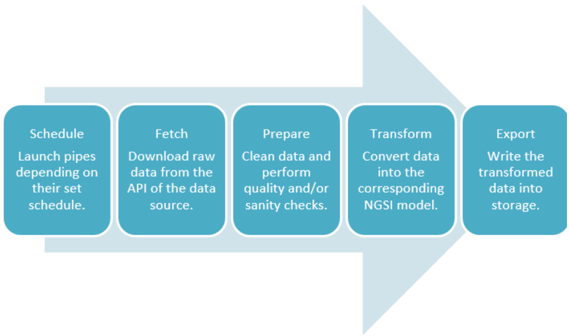

Figure 2. Harvesting process

In detail, the harvesting process would typically consist of the following steps:

1. The scheduler triggers a pipeline
2. The harvester retrieves the data from the source's API and forwards it into the preparation component.
3. After cleaning and validating, the preparation component forwards the data to the transformation component.
4. The data is transformed to the applicable NGSI data model and forwarded to the exporter.
5. Finally, the exporter writes the harmonized data into the data storage component.

The scheduler serves two main purposes: keeping track of existing pipe descriptors and managing triggers for these pipes. Each pipe descriptor is stored as a JSON file and contains a definition of components (endpoints, chronological order, specific configurations) that make up the processing sequence. Each processing chain is defined in one of these files. The scheduler reads these files to become aware of which pipes are available. These can then be assigned to a periodic trigger for recurring execution.

The data harvesting component is responsible for fetching data from a given API. It does not alter the data. It can be considered the entry point of the data into the pipeline. As such, a dedicated component is required for each type of data source. The harvesting component may implement pagination mechanisms for handling data in chunks. However, this does not impact the pipeline – each chunk is handled individually and does not depend on other chunks.

The data preparation component is responsible for performing initial cleaning and sanitation of the data provided by the harvesting component. This ensures a fixed level of data quality and integrity, which is required by the transformation component to operate flawlessly.

Data transformation is a key step in the harvesting pipeline. It cannot be expected that the municipalities provide their data in one of the common data models developed by FIWARE used in the URBANITE context. As such, the transformation of the heterogeneous data sources into common models is vital for frictionless processing of the data henceforth. For a flexible approach, the actual transformation instructions are loaded via scripts, either JavaScript for JSON based payloads or XSLT for XML based payloads. More engines can be added as pipeline modules at a later point in time.

An example of a pipe descriptor is provided in Figure 3. Each of the segments describes a service in the pipe. In the example there are three services, the first named *importing-bilbao-air-quality* that downloads Bilbao air quality data, the second named *transforming-js* that transforms the data according to a JavaScript file and the third one named *exporting-data-storage* that invokes the storage and retrieval component to store the data and its metadata in two dedicated repositories. The segment number field indicates the order in which the service should be executed in the pipe.

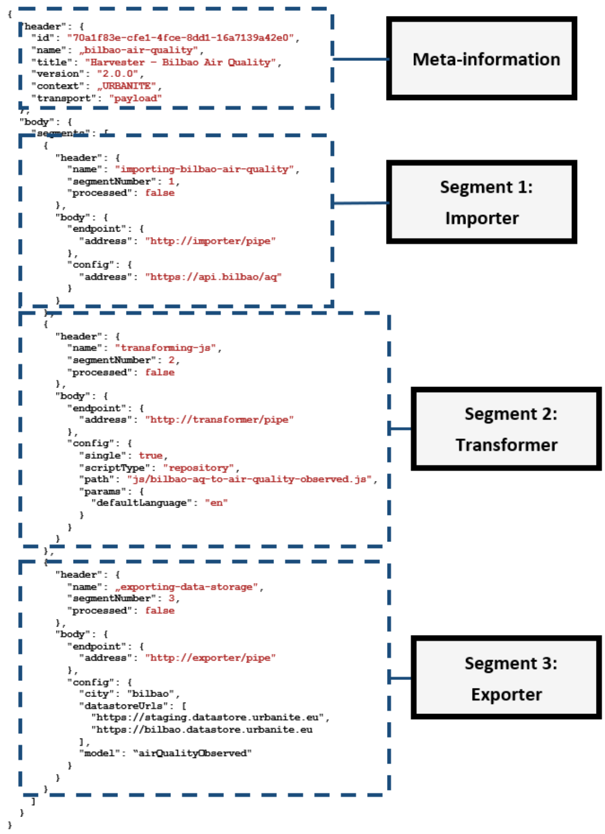

Figure 3. Example of a Piveau Pipe Descriptor

When a pipe is triggered the service in segment number 1 is called. Once finished, data that needs to be passed along the processing chain is written into a payload field of the next component in line. For smaller amounts of data this can happen directly, for larger amounts of data a pointer to an external datastore can be used.

3.2 Data Anonymization

The anonymization component is a RESTful microservice capable of transforming large datasets in conformity with data protection requirements for further data analysis. In order to achieve a certain degree of anonymization the user can mark specific attributes that are likely to reveal information about a person or a smaller group. Those identifiers are then transformed in a way that ensures a sufficient level of anonymization. Currently supported anonymization methods are suppression and generalization, which either delete attribute entries in a row or generalise them according to a fixed hierarchy, such as street -> zip code -> city.

3.3 Data Storage & Retrieval

The Data Storage & Retrieval component provides the means to store and retrieve datasets (transformed to URBANITE common data model compliant with FIWARE) and metadata (DCAT-AP). DCAT-AP [3] is used as the common metadata schema to describe datasets in URBANITE. Two repositories are used, one for the metadata and the other for the transformed data. This is shown in Figure 4.

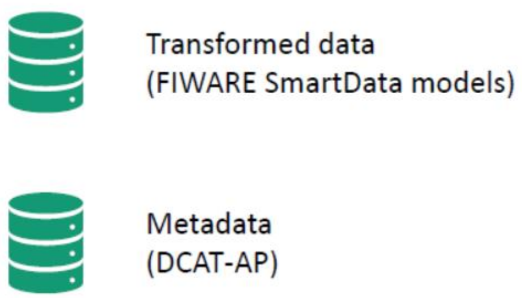

Figure 4. Data Storage & Retrieval repositories

The main concepts of the DCAT-AP model are catalogues, datasets and distributions. A catalogue represents a collection of datasets; a dataset represents a data collection published as part of a catalogue; and a distribution represents a specific way to access to specific data (such as a file to download or an API). This relationship is shown in Figure 5.

The concept dcat:Dataset informs about the title, description, access rights, creator, frequency, spatial/geographic and temporal coverage, spatial and temporal resolution, publisher, etc.

The concept dcat:Distribution provides metadata about the distribution, e.g. the property dcat:accessURL provides the information about how to access to specific data. Other important metadata related to the distribution are, for instance, the license, a description, the format of the data (e.g. CSV, JSON), etc.

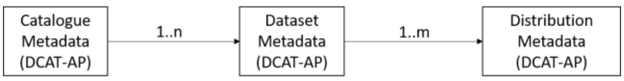

Figure 5. Simplified DCAT-AP Model

The Data Storage & Retrieval component provides REST APIs so that the Exporter of the harvesting process can store the transformed data. Besides, a new DCAT distribution is stored which is associated with the existing metadata of the dataset, with accessUrl equal to the API endpoint to access the transformed data. An example of this is shown in Table 1.

Table 1. Instance of a distribution in JSON-LD format


```
{
  "@id" : "https://urbanite-project.eu/ontology/distribution/009b9f0e-e780-4e9d-8153-520dc8943195",
  "@type" : "dcat:Distribution",
  "description" : "Air Quality information for bilbao day 2021-05-01 in NGSI-LD representation",
  "format" : "http://publications.europa.eu/resource/authority/file-type/JSON_LD",
  "license" : "http://publications.europa.eu/resource/authority/licence/CC_BY",
  "title" : "Air Quality information for bilbao day 2021-05-01",
  "accessURL" : "https://bilbao.urbanite.esilab.org/data/getTDataRange/airQualityObserved/bilbao?startDate=2021-05-01T00%3A00%3A00.000Z&endDate=2021-05-01T23%3A59%3A00.000Z"
}
```


The technology stack used to implement the component consists of three levels, as depicted in Figure 6.

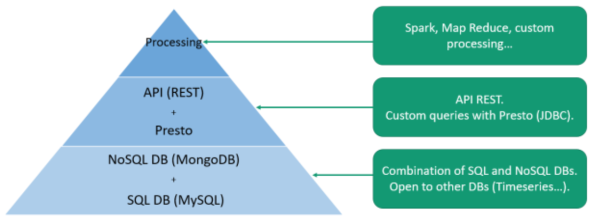

Figure 6. Data aggregation & storage technology stack

At the bottom level we have the storage repositories, being a combination of different types of databases: SQL databases, like MySQL and NoSQL databases, like MongoDB. The design is also open to the usage of other storage mechanisms that may be useful in the future, such as timeseries databases, files, semantic triple stores, etc.

The intermediate level offers the mechanisms for both storing and retrieving data. In turn it consists of two components: a REST API with predefined methods for inserting or accessing data and metadata, and a JDBC connection, through the Presto software, to perform custom queries (SQL statements) different to those offered by the API. All the interaction with the storage system is made through these two mechanisms, not allowing direct access to the data. This makes the choice of the specific database that stores the data transparent to the upper processing layer and can be modified without affecting the processes that make use of the component.

Finally, at the top level we have the processes that can be defined to feed the databases or make use of the data, e.g. data aggregation processes.

3.4 Data Catalogue

The Data Catalogue offers the functionalities to discover and access the datasets collected and managed by the components of the URBANITE ecosystem. Apart from the possibility to search over these datasets, the Data Catalogue also offers the possibility to search useful data across external "federated catalogues" (such as Open Data Portal) to increase the chance to find useful data.

The administrator is in charge of managing the federation of the catalogues, where a catalogue represents a data source. He/she can add new catalogues, delete or edit the existing ones. Moreover, the administrator can manage the platform configurations.

The end-user is then able to perform a federated metadata search among the harmonized DCAT-AP datasets provided by the federated catalogues. Moreover, the end-user can perform SPARQL queries over the federated RDFs provided by the federated catalogues, or he/she can access to statistics about the federated catalogues.

The Data Catalogue exposes APIs to access its functionalities; thus, an external system will be able to interact with the platform using such APIs.

The Data Catalogue is based on Idra [4]. Idra is a web application able to federate existing Open Data Management Systems (ODMS) based on different technologies providing a unique access point to search and discover open datasets coming from heterogeneous sources. Idra uniforms the representation of collected open datasets, thanks to the adoption of international standards (DCAT-AP) and provides a set of RESTful APIs to be used by third-party applications.

Figure 7 depicts the interaction among the Data Catalogue and the other URBANITE's components.

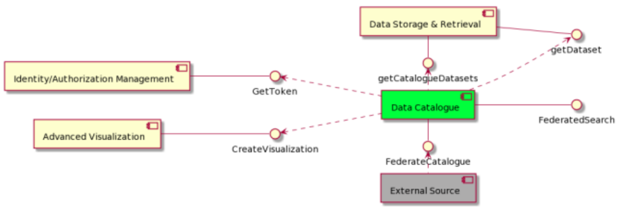

Figure 7. Data Catalogue - Component diagram

The Data Catalogue interacts with 1) Identity/Authorization Management component to allow administrators to access their specific functionalities retrieving the access token that will be further provided to the APIs, 2) Advanced Visualization to build visualization taking advantage of the DCAT-AP distributions it manages and 3) Data Storage & Retrieval to retrieve DCAT-AP datasets and distribution metadata. Finally, the Data Catalogue component is able to federate external sources such as Open Data portals or other sources providing DCAT-AP metadata.

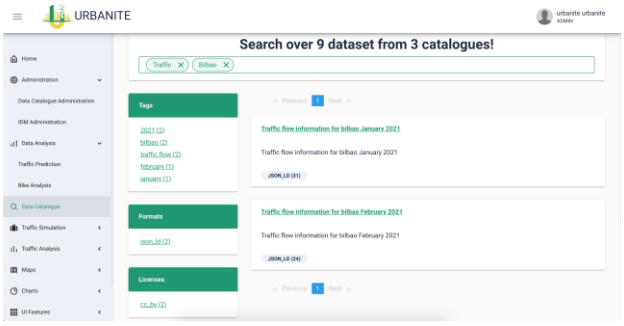

Figure 8. Data Catalogue – Dataset search (example)

Figure 9. Data Catalogue – Details of a dataset (example)

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Traffic Simulation for Mobility Policy Analysis

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ABSTRACT

Recently urban mobility has been changing quickly due to the growth of cities and novel mobility methods' introduction. These changes are causing ever greater traffic congestion and urban pollution problems. To deal with the growing complexity of urban mobility and traffic systems we are developing a system to support the decision makers in the URBANITE H2020 project. An integral part of the system is a system for simulation of mobility policy proposals based on traffic simulation. The simulations are used for evaluation of policy proposals. We developed a system for automatic simulation creation and an algorithm for population synthesis based on open data available for multiple cities.

KEYWORDS

smart city, traffic simulation, mobility policy

1 INTRODUCTION

As cities are becoming more populous, traffic congestions, pollution and other problems are becoming harder to handle. Such complex and interconnected issues, also called wicked problems, are hard to deal with and any policy targeting these issues may be seen as undesirable from certain stakeholders' point of view or may have unforeseen side effects. An example of a wicked issues is moving the residents from using cars to driving bicycles or using public transit [6].

This paper presents a method for using traffic simulations among other analysis tools to analyse and evaluate mobility policies. The developed method aims to contribute to solving such problems in the urban mobility domain by simulation of the changes and calculation of key performance indicators (KPIs) [7], co-designed with the city stakeholders.

The method was developed with two goals in mind. The first is to empower the administration to easily run new simulations with less involvement of technical experts and thus shorten the feedback time from idea to the results of the simulations. The second goal is to enable the automatic creation of multiple simulations by variation of specific parameters within given constraints to algorithmically produce candidate solutions for specific problems.

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The rest of the paper is organized as follows. Section 2 covers mobility policy simulations and overviews the selected traffic simulation tool. Section 3 describes the high-level view of the support system for mobility policy design and the role of the mobility policy simulation in the system. Section 4 overviews the process of partially automated simulation creation including the descriptions of data preparation processes, the design of the underlying relational database and the algorithms developed for each step of the simulation creation. The paper concludes with Section 5, which summarizes the paper and presents ideas for future work.

2 OVERVIEW OF THE SYSTEM FOR MOBILITY POLICY DESIGN

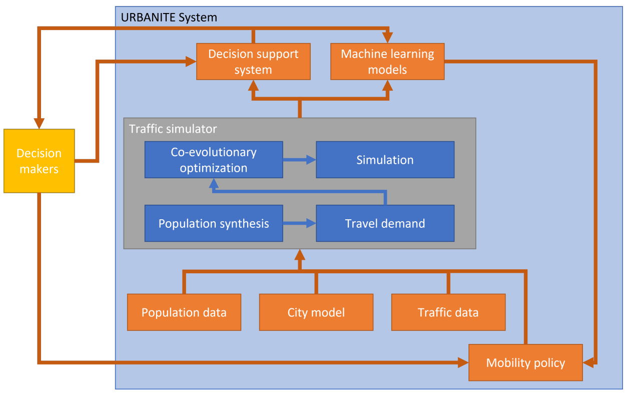

Figure 1: Architecture of the URBANITE system.

The URBANITE system consists of several components, including a data platform, AI-based tools including the mobility policy simulation, and tools for stakeholder engagement, including a forum and a social policy laboratory [11]. In this paper we focus on the architecture of the mobility policy simulation shown in Figure 1.

The decision makers work with the system in an interactive mode by evaluating and improving policy proposals in an iterative fashion, i.e., by defining the mobility policy proposals, which are simulated and evaluated by the system. In each iteration, they use the insight gained to modify the policy proposals. However, the system is also able to search for mobility policy proposals within user provided constraints. These proposals are automatically simulated and evaluated, and the decision makers are presented with a selection of the best ones according to the selected KPIs.

The main inputs to the mobility policy simulation system are the proposed mobility policy and the data required for the simulation: the population data, the city model and the traffic data. Examples of mobility policies are described in Section 3.

The mobility policy simulation module executes the following steps to create and run the simulation:

- Population synthesis is the process of using the population data to create the artificial agents.
- Travel demand generation takes the generated agents and their activities, and generates the trips that the agent will take to arrive to the locations of their activities.
- Finally, before the simulation is run the trips are optimized to fit them to the known traffic data.
- The simulation run is performed and the simulation recorded for further analysis and visualization, and to provide data for the machine learning models.

The simulation results are used by the decision support system to calculate the KPIs, evaluate the mobility policy proposals and provide multi-attribute decision analysis, as well as by the machine learning models used for policy proposal.

3 MOBILITY POLICY SIMULATION

Historically, modeling of mobility started with analytical modelling, mostly based on economic models combined with numerical methods for traffic estimation [3]. At the same time, simulation models were also developed [12]. A significant improvement came with the introduction of agent-based simulations, which are used for simulation of complex self-organizing systems.

3.1 Traffic Simulations

The URBANITE mobility policy simulations are based on traffic simulations provided by the open source package MATSim [4], a Java framework for traffic simulations. The selected traffic simulation framework is a state-of-the-art microscopic multi-agent traffic simulation package that allows the creation of traffic simulations with features such as multi-modal trips, support for bicycles and micro-mobility, public transit support, and emissions estimation.

Some drawbacks of the MATSim framework are high computational complexity, demand for high quality input data[1] and highly complex process for creating high quality simulations. The selection of MATSim among the available microscopic traffic simulation software options is based mostly on its extensibility and flexibility.

3.2 Representation of Mobility Policies

Mobility policy is a very wide category and general policy representation is out of the scope of this work. Instead we focus on specific policies. Besides the policy representation, appropriate KPIs are also required. This section focuses of four distinct types of policies that are considered by the pilot cities within the URBANITE project and the KPIs selected to evaluate them.

3.2.1 Closing a Major Square for Private Car Traffic. Bilbao is a city near the northern shore of Spain and the largest city of the Basque Country with nearly 350,000 residents. The policy proposed for simulation is closure of the Moyua square in the city for all private car traffic. Main goals of the proposal are to improve the air quality at the square and to relieve traffic trough the square.

From the simulation point of view, this is a relatively simple change of the city's road network. The change is implemented by changing the properties of affected road segments in the network to disallow private car traffic. Public transport and emergency vehicles are not affected by this change as well as pedestrian and bicycle traffic.

KPIs are selected in accordance with the goals of the policy. To estimate the effects on the air quality in the area, the daily amounts of different air pollutants emitted at the square and in the nearby areas are recorded. We expect that there will be less pollutants emitted in the square and some increase in the surrounding areas as the traffic will be redirected to them.

3.2.2 Changing a Major Road to a Bicycle Highway. Amsterdam is the capital city of the Netherlands as well as its largest city with over 1.5 million residents in the urban area. It has a highly developed bicycling culture to the point where bicycle traffic jams often form at the peak traffic times. The policy proposed is to close one of the major roads into the center, the Oranje Lopper, for motorized traffic. While similar to policy proposed in Bilbao, the goals of Amsterdam are mainly to alleviate the bicycle traffic by introducing a new bike highway into the city center.

To represent the policy for the simulation, we change the properties of the road segments that make up the Oranje Lopper to disallow private car traffic and instead introduce a number of new bicycle lanes.

KPIs selected are the number of bicycles using the new bike highway and more importantly, average bicycle travel times between the city parts connected by the Oranje Lopper.

3.2.3 Alleviation of Ferry Traffic via Building of a new Tunnel. Helsinki is the capital city of Finland. The Helsinki port is also the busiest passenger port in the world, which causes regular traffic jams in the Jätkäsaari area where the traffic from the port to the mainland is forced to use a single road. The policy proposal in Helsinki includes building a tunnel connecting the port directly to the motorway with the goal of alleviating the traffic jams that form periodically when ferries arrive to the port.

This policy is represented by the addition of new links to the road network representing the tunnel. To test this proposal, the ferry arrivals are modelled as seafaring public transport with forced high loads of vehicles arriving as scheduled.

The main KPI for this policy is the traffic flow at the existing point of crossing to the mainland. Another significant factor for the evaluation of this policy is the amounts of air pollutants emitted in the Jätkäsaari area.

3.2.4 Addition of new Bus Lines to Under-Connected Areas. The last policy we consider is the addition of public transport lines to under-connected areas of the Messina municipality in Sicily, Italy. Generally the city is well connected by public transport, however as the city is caught between the sea shore and a mountain area, some of the more remote parts lack connectivity and are only accessible by private vehicles. These areas are also generally too remote to access the city by foot and too mountainous for everyone to use bicycles.

To simulate this policy, we add new bus lines by creating the GTFS data compatible with existing public traffic and including it in the simulation.

[1]In the context of URBANITE project, which this work is a part of, data gathering and quality assurance are parts of the project.

4 CREATING SIMULATIONS

To create a traffic simulation using MATSim, a set of input data needs to be defined, and the simulator's configuration must be specified. The simulation is run in two consecutive steps: first, the agents' actions are optimized using a co-evolutionary algorithm; second, the final run of the simulation is stored and analysed.

4.1 MATSim Input Data

In this section we describe the input data necessary to run the simulation, and the process for creating these files. For each of the files we also describe the data model and explain how the data is used.

4.1.1 Road Network. The road network represents the traffic infrastructure and its properties such as lane capacity and max speed. Currently, we rely on Open Street Maps [10], a crowd-sourced publicly accessible map database. It is a very valuable resource, however due to its nature it is not complete and there may be some inaccuracies in the data.

The resulting network is a collection of nodes and link. Each link represents a straight part of a single lane and connects two nodes. The link also contains other relevant information such road type, speed limit, road or street name, etc. The nodes represent the location via coordinates. This means that a single road or street is made of multiple links that may have different properties.

4.1.2 Facilities. To get the data about specific places in the city, such as hospitals, schools, parks and workplaces among others, we provide the simulator with a list of facilities. These are gathered from OSM along with the network itself and attributes are added from the city datasets. The attributes of interest include number of employees, average number of daily visitors, number of employee and visitor parking spots, etc. Before running the simulation, the facilities and the network are pre-processed together to match the coordinates and other attributes between the files.

4.1.3 Agent Plans. Agent plans are the daily plans of each of the agents that represent the population. These are described as a list of activities and a list of trips that allow the agent to engage in the activities. The agent plans are the results of the population synthesis and travel demand modelling, described in Section 4.4. There are multiple algorithms for population synthesis that are developed for working with different sets of available input data [2].

The trips for each agent are used for the final simulation run. The data contains a collection of trips, each made up of multiple trip legs that may use different transportation modes (e.g., an agent may take a bus to go to work but walk back home).

4.1.4 Vehicles. When interested in vehicle-related data, such as amounts of certain pollutants emitted, data about the vehicles in the city are necessary. Multiple types of vehicles can be defined with attributes such as vehicle type, engine technology, cylinder displacement and latest EURO emission standard it supports. A simulation using this data can be analysed for amounts of pollutants emitted per link for each vehicle by using the HBEFA [9] emission factors.

To use the defined vehicles, the agent population has to be split up into multiple subpopulations. Each subpopulation may link a specific vehicle fleet (a set of vehicles) that the agents can use.

4.2 Automating Simulation Creation

To automate the creation of mobility policy simulations, the following steps were taken:

- The entities representing input data are connected via appropriate relations and a relational database is designed. The input data is related to a simulation instance.
- Processes and algorithms for creating the input data are developed and implemented.
- Simulation results are stored and exported for visualization and further analysis.

We defined a database that allows the simulations to be automatically created and compared using a multi-attribute decision analysis methodology. To allow the user easy comparison of different simulation outcomes, the table `Scenario` includes multiple simulations. Each `Scenario` links to a `Decision Model`, that is designed and evaluated using the multi-attribute decision analysis tool DEXi [1]. This setup of entities `Scenario`, `Simulation` and `Decision Model` allows for a common and automated evaluation and comparison of different simulation results.

At the same time, the `Simulation` entity is linked to entities `Network`, `Agent Plans` and `Vehicles`. These include all the data that is needed to run the simulations.

4.3 Road Network Preparation

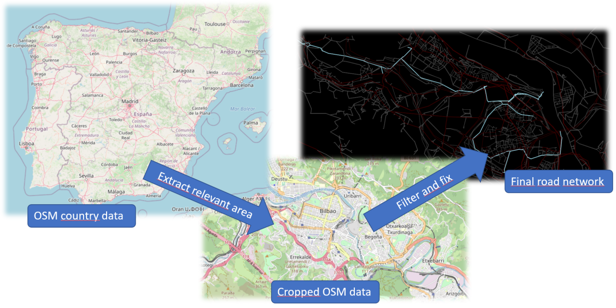

Figure 2: (1) The country wide map is retrieved from OSM. (2) The relevant area is extracted. (3) The map data is filtered and the minimal road network is stored.

OSM is limited by the area size it can export using the API. Instead, we download the binary map data for the entire country from the map catalogue. We use an open source tool Osmosis to extract the relevant area and filter out all the unneeded data in order to keep performance of the simulations to a minimum. Next, we remove any broken links, unconnected links and parts of network that are isolated from the greater connected network, usually artifacts of extracting the selected area.

4.4 Population Synthesis Algorithm

The selection of the algorithm is limited by the data available in the four pilot cities. Another important goal of the algorithm selection is to use mainly open data. Often the studies in this field are not reproducible due to use of proprietary data or data that is not publicly available, as well as the use of proprietary software. The common population model used for population synthesis is shown in Figure 3. The city is split into existing statistical districts and each district is modeled separately. Each district has a population model and a corresponding vehicle fleet used for estimation of air pollutants emitted.

We adapted an algorithm developed for population synthesis using publicly available data in Paris [5], in order to process the data available in the pilot cities. It consists of the following steps:

(1) Sample the marginal distributions of the socio-economic data. Each household is assigned a home location and agents are generated for the household by sampling the marginal distributions of the population attributes.
(2) Iterative Proportional Fitting [8] is used to improve the matching of the agents' attributes by fitting to a small sample of the census data.
(3) Households are assigned income levels sampled from the income level marginal distribution.
(4) Activities are generated and activity chains are assigned to each agent. First, the primary (work and education) activities are considered, then secondary (shopping and leisure) activities are added, based on the travel surveys and facility data.

The lists of households, persons, activities and trips generated need to be optimized to match the traffic data before the final simulation. The initial version of the algorithm was already developed and is based on the open-source implementation of the algorithm described in [5], while the final version is under development.

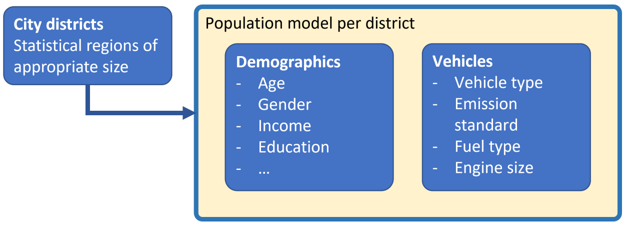

Figure 3: Each district has a separate population model and vehicle fleet.

5 CONCLUSION

We are developing a mobility policy simulation module as a part of the URBANITE system for mobility policy design support. The designed module consists of an open source multi-agent traffic simulation system, population synthesis algorithm including travel demand modelling and the co-evolutionary optimization algorithm for fitting the simulations to existing traffic data.

The system enables mobility policy simulation by implementing the processes for creating the simulations using open data and with no proprietary software required. Using open data allows the users to develop algorithms applicable to multiple cities and ensures the reproducibility of results.

The algorithm for population synthesis and travel demand modelling was selected and adapted to the data available and pilot cities' needs, and preliminary simulation were developed.

The research on this topic is far from concluded. Some of the future work include development of the co-evolutionary simulation fitting algorithm and the final implementation of the population synthesis algorithm.

ACKNOWLEDGMENTS

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Machine Learning-Based Approach for Estimating the Quality of Mobility Policies

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ABSTRACT

Cities are increasingly turning towards specialized technologies to address issues related to their significantly increased transport demand. Municipalities and transport authorities try to face these problems in order to achieve their objectives by taking various actions in the domain of public transport, air and noise pollution, road accidents, etc. The primary objective of this research is to explore the role of machine learning (ML) in mobility policy quality estimation using microscopic traffic simulations. The main idea is to use one simulation run as one training example. The features are represented by several group of parameters that are related to the input and output of the simulation, while the target variables are represented using key performance indicators (KPIs). The city of Bilbao is chosen as a use case. We have analyzed how closing the Moyua square in the city center and changing the number of cyclists there can affect the air pollution by estimating the CO2 emissions. Several machine learning algorithms are tested and the results show that by closing the main square in the city center and increasing the number of cyclists the CO2 emissions reduce.

KEYWORDS

machine learning, smart cities, mobility policy

1 INTRODUCTION

According to United Nations population estimation, the total population is exponentially increasing and by 2050 will reach 9 billion, i.e. it will increase for 2 billion from now [11]. This demographic growth will greatly impact on the transportation system in metropolitan areas since most population will be located there. As a result far more attention must go towards serving the needs and aspirations of the people with the aim to maintain the environmental, social, and economic costs at the same time [12].

In this context different mobility policies are tested and evaluated in order to achieve the desired city goals. Since implementing different scenarios in real life is an expensive process microscopic traffic simulations are widely used as a valuable support tool for evaluating transportation facilities or systems. Using the simulations we can see how some actions may impact the dimensions that we are interested in without making those changes in real life.

Currently, most of the mobility policy evaluation techniques rely on experts in urban/spatial planning using on simulation results [10]. Since the simulations create large amount of data, including data from optimization steps, various data analysis can be applied. In this context machine learning techniques can be applied to automate the evaluation of mobility policies and address the objectives of the cities.

As part of the URBANITE project we are developing a machine learning module using data from microscopic transport simulator that will help decision makers in the what-if analysis. More precisely, we propose a system to estimate the quality of previously simulated mobility policies using machine learning methods.

The rest of the paper is structures as follows. Section 2 explains the URBANITE approach and the relevant modules for this research. In Section 3 the data collection process is explained. Then, Section 4 presents the results of the machine learning module. Finally, Section 5 concludes the paper with ideas for future work.

2 OVERVIEW OF THE URBANITE APPROACH

The main objective of URBANITE approach is to build an intelligent platform that can use data from heterogeneous sources in order to help the city managers in the decision-making process. To achieve this aim, several modules are developed. In this section we will give an overview of only the relevant ones shown in Figure 1

The traffic simulator is used to simulate various mobility policies during the the policy evaluation process. The input files to this module are related to the network map, travel demand, public transit data etc. Based on the simulation output, target variables e.g. air pollution levels for the machine learning algorithms are calculated, based on which the models are build. This approach is able to process large amount of data in order to find the best mobility policy.

Besides automatic selection of mobility policy URBANITE also supports policy selection by the experts with the use of the decision support system. In addition to processing the simulation data this system also relies on expert knowledge in order to build the hierarchical decision models and satisfy the user preferences.

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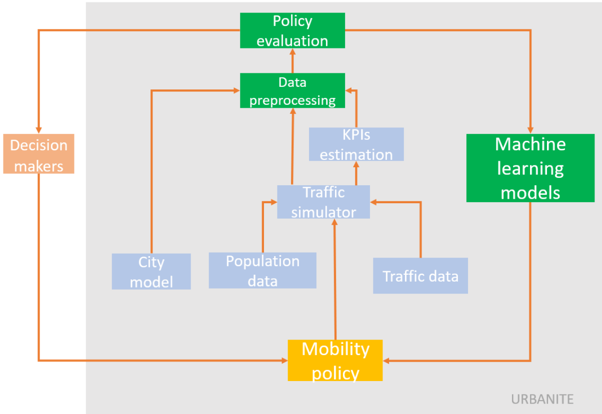

Figure 1: Modules of URBANITE approach.

Both approaches are used in the policy evaluation process with the difference that machine learning module relies on algorithms that automatically select the best mobility policy. In the next sections the simulation and machine learning process are described in detail.

3 DATA COLLECTION

3.1 Simulation

In order to collect the data, a microscopic traffic simulation tool was used. Several state-of-the-art solutions were tested and MATSim was chosen as the most suitable one. MATSim [6] is an open-source tool implemented in Java. It is used for microscopic modeling that enables us to simulate and analyze components on the network such as traffic flow, congestion, public transport, behavior of cyclists, etc. One of the core concepts is the co-evolutionary optimization where the individuals' plans are evolving in the presence of all other persons doing the same.

To run the simulator several input files need to be provided that are related to the city model, traffic and population data. For the creation of the transport demand e.g. persons with their daily plans and mode of transport real data from census and other travel surveys is required. Since there is no complete dataset containing the socio-demographic characteristics of individuals at a small geographic scale because of privacy concerns a transport demand was generated based on known random variables.

After providing all the required input we can run the simulation which is optimized by configurable number of iterations (see Figure 2). Each individual agent learns by maintaining multiple plans which are scored by executing them in the mobsim, selected according to the score and when needed, modified. The iterative process consists of the following steps:

- Mobsim simulation
- Scoring
- Replanning

Every iteration starts with an initial demand simulated by the mobility simulation and then evaluated by the scoring module as a central element of the simulator [9].

The MATSim scoring module evaluates the performance of a plan in a synthetic reality and determines the choice of person's plan in the next iteration. Next, only plans with higher scores are selected by the agent - others are deleted in the replanning step. The scores are computed using scoring function taking into account the performance of activities and travel time. A typical score is calculated as follows:

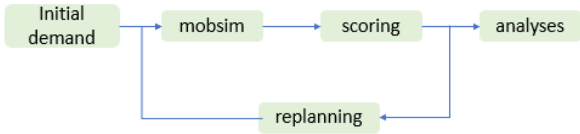

Figure 2: MATSim cycle.

$$S_{\text{plan}} = \sum_{q=0}^{N-1} S_{\text{act},q} + \sum_{q=0}^{N-1} S_{\text{trav,mode}(q)} \quad (1)$$

Here utility functions are used to represent a basic scoring function or in other words the utility of a plan S_{plan} is computed as sum of all activity utilities $S_{\text{act},q}$, plus the sum of all travel utilities $S_{\text{trav,mode}(q)}$. N represents the number of activities. For scoring, the last activity is merged with the first activity to produce an equal number of trips and activities. Positive scores are obtained for desired events and negative for unwanted ones.

Finally, the optimization step takes part where four dimensions are considered: departure time, route, mode, and destination. Each of the agents has a memory of M plans that have been observed in the past and which have obtained a score. In the first step the replanning process checks whether the agent's memory exceeds the limit. If so one of the existing plans is removed according to previously computed scores. If the plan is removed that was currently selected for execution, a random one among the remaining ones is selected. After a certain number of iterations an equilibrium state on the network is reached improving the initial scores.

Several files are produced as output of the simulation that are related to specific iteration or they summarize a complete run, e.g. events file that contains every action taken on the network, and travel distance statistics showing the distance traveled per mode. These results are used to compute the features for the machine learning module and to define the target variable. More precisely the input features consists of simulation input and output data which can be directly influenced by the user. On the other hand the target variables depend on the simulation results and cannot be directly set by the user which makes them relevant for the decision-making process of particular mobility policy. These variables are summarized in Table 1.

Additional MATSim package was used to calculate the CO_2 emissions which are used as a target class in the prediction process. The tool calculates warm and cold-start exhaust emissions by linking MATSim simulation output to detailed emission factors for road transport.

3.2 Scenarios

In order to gather the dataset, 14 simulations were executed by applying different policies in the city of Bilbao, Spain. The main objective is to see the impact of closing the Moyua square in the city center for private traffic.

Two scenarios are implemented: the baseline scenario of the current network situation and the modified scenario representing the closure of Moyua square as one possible policy. All other

Table 1: Input data and target variable of the machine learning module

ML input		Target variable
Sim input	Sim output	
Surface of a road	Number of cars	CO_2 emission
Capacity of road	Number of cyclists	
Number of lanes	Number of public	
Type of district	transport vehicles	
Number of bus stops	Average travel time	

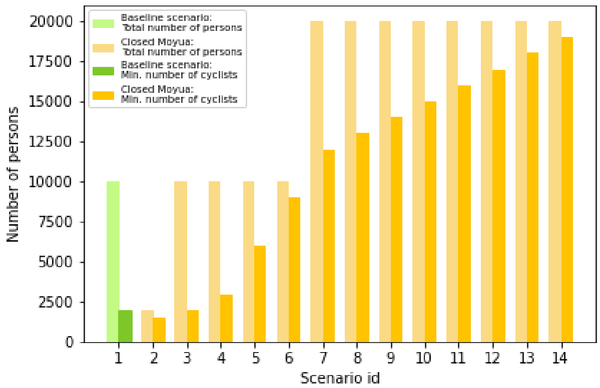

Figure 3: Number of persons and cyclists per scenario instance.

instances are variations of the second scenario where the number of cyclists varies from 1500 to 19000 while changing the number of inhabitants from 2.000 to 20.000, respectively. This change in number of cyclists does not represent a specific policy but shows what would happen if in conjunction with the applied policy also the number of cyclists changes. Figure 3 depicts these variations where with green is marked the baseline scenario and with orange the other scenario and all its variations. The first instance represents the baseline scenario with 10000 inhabitants and 2000 cyclists, while the remaining instances represent the second scenario with all variations. The second instance contains 2000 inhabitants with at least 1500 cyclists. The next four instances are representing 10000 population with up to 9000 cyclists while reducing the private transport. The rest of them represents 20000 inhabitants with up to 19000 cyclists. The number of public transport vehicles stays the same in all variations.

Figure 4 shows the results of the applied policy. More precisely it shows the relationship between number of cyclists and the level of CO_2 emissions. The x-axis represents the number of cyclists nearby the square and and y-axis represents number of cyclists in the center. The different colors denote the amount of CO_2 emissions as a target variable where with orange circle is marked the baseline scenario. This figure shows that by closing the main square for private traffic and reducing the number of private vehicles nearby it, the level of CO_2 emission is decreasing.

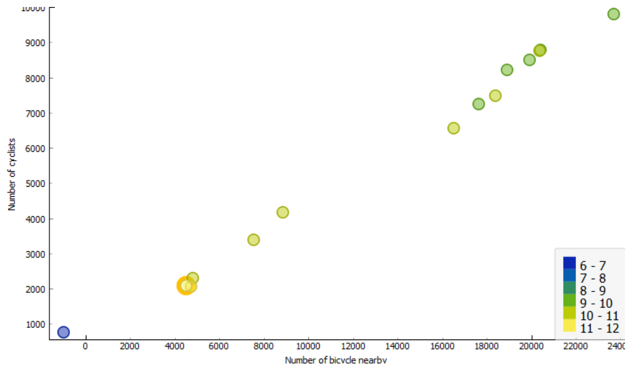

Figure 4: CO_2 emissions in the Moyua square. The baseline scenario is marked with orange circle.

4 MACHINE LEARNING

4.1 Methods

Several machine learning models were applied using Orange [3]: k-Nearest Neighbors, Decision Tree, Support Vector Machines, Random Forest, Linear Regression, Gradient Boosting, and Neural Network.

The k-nearest neighbor (kNN) is a semi-supervised learning algorithm that requires training data and a predefined k value to find the k nearest data based on distance computation. If k data have different classes the algorithm predicts class of the unknown data to be the same as the majority class [1].

Tree splits the data into nodes by class purity. The top-most node is called root, the bottom ones leaves, and all other nodes are internal nodes connected to each other with edges. Each edge represents satisfaction of the node condition, and each leaf node determines the class assigned to the instances that met the conditions of the internal nodes on the path from the root node to the leaf node [5].

Support Vector Machines (SVM) is a two-grouped classifier where input vectors are non-linearly mapped to a high-dimension feature space. In this feature space a linear decision surface is constructed. Special properties of the decision surface ensures high generalization ability of the learning machine [2].

Random Forest consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes model's prediction. A large number of relatively uncorrelated models (trees) operating as a committee outperform any of the individual constituent models.

Linear Regression is commonly used in mathematical research methods, where it is possible to measure the predicted effects and model them against multiple input variables. It is a method of data evaluation and modeling that establishes linear relationships between variables that are dependent and independent [8].

Gradient Boosting tries to convert weak learners into strong ones by training many models in a gradual, additive and sequential manner where the gradient of the loss function is being minimized, with respect to the model values at each training data point evaluated at the current step [4].

Neural Network model simulates a large number of interconnected processing units that resemble abstract versions of neurons where the processing units are arranged into layers. The units are connected with varying connection strengths (or weights). Input data are presented to the first layer, and values are propagated from each neuron to every neuron in the next layer. Eventually, a result is delivered from the output layer. The network learns by examining individual records, generating a prediction for each record, and making adjustments to the weights whenever it makes an incorrect prediction. This process is repeated many times, and the network continues to improve its predictions until one or more of the stopping criteria have been met [7].

4.2 Evaluation Results

We have evaluated the machine-learning algorithms described in Section 4.1. The data for evaluation of the algorithms is split randomly 10 times and the average results are computed. We have compared four evaluation metrics:

- Mean squared error (MSE) measures the average of the squares of the errors or deviations (the difference between the true and estimated values).
- Root mean squared error (RMSE) is the square root of the arithmetic mean of the squares of a set of numbers (a measure of imperfection of the fit of the estimator to the data).
- Mean absolute error (MAE) used to measure how close forecasts or predictions are to eventual outcomes.
- R2 is interpreted as the proportion of the variance in the dependent variable that is predictable from the independent variables.

The results are shown in Table 2. According to MSE, RMSE, and R2 the best model is kNN, while according to MAE the best model is SVM.

Table 2: Evaluation results

Model	MSE	RMSE	MAE	R2
kNN	4.718	2.172	1.416	-0.372
Tree	5.387	2.321	1.431	-0.567
SVM	4.953	2.225	1.298	-0.441
Random Forest	5.093	2.257	1.404	-0.482
Neural Network	11.264	3.356	2.583	-2.277
Linear Regression	8.076	2.842	2.041	-1.349
Gradient Boosting	5.193	2.279	1.324	-0.511

5 CONCLUSION

In this paper we showed how machine learning can be used in mobility policy evaluation helping the urban development in cities. As large amount of data is produced from simulations, machine learning techniques can be applied to automatically choose the best policy.

We defined the mobility policy for Bilbao. Then, using microscopic traffic simulation the two scenarios were implemented: baseline scenario of the current network state and the modified scenario representing closure of Moyua square for private traffic. In order to gather more data, variations of the second scenario were produced by changing the proportion of cyclists and private car users. After gathering sufficient data, machine learning techniques were applied to evaluate the performance of the policy. Changing the number of cyclists in combination with the second scenario showed that the level of CO_2 emissions can be decreased or in other words, the proposed policy proved fairly good.

In future work, more policies will be tested and evaluated using the proposed approach. Then, advanced machine learning and deep learning techniques will be applied to improve the current results. Finally, data from simulation runs in the optimization step can be used to expand the current dataset.

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Visualizations for Mobility Policy Design

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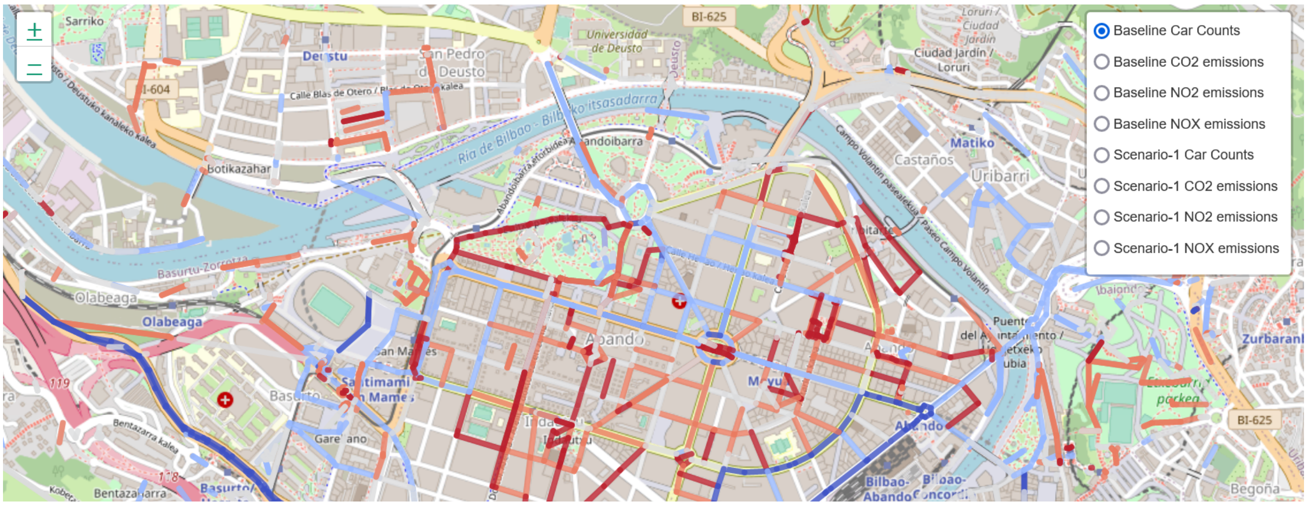

Figure 1: Visualization of simulated traffic flow intensity in center of Bilbao.

ABSTRACT

Cities around the world are rapidly gaining population as more people are moving to urban areas from the periphery. At the same time, novel urban mobility solutions are emerging such as e-cars and micro-mobility. Thus, urban traffic is getting heavier and more complex. To deal with these problems the H2020 URBANITE project is developing tools for city administrations including a data platform, mobility policy validation via traffic simulation, decision support for multi-attribute decision analysis and a visualizations module, described in this paper. We consider different types of visualizations in the domain of urban traffic and select most appropriate, implementing a module used for data visualizations for the system.

KEYWORDS

smart city, urban mobility, visualization

1 INTRODUCTION

Cities' mobility landscapes are rapidly changing due to the raising populations as well as new and disruptive mobility modes that are emerging. As the populations of cities are growing, so are occurrences of traffic congestions, air pollution and traffic noise in urban areas. At the same time, introduction of novel mobility modes both in the sector of micro-mobility (e-scooters, bike sharing etc) and sharing services in other sectors cause dynamics of the urban traffic to change [3]. This makes it increasingly difficult to model the growing complexity of the urban mobility as well as predict the effects of specific policies. This makes the prediction of possible effects of mobility policies more difficult but also more important. The importance of policy effects has been shown on the example of e-scooters [1]. They offer a clean and sustainable way of travelling the first and last kilometer of the trip but can also be very dangerous when not properly regulated.

We are developing a new AI assisted tool set for supporting the development and evaluation of urban mobility policies as part of the URBANITE H2020 project [7]. The project includes a mobility policy simulation, a recommendation system for policy design support, advanced visualization suite and a machine learning component for quick evaluation of expected policy results. This paper focuses on the visualizations of the traffic data, simulation results and decision analysis.

The end users of the tool set are city administrations (generally not technical personnel), urban mobility planners (experts on mobility) and interested citizens (laymen). These groups differ greatly with regards to their knowledge as well as the intent of interacting with the system. Citizens are interested in understanding the administration's actions but do not have a direct

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possibility to work with the system. Urban mobility planners are mostly already using traffic simulation tools and data analysis tools and require a highly detailed view of the data and analysis results. They are not limited by their knowledge and are used to working with complex tool sets. The city administrators however are similar to the citizens in that they are generally not experts on urban traffic and mobility, but are expected to make decisions about policies. The visualizations developed are primarily aimed at the city administrators with the goal to help them understands and interact with the data available, compare the results of different policy proposals and help with the interaction of the experts with the administrators. The second goal of the visualizations is to inform the public and democratize mobility planning. To achieve that the visualizations should be self explainable.

The paper is organized as follows: Section 2 overviews the common visualizations and their advantages and disadvantages, Section 3 covers the selection of visualization methods for first release and Section 4 describes the implementation of specific visualization methods.

2 VISUALIZATIONS IN THE TRAFFIC AND MOBILITY DOMAINS

This section overviews the common data types in the domains of traffic and mobility and the visualization methods commonly used to represent the data. The data types overviewed are traffic flows, air pollution and specific pollutant emissions, general tabular data, geo-spatial data and geo-temporal data.

2.1 Spatio-Temporal Data

In the domains of urban mobility and traffic spatial data is very common, since most of the data is related to specific roads or locations within the city. This category contains all such data, including the road networks (city maps), traffic flows on roads and streets, trips made and modal splits of traffic in specific locations, as well as population properties in different statistical districts of the cities, locations of important facilities such as hospitals and schools, parking lots and public parking garages and public transport lines. Some of these types of data are further discussed bellow in the section Traffic Data.

These data are best represented as interactive layers on a map. Each layer must be visually distinct from the underlaying map to ensure the visibility of the data. Often it is less important that the map itself is easily readable as it serves mostly as a spatial anchor that allows the easy recognition of general locations. To ensure the understandability of the geo-spatial visualizations data layers can be interatively selected so only the relevant data is shown at the same time.

To keep the data minimally cluttered and therefore more understandable we do not show details of the data on the map unless the user hovers the mouse over some part. In this case, a popup with the details of the selected locations are shown. This can be seen on the Figure **??**, where the demographic data is shown for each district. Generally one of the attributes is shown using a color scale on the map and other attributes are only shown when user hovers over a specific city district.

The most intuitive way to show time-dependant data is by animating the visualiziations. To simplify the interaction and thus reduce the mental overhead we show a timeline below the geo-spatial view. The user may select the time they are interested in or play the animation at different speeds. An example is not shown due to the limitations of printed media.

2.2 Traffic Data

Traffic data includes traffic counts, trips, and Origin-Destination (OD) matrices. There are multiple ways of visualizing these data. Following is a brief overview of common visualization methods used on these types of data.

2.2.1 Traffic counts. Traffic counts at a specific location are commonly shown via line charts where the horizontal axis represents time (usually one day) and the vertical axis represents number of vehicles passing the location. To compare data from several specific locations we can show multiple lines on the same chart using different colors.

To visualize the traffic counts all over the city simultaneously geo spatial map based visualizations are commonly used, either as point-based or line-based map layers. Point-based visualizations are best suited when the traffic counts are measured using existing sensing devices such as induction loops or smart cameras. Such sensing devices are usually not available on every road segment. In this case the points locate the sensors while the values measured are commonly color coded.

2.2.2 Traffic flows. Traffic flow is the amount of vehicles that pass a certain point on the road in a time slot. Traffic flows are commonly visualized using line-based map layers, where the traffic flow is represented either by line thickness or color. To specifically show the modal split of the traffic flows we can show them separately or at the same time. In the latter case it is best to use color codes to represent different types of vehicles and line thickness to represent the traffic flow.

2.2.3 OD matrices. OD matrices hold the information about number of people moving from parts of the city to other parts. Commonly the spatial resolution of the OD matrices matches statistical regions. OD matrices are commonly obtained using travel surveys, estimated using GPS traces of trips and public transit data.

Common method for visualizing the OD matrix data is to show the matrix as a heat map with rows and columns labeled with the name of the district. Such visualizations are hard to understand and under certain conditions can be cluttered, decreasing their readability.

Alternatively OD matrices can be shown on a map via connections between districts. The intensity of travel between two parts is commonly represented via the connection thickness, while color is typically used to distinct different connections. This method is easier to understand, but readability depends on the geographical positions of the districts.

2.3 Air pollution

Air pollution levels are usually visualized using heat map layers on top of the city map, and are therefore counted among the geo-spatial visualizations. Generally the most common method for visualizing air pollution is an air quality index heat map. Some of the advantages of visualizing air pollution as a heat map are high understandability and very low visual cluttering. A negative aspect of heat maps in this use case is that air pollution often does not spread equally in all directions due to air movements and buildings blocking the pollutants' paths. This is however not very important as the users are mostly interested in general pollution levels and in the case of the URBANITE project the levels of specific pollutant emissions.

3 SELECTION OF METHODS

The selection of methods to be implemented was based on the pilot city requirements, data availability and the available simulation outputs. In order to support comparing the measured data and the simulation results we are limited to using visualizations that are appropriate to both.

This section covers the visualization methods we have selected and is split by the type of data into traffic, air pollution, and other data visualizations and concludes with a brief discussion of the color maps chosen to represent the values.

3.1 Traffic data

The category of traffic data contains multiple different data types that have to visually represented using different methods. Some of the data that is shown using the methods for geo-spatial data visualization are:

- Traffic counts, shown either geo-spatially by aggregating the counts per day or geo-temporally by aggregation of the counts per specific time slot, commonly hours. Traffic counts at a specific location depends on time.
- Traffic flows, measures in vehicles per hour passing a road. The traffic flow at a specific location depends on time. The specific flows for different modes, such as public transport, heavy duty vehicles, bicycles and pedestrians are currently visualized separately.
- Congested roads. Simplest way of identifying problematic roads or junctions is to show the locations of congested traffic. We can detect congested traffic and traffic jams by searching for road segments with high traffic density and travel speed below the free-flow speed [8].

Some of the more detailed traffic data are better visualized using simpler charts. Traffic flows at specific locations over time are shown using a line chart. Traffic flow predictions at specific locations are shown using a line chart with the confidence interval included to inform the user that these are not exact. Modal splits of traffic at specific locations as well as city-wide aggregations of modal splits are visualized using area charts or stacked area charts.

3.2 Air pollution data

Due to the data available in pilot cities as well as the results of the traffic simulations we are not able to map the air quality index. Instead of air quality index, the data available includes levels of specific pollutants at existing measuring stations and the simulated levels of the same pollutants.

Therefore we show the available data: measurements at existing air quality monitoring stations are shown as a sparse heat map layer showing the levels of selected pollutant while the simulated pollutant emissions are shown as a layer over each road segment that shows the selected pollutant level.

4 IMPLEMENTATION

The visualization were implemented as part of the URBANITE user interface (UUI). We focus on the UUI modules used to analyse the simulation results and the comparison of two simulations.

The UUI is implemented using the Angular framework [4] mostly in TypeScript with some JavaScript parts. For ease of integration and to be able to package the UUI module as an Angular module we opted to use JavaScript libraries Leaflet.js [2] and echarts [5]. Leaflet.js is used for all geo-spatial and geo-temporal visualizations. It provides an interactive map and the functionality to add custom layers to the map. We use the library Echarts to implement any line charts and spider charts.

4.1 Map based visualizations

Multiple visualizations were developed to visualize certain geo-spatial data:

- Visualization of the traffic flows is shown on Figure 1. Each street is overlaid with a line, colored according to the traffic flow intensity. Less intensive flows are shown with blue hue and more intensive flows are shown in red. The color scale consists of a five color ramp selected for best visibility on the base map.
- Visualization of emissions of specific pollutants. Each street is overlaid with a line, colored according to the amount of selected pollutant. Streets with less emitted pollutants are shown in blue and streets with more are shown in red.

These visualizations are implemented using JavaScript and based on maps provided by the library Leaflet.js[2]. The overlays are generated from the simulation results by aggregating road network links by street name and summing the selected attribute for the day or per hour, thus enabling animated visualization of changes throughout the day or a static daily attribute visualization.

4.2 Color maps

We use one color map for all the visualizations that are based on the city map. The color map selected must be diverging in order to highlight best and worst values according to their desirability. The chosen map a diverging color map using red colors for undesired values and blue for desired values. The color map should also be appropriate for color blind users to avoid potential misunderstandings. With the requirements of the color map defined, we selected a color map named cold-warm [6] that fits our needs. The color map is shown on Figure 2 and is a a diverging color map that is colorblind safe. We have opted to use a five step color map instead of the full gradient to make the extreme values stand out more.

Figure 2: Color map used for overlays. Blue color is used for desired values and red color is used for undesired values.

4.3 Interactive charts

We use interactive charts implemented using the echarts library to implement line charts, histograms and spider charts. Line charts are used to analyse the modal splits on specific streets and the level of selected emitted pollutant (CO_2) using an overlaid area chart. These were made interactive to allow the user to zoom in and move the viewport around. Hovering over any of the lines shows the number of trips of the appropriate modes as well as the mode the line represents.

The same visualizations were also implemented as 3D line charts as shown on Figure 3. Lines are replaced with strips and instead of adding an area map to show the emitted pollutant levels they are color coded using the strip color. These allow more interactions such as panning and rotation.

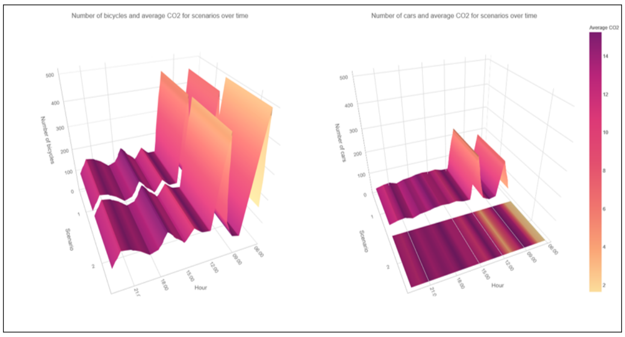

Figure 3: Visualization of the modal split between car and bicycle trips and the amount of the CO_2 emitted on the selected street The CO_2 levels are color coded.

A spider chart was implemented using the echarts library for multi-attribute comparison of different simulation results. This allows the user to recognize the dominant solution at a glance based on the size of the area that represents the simulations. On the other hand they allow us to show the detailed values of multiple, potentially competing attributes. Thus the user is able to understand the data at a glance on some level while also providing the details when the user hovers the mouse over axes of the spider chart or the line representing a single simulation result. An example of the spider chart can be seen on Figure 4.

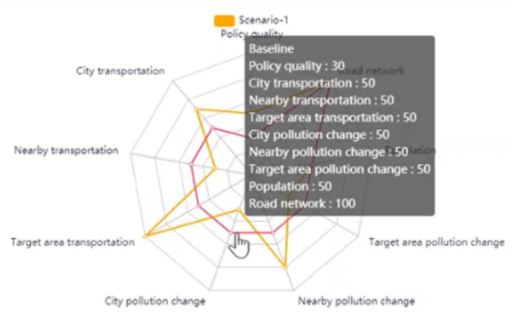

Figure 4: The spider chart shows the comparison of two different proposed mobility policies based on the simulation results. We can see the popup that shows values of all attributes of one of the simulations.

5 FUTURE WORK

There is a lot of room for improvement and the work is ongoing. Several visualization techniques covered are not yet finished, such as the geo-temporal visualizations and the heat maps. The next step is to finish the implementations of all the selected visualization types and to improve the visual appeal of the visualizations.

In order to compare the air quality measured with the results of simulations which provide estimations of the levels of emitted specific pollutants the data must first be transformed to an estimation of the air quality index. An alternative to this approach should it prove infeasible is to use the simulation results to estimate the measurements at the location of the measuring stations.

6 CONCLUSIONS

1 we overviewed the common methods of visualization of common traffic data

We have overviewed the mobility related open data-sets available in four major European cities and identified the most important for dealing with urban mobility policy. Several different sorts of data were analysed and appropriate visualizations were selected. Some of the visualizations are implemented, specifically traffic count, daily trips, and emitted air pollutant visualizations, among with some of visualizations of policy comparison.

The module implementing the visualizations supports the needs of the urban mobility analysis tool-set that we are developing. The visualization selection and implementation fits the needs of different users and will be further improved as we gather feedback from the pilots.

ACKNOWLEDGMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870338. The authors acknowledge the financial support from the Slovenian Research Agency (research core funding No. P2-0209).

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URBANITE Ecosystem: Integration and DevOps

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ABSTRACT

URBANITE is a collaborative research and innovation project whose outcomes are mainly software based. These outcomes will be implemented in a collaborative manner by different development teams from different partners. In order to manage the development environments, and the integration of the different software components in on time releases, the proper DevOps strategy and processes has been defined and set up.

This paper describes the URBANITE integrated architecture at month 12, with a theoretical vision of the URBANITE system that will cover all the functional and non-functional initial requirements set by the technical work-packages considering the social perspective and the input of the use cases.

The definition of the interactions among components is shown through the specification of the interfaces, considering the dataflows envisioned for meeting the needs of the different stakeholders. Different tools, environments and strategies envisioned for the management of the development, integration and validation stages of the software components to be implemented during the life cycle of the project are described as part of the integration strategy.

KEYWORDS

DevOps, Integration, Ecosystem, Requirements, Architecture, Prototype.

1 REQUIREMENTS

The process for setting up the URBANITE Ecosystem receives inputs from the rest of technical components, related to the data management and simulation processes, regarding to:

- Technical (software) requirements, expressing both functionality needs and non-functionality aspects.
- Architectural structure and configuration of the components implemented in different work packages.
- And about how to integrate them into the overall URBANITE UI.

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Also the Use Cases propose functionalities for the URBANITE ecosystem, that will be considered for being part of the URBANITE ecosystem and prioritize for their implementation.

This platform will comprise the URBANITE components implemented, Key Results or KR from now on, (Key Result KR1-Virtual Social Policy Lab, KR3-Data Management Platform, KR4- Algorithms) and their integration in the URBANITE ecosystem (KR5).

The elicitation of the first version of the functional and non-functional requirements for the URBANITE ecosystem and the related components is described as an iterative process where both the technology providers and use case providers' have participated.

For the functional requirements a combined approach has been followed: 1) a top down approach led by the technology provider partners, who have defined the first set of functional requirements and 2) a bottom up approach where the needs of the Use Cases have been monitored and UC initial requirements have been extracted. For the Non-Functional Requirements, these have been detailed per component, including relevant aspects, such as performance, usability or resources needs for deployment.

All these requirements will serve for the continuous development and improvement of the URBANITE ecosystem, through the different releases, validation processes and reviews of the requirements.

The URBANITE ecosystem will include all the components for data management, analysis and support to the decision making that are going to be created/developed/implemented in the context of the URBANITE project. The first version of the requirements will be updated in further reports and analysis.

Several sources will be used to elucidate the requirements for the URBANITE ecosystem:

- **Requirements coming from the URBANITE action specification**: These requirements cover the functionalities described in the URBANITE action specification. The first version of these requirements has been described by the Technology providers partners (Fraunhofer, Tecnalia, JSI and Engineering Ingegneria Informatica) based on the URBANITE approach and high-level architecture description included in the URBANITE action.

- **Requirements coming from the Use Cases**: The Use Cases proposed functionalities for the URBANITE ecosystem, so that the features offered can cover their needs.
- **Requirements coming from the co-creation sessions (SoPoLabs)**: It is expected that some requirements may be derived from the SoPolabs that will be conducted in the context of WP2. If relevant these requirements will be considered for the URBANITE ecosystem and prioritize for their implementation.

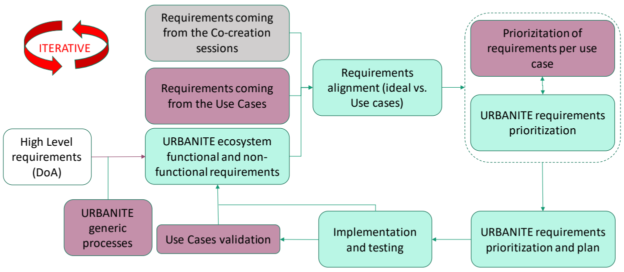

Figure 1: URBANITE process for requirements gathering and prioritization

The different users of the URBANITE platform to perform any of the previously described are:

- PA (Public Administration): This actor is the user from the public administration, usually the civil servants.
- Citizens: This actor is the citizen that is using any of the components in the platform.
- Platform administrator: This is the administrator of the platform who can install components, check the status of the included components, etc.

2 ARCHITECTURE

The detailed description of the entire global architecture of the URBANITE ecosystem as a general representation of it, is in its first version and can evolve following the needs of the project. Structural and behavioural analysis of each component of the architecture was performed identifying interactions and dependencies among them.

Three layers of components can be observed and identified by colours:

- Yellow components are those that manage the data, and implemented withing the WP3
- The purple ones are dedicated to the simulation and analysis of the data ingested to the system for the yellow ones.
- And the grey components are those related to the UI, as the entry point to the platform and for user management.
- There is also a green component considered as a repository of the datasets stored by the data management layer.

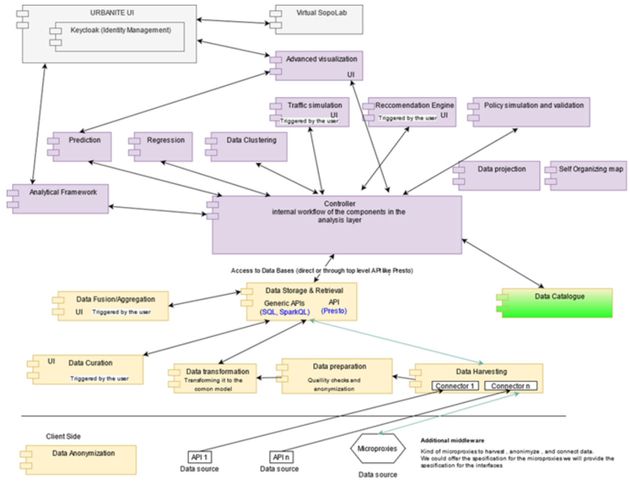

Figure 2: First version of URBANITE architecture

In the Month 15 of the project, the architecture is a reduced version of the overall URBANITE architecture and consists of the components that provide the functionalities designed covering the current version of the requirements.
The components are:

- URBANITE UI: The entry point to the URBANITE Ecosystem, that allows users to access the functionalities provided by the URBANITE platform at this point of the project.
- Identity Manager (Key Cloak): This component is in charge of securing the access to the other URBANITE's component, whenever security is needed. It is called by other components that interact with the user.
- City Bike Pattern Analysis: This module analyses GPS information related to the mobility of the bikes and transform it into more useful data.
- Traffic Prediction: It performs heuristic prediction for the vehicle flow at a location within the city by the processing of historical values measured by a fixed sensor and other information.
- Traffic Simulation: It offers the simulations of traffic under specified conditions, as proposed mobility policies, different weather conditions, changes to the traffic infrastructure, etc.
- Scheduler: It triggers a pipeline for the harvesting process, downloading data from a list of configured APIs within defined periods of time.
- Data Harvester and Transformation: It is responsible for fetching data from a given API, being the entry point of the data into the pipeline. Then a transformation is done into common models.
- Data Storage and Retrieval: This module stores and retrieves datasets metadata and related data in repositories DCAT-AP compliant metadata and transformed data.
- Data Catalogue: It allows to discover and access the datasets collected and managed by the components of URBANITE Ecosystem for data acquisition, aggregation, and storage.

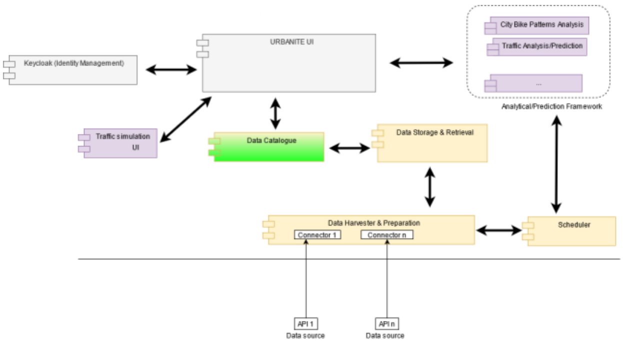

Figure 3: Month 15 version of URBANITE architecture

3 INTEGRATION AND DEVOPS STRATEGY

This section presents the infrastructure and tools planned to be used internally for the development and operation. The DevOps approach requires the set-up of a development and delivery pipeline, that consists in the stages an application goes through from development through production.
The URBANITE iterative and incremental approach mandates the adoption of a development and deployment process able to fully support it. That is why the project will adopt a DevOps approach in the development of all KRs. DevOps integrates development and operations into a single-minded entity with common goals: high-quality software, faster releases and improved users' satisfaction. DevOps also incorporates a number of agile principles, methods, and practices such as continuous delivery, continuous integration, and collaboration [1].
The different KRs, which are the outcomes of URBANITE [2], are composed of several software components that will be implemented by different partners following different technologies.
In URBANITE, the DevOps approach will be structured in three environments as depicted in the figure.

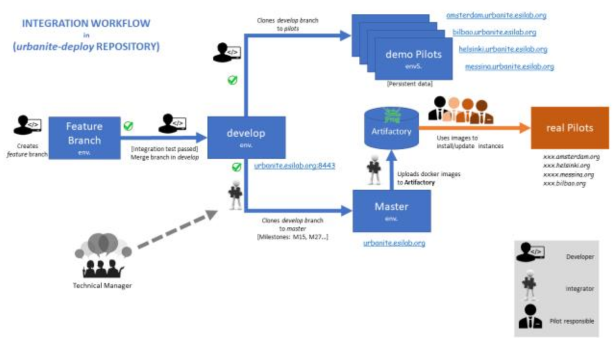

Figure 4: Continuous Integration and DevOps approach

The description of the environments that are part of the integration system:
FEATURE BRANCH: Temporary environment that is created each time a developer wants to integrate a new version of his component. It just checks that the new version of the urbanite platform builds without problems and is destroyed afterwards.
DEVELOP: Environment that contains the last version of the components running together. Dedicated to test new features, interfaces, and communications among components.
MASTER: Contains a specific version of the platform, frozen for specific Milestones.
DEMO PILOTS: Four environments, one for each city, where the integrated platform is replicated and adjusted to the characteristics of the use cases. It is a previous step for testing the platform before setting up in the infrastructure of the municipalities.
REAL PILOTS: the installation of the platform in each municipality's infrastructure. To be done after the integration phase once a stable version is achieved to test the use cases.
Apart from that, in order to support developers during the integration, we provide:
A Portainer instance that allows to access the logs and the console of every container in every environment.
An Artifactory instance to store the images of the containerized components. These images will be used to deploy the final version of the platform in the real Pilots.

4 URBANITE ECOSYSTEM

The main result of the URBANITE project is the URBANITE Ecosystem and aggregates all aspects of the project, namely the citizen participation, both social (citizen participation, attitude and trust in disruptive technologies, co-creation) and technical aspects (data management platform, algorithms and so on).

The URBANITE UI is an integration framework at User Interface level.
The integration strategy provides different approaches that can be followed:

1. **External component integration**
   Iframe: the external application is included in the UI through an iframe
   External link: the application is referenced in a dedicated section of the UI, and a specific link is provided to the user
2. **Template component integration:** the external application, that must provide a set of REST APIs for developing a specific component included in the UI.

The URBANITE UI is an Angular application built taking advantage of Nebular, ngx-admin frameworks and Eva Design System. With the addition of some of the most popular front-end libraries and packages.
The access to the Urbanite UI is provided through the Urbanite's Identity Manager component (an instance of KeyCloak whose theme is customized following Urbanite's colour palette).
The Urbanite UI provides Role-Based access to specific functionalities following the IDM returned role(s) of the user

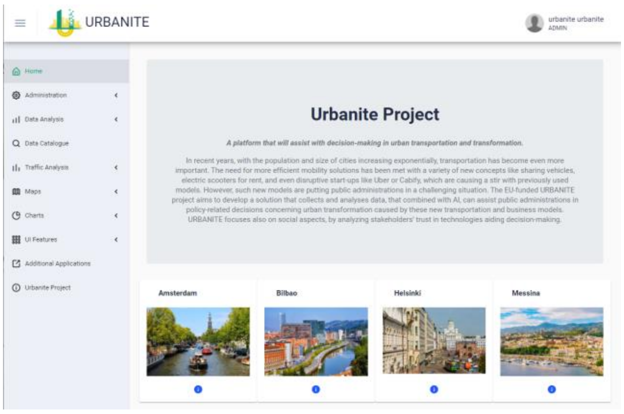

Figure 5: M15 Component's integration REST APIs based

The figure above shows is the URBANITE UI, integrating the components implemented for the M15 version of the prototype, covering the requirements and the functionalities provided by the implementation planned at this point.

The left part of the page includes the available options. Some of them are general utilities, and other are functionalities implemented within the different technical work packages.

- The Home page offers descriptions of the four municipalities and the basis of the URBANITE project. There is an additional information section for each description that allows to extend the details of the selected city.
- The Administration, Data Analysis, Data Catalogue and Traffic Analysis are specific sections that provide services related to the data of the different municipalities.
- Maps: where are two examples of how a developer can build and manage maps, using the libraries provided by this UI.
- Charts: this option displays three possible library alternatives provided by the Urbanite UI to build bars, pies and line charts.
- UI Features: about style examples as colors, icons, typography, and the grid system that should be used for implementing pages to provide responsiveness.
- Additional Applications: is a section where external links to other applications can be added through the URBANITE UI configuration file. For instance, the forum page is linked.
- And the Urbanite Project where included information about the objectives of the project.

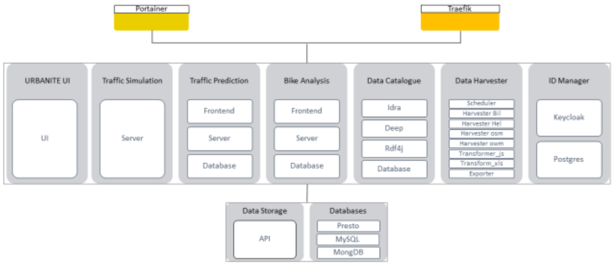

Figure 6: URBANIITE Ecosystem v1

The Figure 6 describes the schema that supports the before explained prototype.

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Zbornik 24. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2021

Zvezek I

Proceedings of the 24th International Multiconference

INFORMATION SOCIETY – IS 2021

Volume I

50-letnica poučevanja računalništva v slovenskih srednjih šolah
50th Anniversary of Teaching Computer Science in Slovenian Secondary Schools

Urednika / Editors

Saša Divjak, Alenka Krapež

http://is.ijs.si

6. oktober 2021 / 6 October 2021
Ljubljana, Slovenia

PREDGOVOR

Letos obeležujemo 50. obletnico poučevanja računalništva v slovenskih srednjih šolah. Leta 1971 je bila namreč imenovana komisija za uvajanje pouka računalništva v srednje šole, v šolskem letu 1971/72 pa se je začelo računalništvo v nekaterih srednjih šolah tudi organizirano poučevati.

Seveda se je samo računalništvo v Sloveniji pojavilo že dobrih 10 let prej. Prvo učenje programiranja v akademskem okolju, sicer bolj omejeno na posamezne tečaje, srečamo v poznih 60. letih prejšnjega stoletja. Spomin na takratne čase bledi in ta konferenca pomeni zbiranje zapisov o tem, kako se je vse skupaj začelo pa tudi nadaljevalo.

Podkonferenca na temo 50 let poučevanja računalništva v srednjih šolah v sklopu tradicionalnega multikonferenčnega dogodka Informacijska družba je ena od oblik zaznamovanja te tudi za tujino častitljive obletnice.

Časa za pripravo konference je bilo malo. Za celovitejši pregled bi morali na njej aktivno sodelovati še mnogi takratni zanesenjaki. A korak naprej pri pripravi zgodovinskega pogleda smo s tem le pripravili in ga bomo lahko v nadaljevanju dopolnjevali. V prispevkih tokratne konference se odsevajo dogajanja tako v Ljubljani kot v Mariboru.

Najprej smo skušali omejiti tematiko na začetke poučevanja računalništva v srednjih šolah v ozkem časovnem obdobju okrog leta 1971. Kasneje smo fokus konference nekoliko razširili tja do leta 1980, torej na čase, ko še ni bilo popularnih PC-jev, še manj pa Interneta; hkrati smo ga širili tudi na izobraževanje na akademski ravni in druge računalniške dejavnosti, predvsem razvojne, ki niso omejene le na srednje šole.

Tako smo prišli do zanimive zbirke pogledov, ki najprej nakazujejo razmere, v katerih je prišlo do pobude za uvedbo pouka računalništva v srednje šole. Pomembno pionirsko vlogo je pri tem igrala komisija za uvajanje računalništva v srednje šole. Potrebno infrastrukturo so takrat nudili nekateri redki računalniški centri. V akademskem okolju je tako marsikomu omogočal prve korake v programiranje legendarni računalnik ZUSE Z 23. V srednješolskem okolju se je hitro pokazala potreba po ustreznih slovenskih učbenikih, ustrezni računalniški infrastrukturi in seveda usposobljenih učiteljih. Zapise simpatično dopolnjujejo pogledi takratnih dijakov, danes uveljavljenih računalničarjev, o doživljanju prvih korakov v programiranju. Praktično v istem času srečamo tudi prve programerske predmete v akademskem okolju, kar je pripeljalo tudi do uvedbe študija računalništva, kmalu zatem tudi informatike na univerzitetnem nivoju. Spomine lepo zaokrožujejo pripovedovanja o celoviti, tudi akademski karieri nekaterih akterjev.

Seveda so to le nekateri pogledi, dejansko moramo gledati nanje kot na drobne, a pomembne kamenčke v pestrem mozaiku čedalje bolj živahnih dogajanj na računalniškem področju. Verjamemo, da lahko sčasoma to sestavljanko spominov še dopolnimo in primerno strukturiramo. To pa je že naloga za nov podvig, katerega rezultati bi lahko bili predstavljeni na naslednjih konferencah.

Prof. dr. Saša Divjak in mag. Alenka Krapež, sopredsednika Programskega odbora

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Matematiki in računalniško izobraževanje, do 1980

Mathematicians and computer education, until 1980

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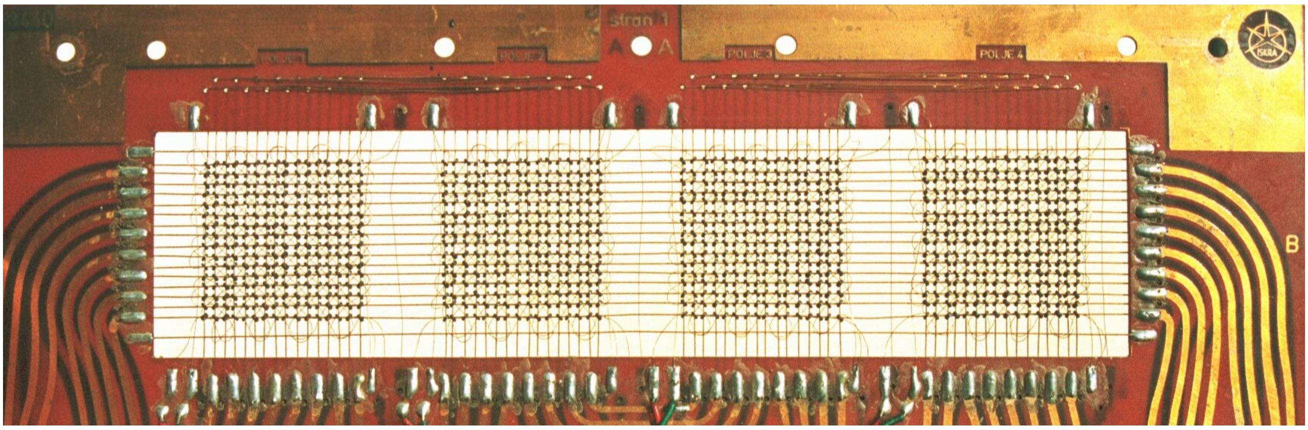

Slika 1: Del pomnilnika računalnika Zuse izdelan v Iskri.

POVZETEK

Sestavek vsebuje osebne spomine avtorja na pomembnejše dogodke v razvoju računalništva v Sloveniji do leta 1980 s poudarkom na izobraževanju.

KLJUČNE BESEDE

računalništvo, matematika, izobraževanje, prvi računalniki, spomini

ABSTRACT

The paper contains the author's personal memories of important events in the development of computer science in Slovenia until 1980, with an emphasis on education.

KEYWORDS

informatics, computer science, mathematics, education, first computers, memories

1 UVOD

Letošnja tema je 50 letnica srednješolskega računalniškega izobraževanja pri nas. Sam sem bil pri začetkih bolj opazovalec. Lahko pa marsikaj povem o kontekstu, v katerem se je to odvijalo. Posebej bi rad povzel vlogo matematikov pri razvoju računalništva pri nas. Podam lahko le osebno videnje dogajanj, ki lahko služijo kot vir za morebitne kasnejše celovitejše preglede.

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O tej tematiki sem pisal že ob drugih obletnicah [1] [15] [3]

2 MATEMATIKA

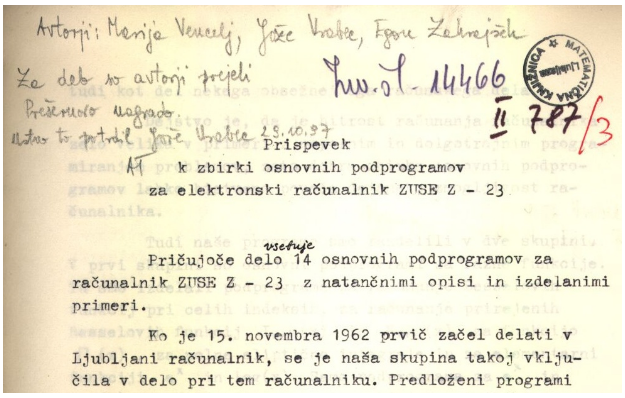
Slika 2: Knjige iz zbirke Sigma.

Študij matematike je prisoten na Univerzi v Ljubljani od njene ustanovitve. Spočetka je podpirala različne, predvsem tehniške, študije. Sam študij matematike pa je bil usmerjen predvsem v izobraževanje učiteljev matematike. Obsegal je pretežno predmete s področja matematične analize (in geometrije, algebre ter teorije števil; na ekonomiji še statistiko). Leta 1949 je bilo ustanovljeno stanovsko Društvo matematikov, fizikov in astronomov, ki vsako leto organizira občni zbor društva in izdaja društveno glasilo Obzornik. Organiziralo je tudi poljudna predavanja po šolah in od leta 1950 republiška tekmovanja iz matematike [9]. Leta 1959 je izšla prva knjiga v zbirki Sigma – Ivan Vidav: Rešeni in nerešeni problemi matematike.

V naslednjih letih je v Sigmi izšlo še več knjig, ki prinašajo "novo" matematiko, pomembno za računalništvo: Vadnal A. (1960) Elementarni uvod v verjetnostni račun, Prijatelj N. (1960) Uvod v matematično logiko, Križanič F. (1960) Elektronski aritmetični računalniki, Bohte Z. (1964) Numerično reševanje enačb, Jamnik R. (1964) Elementi teorije informacije, itd. Prof. Križanič se je z računalniki spoznal med svojim izpopolnjevanjem v Sovjetski zvezi.

Konec petdesetih so na študiju matematike vpeljali novo študijsko smer – tehniška matematika, ki naj bi usposabljala za potrebe gospodarstva. Prvi diplomant na tej smeri je bil Jože Vrabec leta 1963.

3 ZUSE Z-23


Avtorji: Marija Vencelj, Jože Vrabec, Egon Zakrajšek

Za delo so avtorji prejeli Prešernovo nagrado.

... to potrdil Jože Vrabec 29.10.97

Prispevek
k zbirki osnovnih podprogramov
za elektronski računalnik ZUSE Z - 23

Pričujoče delo vsebuje 14 osnovnih podprogramov za računalnik ZUSE Z - 23 z natančnimi opisi in izdelanimi primeri.

Ko je 15. novembra 1962 prvič začel delati v Ljubljani računalnik, se je naša skupina takoj vključila v delo pri tem računalniku. Predloženi programi

Slika 3: Začetek poročila o raziskovalnem projektu izdelave podprogramov za Zuse Z-23.

Leta 1960 je bil ustanovljen Inštitut za matematiko, fiziko in mehaniko (IMFM). Prvi direktor je bil Anton Kuhelj. 15. novembra 1962 je na IMFM na Lepem potu v Ljubljani začel delati prvi pravi računalnik v Sloveniji, Zuse Z-23 (Slika 3). Ta datum lahko štejemo za začetek računalništva pri nas. Pred tem so zahtevne izračune opravljali na računalniku IBM 705 na Zveznem zavodu za statistiko v Beogradu.

Okrog računalnika Zuse se je zbrala skupina mlajših učiteljev, raziskovalcev in študentov (Zvonimir Bohte, Tomislav Skubic, Egon Zakrajšek, Janez Štalec, Janez Lesjak, Jože Vrabec, Marija Vencelj, Tomaž Kalin, Dušan Magušar, Janez Grad, Cveto Trampuž, Mira Volk, Jana Birk, Boštjan Vilfan, Jernej Kozak, France Dacar, Andrej Kmet, Gabrijel Tomšič, Zdenko Breška, Iztok Kovačič, ...,), ki so postavljali temelje računalništva pri nas. Posebej je izstopal Egon Zakrajšek (diplomiral 1965) [21] [20]. Na študiju tehniške matematike so bili poleg predmeta numerična analiza še trije računski praktikumi – pri tretjem so uporabljali Zuse.

Zuse je bil računalnik v pravem pomenu besede – bil je namenjen predvsem za računanje. Zato je bil velik poudarek na numerični analizi, ki jo je pri nas začel razvijati Zvonimir Bohte – Dragi s sodelavci. Uporabljen pa je bil tudi v druge namene [23].

Slika 4: Zvonimir Bohte in Egon Zakrajšek.

4 TEHNIŠKA MATEMATIKA

Konec osnovne šole in nato v gimnaziji sem bil uspešen na matematičnih tekmovanjih. Na njih sem spoznal Tomaža Pisanskega – Toma in čez njega Franceta Dacarja. Maturiral sem leta 1967. Ker so mi ponudili štipendijo Sklada Borisa Kidriča, sem se odločil za študij tehniške matematike. Ta je takrat poleg matematičnih in fizikalnih predmetov vključevala še nekaj tehniških, kot so mehanika, strojni elementi in tehniško risanje, teorija preklopnih vezij ter teorija sistemov.

Leta 1969 smo na IMFM dobili nov računalnik IBM 1130, ki je dobil svoj prostor v novi zgradbi matematike in fizike na Jadranski 19.

Poleg numerične analize smo imeli tudi računski praktikum. Računali smo na računskih strojčkih. Za mojo generacijo so prispele nove Facit-ke. Sam sem izvisel (ni jih bilo dovolj) in sem dobil staro Olivetko. Izkazalo se je, da sem pravzaprav imel srečo – Olivetka je imela papirni trak na katerem je beležila sled izračunov. Računalniške predmete je predaval Egon. Najprej smo spoznali programski jezik fortran. Tisto leto so izšla skripta za fortran, ki jih je napisal mariborski matematik Milan Kac [16]. Egon je svoj učbenik objavil leta 1973 [19]. Leta 1968 je Donald Knuth začel objavljati svojo zbirko knjig The Art of Computer Programming, ki so precej vplivale tudi na računalniška predavanja na matematiki. Na primer, Tomo je za diplomsko temo (pri Egonu) izbral generatorje slučajnih števil. Dodatne računalniške vsebine so bile vključene v specialne tečaje. Sam sem tako spoznal jezik algol. Izbral sem tudi seminar iz linearnega programiranja. Pri programerskem praktikumu sem sam razvil algoritem za problem najkrajših poti (Forda in Dijkstra takrat še nisem poznal). Rešitev sem sprogramiral v fortranu in algolu. Algolski program je dajal pričakovane rezultate, v fortranskem pa sem skoraj pol leta iskal napako [4]. Diplomsko temo sem si izbral iz logike – Rekurzivna aritmetika (mentor Niko Prijatelj).

5 IJS E4

Računalništvo se je razvijalo tudi na Inštitutu Jožef Stefan (IJS). Glavno vlogo je imel Anton P. Železnikar – Antek, ki je leta 1965 doktoriral iz prekrivnih algoritmov [24]. Z njim je sodeloval tudi France Dacar in se na oddelku E4 tudi zaposlil. Na oddelku so bili še Janez Korenini, Rudi Murn, Peter Kolbezen, Marjan Špegel, Boštjan Vilfan in Andrej Jerman-Blažič. France Dacar je naju s Tomom povabil k sodelovanju z oddelkom. Tematika je bila odkrivanje napak v elektronskih vezjih. Tako sva se srečala s teorijo grafov in se vanjo poglobila (knjige Ore, Berge, Harary, Zykov). Poleg tega smo se precej ukvarjali s teorijo avtomatov in jezikov. Nekoliko za nama so na oddelek prišli še Ivan Bratko –

Slika 5: Anton P. Železnikar in Boštjan Vilfan.

Bruc, Vladislav Rajkovič, Iztok Lajovic, Iztok Sirnik, Jože Knez, Miroslav Smolej, Borka Džonova in Peter Tancig.

Oddelek (predvsem Andrej Jerman-Blažič) je že od leta 1965 v začetku oktobra na Bledu organiziral računalniško konferenco FCIP (International Symposium on Information Processing), ki se je leta 1972 preimenovala v Informatico. Vabljeni predavatelji Bauer, Wirth, in drugi.

Oddelek je nudil dobro okolje za samorazvoj. V sedemdesetih smo o svojih rezultatih v glavnem poročali in objavljali v zbornikih domačih srečanj FCIP / Informatica, Etan in ADP; deloma v slovenščini, deloma v angleščini.

6 FE, RRC, RCU, ISKRA, INTERTRADE IN DRUGI

Slika 6: RRC.

Računalništvo se je razvijalo tudi na Fakulteti za elektrotehniko – profesorji Jernej Virant, France Bremšak, Ludvik Gyergyek in Slavko Hodžar [11].

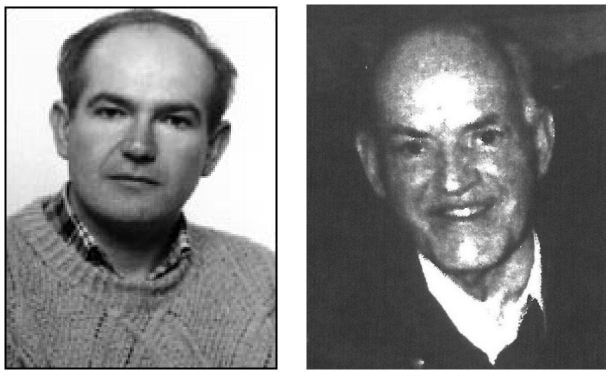
Leta 1968 je bil za potrebe gospodarstva, uprave in raziskav ustanovljen Republiški računski center (RRC) z računalnikom v Stegnah, najprej CDC 2100 kasneje pa CDC 3300 [12]. Za koordinacijo med Univerzo, IJS in RRC je bil leta 1971 ustanovljen Računalniški center univerze v Ljubljani (RCU). Zaradi povečanja potreb je RRC leta 1971 nabavil zelo zmogljiv računalnik CDC Cyber 72, ki je omogočal oddaljeni dostop s terminalskih računalnikov.

Na IJS se je izoblikovala še ena računalniška skupina – Uporabna matematika, ki jo je vodil Marjan Ribarič in so jo pretežno sestavljali matematiki: Jana Birk Vrabec, Mira Volk, Drago Čepar, Ivica Mandelc, Milena Kosec in drugi.

Leta 1969 so računalnik IBM 1130 dobili tudi na Višji tehniški šoli v Mariboru (Milan Kac, Darinka Ferjančič Stiglic, Bruno Stiglic) [16].

V gospodarstvu se je s svojo ponudbo uveljavil predvsem Intertrade (IBM). Ponujal pa jih je tudi Univac in drugi. Oktobra 1969 je v Radovljici začel z delom Intertradov šolski center.

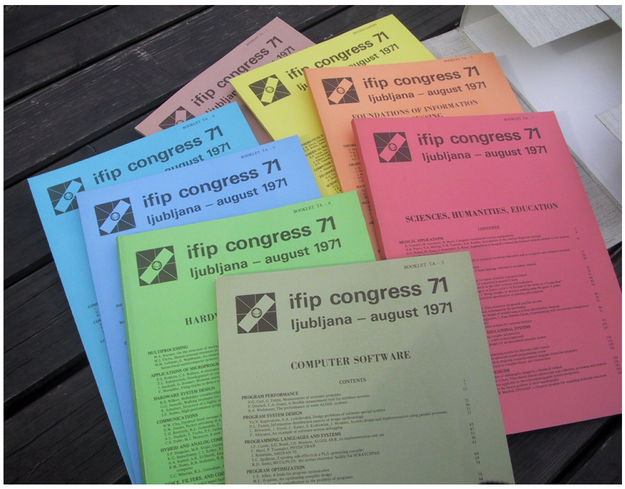
7 RAČUNALNIŠTVO V SREDNJIH ŠOLAH



Slika 7: Izidor Hafner in Branko Roblek.

V šolskem letu 1969/70 je Izidor Hafner začel uvajati računalništvo kot "praktično znanje" (izbirni predmet) na Šubičevi gimnaziji. Na njegovo pobudo je leta 1970 svetovalec za računalništvo na Zavodu za šolstvo RS Branko Roblek začel priprave za uvajanje računalništva kot izbirnega predmeta v srednje šole. Najprej so pripravili in izvedli izobraževanje učiteljev. Izšel je tudi priročnik za učitelje. Računalništvo je zaživelo na nekaj šolah v šolskem letu 1971/72. Nekakšen vrh teh prizadevanj predstavlja srednješolski učbenik Uvod v računalništvo, ki sta ga napisala Ivan Bratko in Vladislav Rajkovič. Na E4 se je pojavilo nekaj gimnazijcev: brata Reinhardt, Mark Martinec, Dare Levstek, Iztok Tvrdy, Henrik Krnec in drugi [10].

8 IFIP 1971



Slika 8: Zvezki IFIPovega zbornika.

Anton P. Železnikar in Silvin Leskovar sta pri mednarodnem združenju za področje računalništva IFIP (International Federation for Information Processing) uspela pridobiti organizacijo 5. kongresa združenja v Ljubljani od 21. do 27. avgusta 1971.

Pri organizaciji kongresa se je zelo angažiral Marjan Špegel in si s tem pridobil možnost doktorskega študija v ZDA. Mladi z IJS in univerze smo dobili vlogo tehničnih sekretarjev in smo skrbeli za gladek potek predstavitev v raznih dvoranah po Ljubljani.

Ob IFIPu je izšla knjiga Elektronski računalniki, ki prinaša temeljna znanja o računalnikih in štirijezični slovar računalniških izrazov [17].

9 PRVA POLOVICA SEDEMDESETIH

Kongres IFIP'71 in novi računalnik Cyber 72 sta zelo vzpodbudno vplivala na razvoj računalništva pri nas.

Leta 1972 je bilo ustanovljeno Slovensko društvo Informatika. Z delom je začel Računalniški center na FSPN in naslednje leto še Inštitut za biomedicinsko informatiko (IBMI).

Na Dragijevo pobudo se je jeseni leta 1971 začel sestajati Seminar za numerično in računalniško matematiko – Sredin seminar [5]. Udeleževali so se ga matematiki in računalnikarji z različnih ustanov. Bil je odprt za najrazličnejše teme in je spremljal delo sodelujočih ter v naš prostor prinašal novosti. Po seminarju smo nadaljevali druženje Pod lipo in daljše obdobje še "na čaju" pri Egonu doma, kjer smo preizkušali najrazličnejše družabne igre (Monopoli, Cluedo, mahjong, kariere, tihotapci, itd.).

Na študiju tehniške matematike se je začela graditi računalniška "vertikala" – vsaj en računalniški predmet v vsakem letniku. Začela so se tudi predavanja iz računalništva (Jernej Kozak) za druge oddelke FNT: kemija, kemijska tehnologija, tekstil, farmacija in montanistika. Egon je za Sredin seminar pripravil ciklus predavanj iz Algola 68 [5, št. 29, 30]. Imel je tudi tečaj iz zbirnika računalnika Cyber in napisal več priročnikov za uporabo sistemskih programov (SCOPE 3.4, UPDATE, NOS/BE, CCL, Plotter).

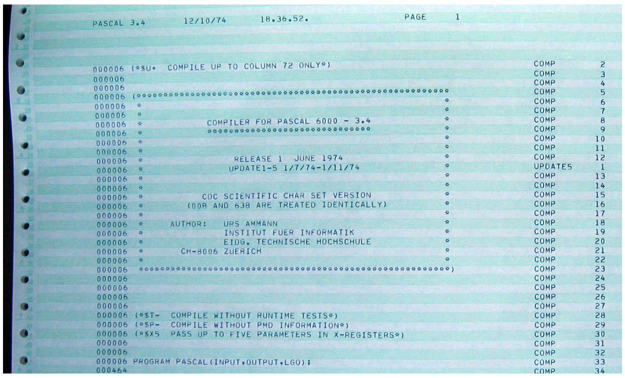
Ljubljano je nekajkrat obiskal Robert Korfhage, ki je imel tudi tečaj iz teorije grafov.

Precej odmeven je bil Dijkstrov članek v CACM "Go to considered harmful", ki je privedel do strukturiranega programiranja [5, št. 28, 51]. Za teorijo algoritmov je bil zelo pomemben Karpov članek v katerem je pokazal, da za nekatere probleme, za katere so bili znani le eksponentni točni algoritmi, najbrž ne obstaja polinomski algoritem (NP-polnost).

Z doktorskega študija na MIT v ZDA se je vrnil na IJS Boštjan Vilfan. Prinesel je nov veter. Med drugim je začel projekt pisanja prevajalnika za jezik PL/1. Meni je bilo dodeljeno prevajanje aritmetičnih izrazov [2]. Izkušnja je bila zelo poučna – postalo mi je jasno od kod ideje za posamezne vrste slovnic (gramatik), ki sem jih poznal iz člankov o formalnih jezikih. Drug projekt je bil kodiranje (v zbirniku) sprememb za telefonske centrale Metaconta, ki so jih pripravljali v Iskri. Pri tem sem spoznal pomembnost polne informacije – večkrat sem moral v Kranj zaradi nepopolnih specifikacij. Na Sredinem seminarju sva z Vilfanom imela ciklus predavanj o rekurzivnih funkcijah [5, št. 7]

V šolskem letu 1972/73 se je na FE v sodelovanju s FNT, matematika začel dvoletni (zadnja dva letnika) študij računalništva [11]. Matematika je pokrivala predmete: numerična analiza (Zvonimir Bohte), diskretne strukture (Niko Prijatelj), analiza (Peter Petek) in linearna algebra (Edvard Kramar).

Bruc, ki je bil izvrsten šahist, se je začel ukvarjati z umetno inteligenco [5, št 37]. Sodeloval je tudi z Vero Levovnik iz Iskre (v Tobačni tovarni). Vprašal me je, če bi pripravil pregled literature o delu z razpršenimi (hash) tabelami. Ugotovil sem, da obstajajo kvadratične funkcije pregledovanja, ki preiščejo celotno tabelo. O tem sem objavil članek v CACM [6] [5, št. 22, 23].


```
PASCAL 3.4       12/10/74       18.36.52.                 PAGE     1

000006 (*$U+  COMPILE UP TO COLUMN 72 ONLY*)                          COMP        2
000006                                                                COMP        3
000006                                                                COMP        4
000006 (*******************************************************       COMP        5
000006  *                                                     *       COMP        6
000006  *                                                     *       COMP        7
000006  *            COMPILER FOR PASCAL 6000 - 3.4           *       COMP        8
000006  *            ******************************           *       COMP        9
000006  *                                                     *       COMP       10
000006  *                                                     *       COMP       11
000006  *                RELEASE 1  JUNE 1974                 *       COMP       12
000006  *               UPDATE1-5 1/7/74-1/11/74              *       UPDATE5     1
000006  *                                                     *       COMP       13
000006  *                                                     *       COMP       14
000006  *             CDC SCIENTIFIC CHAR SET VERSION         *       COMP       15
000006  *          (00B AND 63B ARE TREATED IDENTICALLY)      *       COMP       16
000006  *                                                     *       COMP       17
000006  *       AUTHOR:    URS AMMANN                         *       COMP       18
000006  *                  INSTITUT FUER INFORMATIK           *       COMP       19
000006  *                  EIDG. TECHNISCHE HOCHSCHULE        *       COMP       20
000006  *         CH-8006 ZUERICH                             *       COMP       21
000006  *                                                     *       COMP       22
000006  *******************************************************)      COMP       23
000006                                                                COMP       24
000006                                                                COMP       25
000006                                                                COMP       26
000006                                                                COMP       27
000006 (*$T-  COMPILE WITHOUT RUNTIME TESTS*)                         COMP       28
000006 (*$P-  COMPILE WITHOUT PMD INFORMATION*)                       COMP       29
000006 (*$X5  PASS UP TO FIVE PARAMETERS IN X-REGISTERS*)             COMP       30
000006                                                                COMP       31
000006                                                                COMP       32
000006 PROGRAM PASCAL(INPUT,OUTPUT,LGO);                              COMP       33
000464                                                                COMP       34
```

Slika 9: Začetek izpisa pascalskega prevajalnika, december 1974.

Poleti 1974 sem spremljal soprogo Nušo (Anuška Ferligoj) na poletni šoli iz družboslovne metodologije (Essex ECPR summer school) v Colchestru v VB. Sam sem poslušal le predavanja iz analize družbenih omrežij. Večino časa pa sem prebil v računskem centru in knjižnici. V RC sem se srečal z interaktivnim delom z računalnikom po teleprinterju. Med branjem člankov (predvsem iz Acta Informatica) sem se navdušil nad pascalom. Izvedel sem, da teče na Cybru in, da ga je mogoče dobiti brezplačno. Vzpostavili smo stik in proti koncu leta dobili trak s pascalskim prevajalnikom (Slika 9). V začetku leta 1975 je Egon pripravil tečaj iz pascala (z zapiski). Dopolnjene zapiske je leta 1976 izdal v knjigi [22]. V šolskem letu 1975/76 smo pascal, skupaj z obema Wirthovima knjigama, na Matematiki začeli uporabljati pri predavanjih. Knjigi je Boštjan Vilfan prevedel v slovenščino [18].

Dobili smo prve prave terminale, ki so omogočali interaktivno delo z računalnikom [5, št. 52, 53].

Leta 1975 sem se z IJS preselil na FNT, matematika. V šolskem letu 1974/75 sem pri Programerskem praktikumu prevzel skupino študentov, ki je programirala "prevajalnik" za Structran (Structran → fortran) [5, št. 50]. Programiranje smo začeli v fortranu, a, ker ga je Egon čez nek weekend napisal v pascalu, smo nadaljevali v samem Structranu. Glavno povezovalno delo posameznih sestavin je opravil Matjaž Jeran.

Jeseni 1975 sva s Tomom odšla k vojakom.

10 DRUGA POLOVICA SEDEMDESETIH

Po vrnitvi iz vojske sem nekaj časa pomagal pri vajah iz računalništva na ostalih oddelkih FNT. Leta 1978 je Jernej doktoriral in začel predavati na Matematiki predmet Podatkovne strukture in algoritmi [13]. Za njim sem prevzel predavanja na FNT [7]. Prav tako sem leta 1978 od prof. Prijatelja prevzel predavanja iz Diskretnih struktur na študiju računalništva – delo na diplomskem delu in izkušnje z IJS so se mi obrestovale pri oblikovanju vsebine.

V tem času smo se precej ukvarjali s strukturiranim programiranjem, dokumentacijo programov in učenjem programiranja [5, št. 55, 56, 58, 76][14]. Navajali smo se tudi na interaktivno delo z računalnikom. Egon je z Univaca v Zagrebu prinesel zbirko igric napisanih v basicu. Več smo jih poslovenili in usposobili za delo na Cyberu. Zelo priljubljena je bila igra Zakladi (Dungeon). Za učinkovito interaktivno delo so manjkala ustrezna orodja. Nekaj jih je sprogramiral Egon: Mini (interaktivna različica programa Update za vzdrževanje različic programskih in podatkovnih datotek) in Manual (program za oblikovanje besedil). Pri oblikovanju besedil na prvih računalnikih sta bili težavi: na voljo so bile samo velike črke in manjkale so naše črke ČŠŽ. Kljub temu je bilo veliko besedil pripravljenih s programom Manual.

V RC IMFM smo dobili računalnik PDP z grafičnim zaslonom, na katerega je bilo mogoče risati. Prav tako so dobili risalnik v RRC.

Leta 1977 so se po zgledu matematičnih tekmovanj, zopet na pobudo Izidorja Hafnerja, začela republiška tekmovanja srednješolcev iz računalništva [8]. Slovensko društvo Informatika je začelo izdajati revijo Informatica.

Slika 10: Rok Vidmar in DEC SYSTEM 10 na RCU.

Za podporo množičnega dela študentov na računalniku smo leta 1980 dobili na RCU računalnik DEC-10. Ta je med drugim prinesel tudi male črke. Elektrotehna, zastopnik DECa v Jugoslaviji (od 1974), se je prelevila v podjetje Iskra Delta, ki je postalo pomemben dejavnik na področju računalništva. Na obzorju so se pojavili TOZDi in usmerjeno izobraževanje.

OPOMBE

Sestavek vsebuje spomine. Vsega napisanega nisem uspel preveriti v dokumentih. Zato se mi je tu pa tam lahko zapisala kaka netočnost.

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Komisija za uvajanje računalništva v srednje šole

The Commission for the Introduction of Computer Science in Secondary

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POVZETEK

V članku opisujem svoje delovanje na področju računalništva v srednjih šolah in dajem kratke predstavitve članov komisije za uvajanje računalništva v srednje šole.

KLJUČNE BESEDE

Programiranje, pouk, srednje šole

ABSTRACT

In this article, I describe my work in the field of computer science in secondary schools and give short presentations by members of the commission for the introduction of computer science in secondary schools.

KEYWORDS

Programming, teaching, secondary education

1 UVOD

Po maturi l. 1968 na Šubičevi gimnaziji sem se vpisal na študij tehnične matematike na FNT. V jeseni istega leta smo Ivan Bratko, Iztok Lajovic in Vladislav Rajkovič na IJS hodili na tečaj fortrana, ki ga je vodila matematičarka Mira Volk. Računalnik IBM 1130 je prišel šele po koncu seminarja, to je v začetku l. 1969.

Kot študent sem delal na odseku uporabne matematike IIS pri Cvetu Trampužu. Moja prva naloga je bila, da sem prenesel ročne izračune za termo centrale za IB Elektro Projekt na računalnik IBM 1130. Po tem programu je bil izdelan hladilni stolp za blok 4 v Šoštanju (pozneje tudi blok 5).

Takrat sem uvidel, da lahko srednješolec z znanjem programiranja lahko naredi veliko, saj se med gradbeniki ni kaj dosti vedelo o računalnikih. Zato sem prišel na idejo, da se programiranje vključi v srednje šole. Zavedal pa sem se, da je stvar bolj za izbrance. Po mojih takratnih podatkih je bilo za praktična znanja v gimnazijah na razpolago 2 uri tedensko v enem polletju tretjega ali četrtega letnika. Tako sem izvajal praktična znanja iz računalništva na Šubičevi v prvem polletju šolskega leta 1969/70. Kmalu po končanju tega pouka sem zaprosil očeta Vinka (1920-2015), da me poveže z Borisom Lipužičem (1930-2012), direktorjem Zavoda za šolstvo. Na sestanku je sodeloval tudi Branko Roblek, ki je bil na Zavodu zadolžen za obdelavo podatkov. Predlagal sem nekaj ljudi, ki bi lahko sodelovali pri tem. V l. 1970 smo imeli na Zavodu par sestankov, a se od udeležencev spominjam le Rajkoviča, Robleka in Trampuža. Rajkovič je bil zadolžen za pripravo učnega načrta, pouk pa naj bi stekel v šolskem letu 1970/71 na petih gimnazijah. Pouk sem izvedel še v prvem polletju leta 1970/71. Zadnjega sestanka sem se udeležil v začetku leta 1971 in povedal, da zaradi diplome ne bom več sodeloval.

Od dijakov se spominjam Mirka Ivančiča, ki se je pozneje vpisal na Fakulteto za elektrotehniko. Šele po 45 letih sem izvedel, da je bil med dijaki tudi Marko Petkovšek, ki poslušal moja predavanja v 2. letniku, nato pa pri Bratku v 4. letniku. Prav tako sem šele po 45 letih izvedel, da se je organizirani pouk računalništva začel šele šolskega leta 1971/72.

Imenovan sem bi v komisijo za uvajanje računalništva 8.9. 1971, a pri njenem delu nisem sodeloval. Po diplomi septembra 1972 sem takoj dobil službo asistenta za matematiko na FE. Računalništvo sem opustil in se posvetil čisti matematiki.

Že pred projektom septembra 1971 je bilo nekaj primerov seznanjenja srednješolcev z računalništvom. Peter Prelog je na Gimnaziji Trbovlje vključil nekaj fortanskih programov kar v pouk matematike in jih preizkusil na Rudisovem IBM 1130, sam sem na povabilo Marije Munda predaval o fortranu na Gimnaziji Miloša Zidanška v Mariboru… Prvi učitelji računalništva v šolskem letu 1971/72 na gimnazijah so bili Bratko, Kac, Lajovic, Rajkovič, Roblek in Savnik. Za srednji elektrotehniški šoli (Maribor, Ljubljana) podatka nimam, je pa poučeval računaništvo na Vegovi v šolskem letu 1973/74 Veselko Guštin (1948).

Tekmovanju srednješolcev iz računalništva je bilo v planu že l. 1975, da bi povečali vpis na smer računalništvo, vendar se med mojim vojaškim rokom 1975/1976 ni nič premaknilo. Ko sem prišel iz vojske, sem se zadeve lotil in vodil organizacijo tekmovanja kot tajnik komisije za popularizacijo računalništva pri društvu Informatica, ki je imela sedež na IJS. Prvo tekmovanje je potekalo 17. aprila 1977 na FE.[3, 4, 8, 11]

Ko se je pojavilo usmerjeno izobraževanje, se je pojavila možnost za vpeljavo srednješolskega izobraževanja za računalništvo. V tem smislu je bila narejena Virantova študija o

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računalniških poklicih. Na tej osnovi sem se lotil profilov poklicev računalniški in programerski tehnik. Namreč brez sprejetih profilov na Zavodu za zaposlovanje ni bilo mogoče imeti izobraževanja. To smo vključili tudi v raziskavo pri RCPU, kjer se na moje presenečenje preselil projekt z Zavoda za šolstvo. Prvi programerski in računalniški tehniki so prišli na fakulteto l. 1985. Takrat sem zamenjal Hodžarja (1923-2010) pri predmetu Osnove programiranja (fortran, pascal). Tako sem spet stopil za nekaj časa med računalnikarje. [5, 6, 7, 11]
Leta 1987 sem bil predsednik komisije krožkov robotike pri Zavodu za šolstvo.
Ker je minilo 50 let od imenovanja komisije za uvajanje računalništva v srednje šole, se mi je zdelo potrebno, da se spomnimo članov komisije, od 12 članov je živih le še 5. Vrstni red je tak kot v odločbi.

2 KOMISIJA 1971

Branko Roblek (1934–2000) je maturiral na Gimnaziji v Kranju, na Univerzi v Ljubljani je diplomiral iz fizike l. 1959, in iz matematike l. 1962. Od l. 1962 je poučeval na Gimnaziji Škofja Loka. Potem je štiri leta delal na Zavodu RS za šolstvo kot pedagoški svetovalec za naravoslovje in bil imenovan za predsednika komisije za uvajanje računalništva v srednje šole. Leta 1973 se je vrnil na Gimnazijo Škofja Loka in tam vse do upokojitve leta 1992 učil matematiko, fiziko in računalništvo z informatiko. V Društvu matematikov, fizikov in astronomov Slovenije je leta 1970 prejel priznanje za uspešno pedagoško delo in hkrati organiziranje in smotrno vodenje krožkov, posebno astronomskega.

Virant Jernej (1932–2008) je l. 1965 magistriral in l. 1966 doktoriral iz elektrotehnike. Leta 1971 je bil izvoljen za izrednega in l. 1977 pa za rednega profesorja za predmete s področja računalniške logike in računalniških sistemov. Na fakulteti za elektrotehniko je organiziral laboratorij za digitalne računalnike. V času 1977-1979 je bil dekan Fakultete za elektrotehniko.

Cveto Trampuž (1935–1999) je diplomiral l. 1966 na Fakulteti za naravoslovje in tehnologijo v Ljubljani. Od l. 1957 je delal na Inštitutu Jožef Stefan, tudi kot v. d. direktorja Republiškega računskega centra. Med leti 1970-96 je bil zaposlen na Fakulteti za družbene vede v Ljubljani, najdalj kot predstojnik računalniškega centra. Bil je med prvimi računalnikarji v Sloveniji, na FDV pa je v družboslovje uvajal računalniško podprte matematične in statistične metode. Zaslužen je bil za ustanovitev študijske smeri družboslovna informatika.

Egon Zakrajšek (1941–2002) je maturiral na Gimnaziji Jesenice. Diplomiral je iz tehniške matematike. Za podprograme za prvi elektronski računalnik v Sloveniji ZUSE Z-23 (z elektronkami, velik nekaj 10 m3) je dobil študentsko Prešernovo nagrado. Bil je največji slovenski strokovnjak za ta računalnik. Leta 1968 je prevzel vodenje Računskega centra Inštituta za matematiko, fiziko in mehaniko in skrbel tudi za programsko opremo ter reševal računalniške probleme iz drugih strok in iz gospodarstva. Leta 1978 je doktoriral in bil izvoljen v naziv izrednega profesorja.

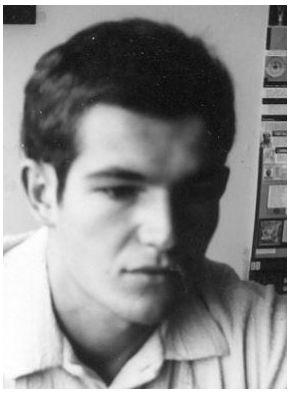
Mira Volk (1939) je maturirala na Gimnaziji Brežice in se nato l. 1957 vpisala na študij matematike. Po diplomi l. 1962 se je zaposlila na IJS. Ko je IJS l. 1972 ustanovil RRC se je prezaposlila na RRC, kasneje pa se je zaposlila nazaj na IJS na odseku za uporabno matematiko. Za potrebe programiranja na računalniku ZUSE Z 23 je bila Mira poslana v Bad Hersfeld, najprej na tečaj algola in potem je za potrebe programiranja IBM 1130 preučila fortran, napisala knjigo in nadalje učila fortran tudi druge.

Janez Lesjak (1942) se je rodil v Novem mestu. Leta 1966 je diplomiral iz fizike. Da je res zašel v računalništvo, je bilo krivo tudi to, da je ZUSE Z23 iz razstavišča ostal l. 1962 v Ljubljani in je bil instaliran na Metalurškem inštitutu, čisto blizu njegovega doma. Skupaj z Zakrajškom sta naredila veliko programov za omenjeni računalnik. Ko je bil nabavljen računalnik Cyber 72 leta 1972 je postal glavni sistemski inženir Republiškega računskega centra.

Vladislav Rajkovič (1946). Po diplomi iz elektrotehnike se je zaposlil na IJS. Leta 1970 je bil zadolžen za pripravo učnega načrta za izbirni predmet računalništvo za gimnazije. Skupaj z Ivanom Bratkom sta napisala učbenik, ki je izšel l. 1974. Sta najzaslužnejša za uveljavitev računalništva v srednjih šolah. Leta 2010 je mu je Univerza v Mariboru podelila naziv zaslužni profesor.

Milan Kac (1924-2010) se je rodil v Lendavi. Leta 1949 se je vpisal na študij matematike v Ljubljani, kjer je diplomiral l. 1953. Najprej je poučeval matematiko na I. gimnaziji v Mariboru, po l. 1960 pa je predaval na Višji tehniški šoli. Doktoriral je l. 1975 na Tehniški visoki šoli v Gradcu. Napisal je več učbenikov za matematiko in l. 1970 priročnik za fortran.
Leta 1992 mu je Univerza v Mariboru podelila naziv zaslužni profesor.

Franc Savnik (1940) se je rodil na Sušaku, maturiral l. 1958 na gimnaziji Brežice in diplomiral l. 1963 na pedagoški smeri PMF Univerze v Zagrebu. S programiranjem se je seznanil kot izredni študent smeri Praktična matematika na PMF. Računalništvo je na Gimnaziji Brežice poučeval 25 let (1971/72 do 1995/1996), tudi med sedemletnim službovanjem na Zavodu za šolstvo SRS (1972/1973 - 1978/79). Leta 1996 je prejel nagrado RS na področju šolstva.



Izidor Hafner (1949) je diplomiral na smeri tehnična matematika l. 1972 in magistriral iz funkcionalne analize l. 1974. Iz računalništva je doktoriral l. 1984. Leta 2000 je bil odlikovan s Častnim znakom svobode RS za zasluge pri uvajanju računalništva in logike v srednje šole ter za delo z mladimi na tem področju.

Bogomir Horvat (1936-2013) je bil predavatelj elektrotehnike na Visoki tehnični šoli v Mariboru. V obdobju 1975-1977 je bil tudi dekan te ustanove. Študenti se ga spominjajo kot odličnega strokovnjaka. Upokojen je bil kot profesor na FERI v Mariboru.

Milan Adamič (1938-2019) se je rodil v Vidmu-Dobrepolje. Leta 1964 je diplomiral s področja pedagogike in psihologije. Leta 1969 je pričel delati na Zavodu za šolstvo kot pedagoški svetovalec za izobraževalno tehnologijo in od leta 1978 kot pedagoški svetovalec za osnovno šolo. Leta 1993 se je zaposlil na Oddelku za pedagogiko FF v Ljubljani.

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50 let od uvedbe predmeta računalništvo v srednje šole: poskusni pouk in učbenik

Introducing Informatics in secondary schools 50 years ago: Experimental teaching and text book

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POVZETEK

Letos mineva 50 let od uvedbe poskusnega pouka računalništva v slovenske srednje šole. V tem prispevku navajamo nekaj zgodovinskih dejstev o projektu uvedbe pouka računalništva pred 50 leti ter opišemo naše lastne spomine na to, kako smo sodelovali pri poskusnem pouku računalništva in kako je nastal učbenik za ta predmet.

KLJUČNE BESEDE

srednješolski pouk računalništva, poskusni pouk, učni načrt, učbenik

ABSTRACT

Fifty years ago, experimental teaching of informatics was introduced in secondary schools in Slovenia. In this paper, we present some historical facts about the introduction of the informatics course 50 years ago, and describe our memories of our own involvement in the teaching of informatics at that time, and the writing of the textbook for this course.

KEYWORDS

teaching informatics in secondary schools in Slovenia, experimental teaching, informatics curriculum, informatics textbook

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1 UVOD

Letos mineva 50 let od uvedbe poskusnega pouka računalništva v slovenske srednje šole. Projekt uvedbe tega pouka je začel Zavod za šolstvo Republike Slovenije l. 1971. V nekaj letih, do š.l. 1974/75, je predmet Računalništvo zajel 65 srednjih šol in 2500 srednješolcev, izšel je učbenik, usposobljenih je bio 75 učiteljev za ta predmet.

S tem projektom je Slovenija močno prehitela druge republike tedanje Jugoslavije in bila po nekaterih ocenah v tem pogledu med vodilnimi v Evropi. Boris Lipužič, tedanji direktor Zavoda za šolstvo, je l. 2010 v opisu tega projekta zapisal [8]: "Poročilo Generalnega direktorata za izobraževanje in kulturo Evropske komisije na sedežu EU v Bruslju za leto 2000/01 navaja, da je Slovenija začela vpeljevati pouk računalništva v srednjih šolah že leta 1974, celo pred Zvezno republiko Nemčijo – ta je uvajanje zastavila šele v poznih sedemdesetih letih (*Basic Indicators on the incorporation of ICT into European Education Systems, Facts and figures, Eurydice 2001, str. 17, Brussels*)." Omenimo, da gornji citat iz Lipužičevega članka ni povsem dobeseden prevod navedbe v originalnem dokumentu Evropske komisije. Tudi ni povsen jasno, kaj je točno mišljeno z letnico 1974. Vendar tudi originalno besedilo nedvomno uvršča pouk v Sloveniji med najbolj zgodnje v Evropi.

V pričujočem prispevku navajamo nekaj zgodovinskih dejstev o projektu uvedbe pouka računalništva pred 50 leti ter opišemo naše lastne spomine na to, kako smo sodelovali pri poskusnem pouku računalništva in kako je nastal učbenik za ta predmet.

2 PROJEKT UVEDBE SREDNJEŠOLSKEGA POUKA RAČUNALNIŠTVA

V tem razdelku so navedena dejstva o projektu uvedbe pouka računalništva v srednje šole v Sloveniji.

5. 4. 1971 je bilo poslano prvo vabilo z Zavoda za šolstvo RS Slovenije za sestanek za pripravo projekta za postopno uvajanje pouka o računalništvu v srednje šole.

13. 4. 1971 je potekal v direktorjevi pisarni na Zavodu sestanek o pouku računalništva na srednjih šolah. S strani Zavoda sta sodelovala Milan Adamič in Branko Roblek, s strani Instituta »Jožef Stefan« Vladislav Rajkovič, Cveto Trampuž in Mira Volk, Fakulteto za elektrotehniko je zastopal Jernej Virant, Republiški računski center Janez Lesjak, INFIM Egon Zakrajšek in Višjo tehniško šolo Maribor Milan Kac. Sprejeta sta bila dva sklepa:

a) V šolskem letu 1971/72 se uvede poskusni pouk računalništva v štirih izbranih šolah. Pouk naj bi se odvijal v obliki izbirnega predmeta v okviru ur za praktična znanja.
b) Treba je izdelati učni načrt in z njim v skladu pripraviti ustrezni učbenik.

Koncem aprila 1971 je Zavod pripravil Projekt uvajanja pouka o računalništvu v srednje šole. Projekt je vodil Branko Roblek. Predvideno je bilo postopno uvajanje s sprotno evalvacijo v šolskih letih od 1971/72 do 1975/76.

Postopno naj bi se povečevalo število šol. Posebej je bil izpostavljen problem učnega kadra. V začetku naj bi poučevali računalniški strokovnjaki iz okolja, ob sprotnem usposabljanju učiteljev iz šol. V ta namen je bil organiziran tečaj za učitelje in pripravljeno gradivo »Računalništvo« sedmih avtorjev (slika 1).

12.7.1971 je Zavod razposlal vabilo petim gimnazijam in dvema tehniškima šolama za pričetek poskusnega izvajanja pouka računalništva.

S pričetkom projekta se je pričela tudi priprava učnega načrta predmeta. Pri tem smo se v večji meri opirali na priporočila IFIP-a, ki je leta 1970 organiziral 2. svetovno konferenco Computers in Education. Posebno vzpodbudo je predstavljal tudi IFIP-71, svetovni računalniški kongres, ki je potekal v Ljubljani.

Učni načrt je obsegal 52 ur. Od tega je bilo namenjenih 8 ur pripravi problema in rešitve ter 22 ur programskemu jeziku fortran. Predvideno je bilo praktično delo na računalniku: izdelava in testiranje programa.

Leta 1974 je izšel učbenik Uvod v računalništvo, ki je bil ponatisnjen še sedemkrat v več kot 20.000 izvodih [3].

Iz leta v leto se je povečevalo število šol, kjer se je poučeval predmet računalništvo, število učencev pa tudi število učiteljev, saj se izobraževanje na že omenjenem posebnem tečaju za učitelje. Ti podatki so prikazani v tabeli 1.

Rezultati projekta so bilo objavljeni tudi na IFIP 2nd World Conference Computers in Education leta 1975 [6].

Leta 1977 so se pričela tudi tekmovanja srednješolcev iz računalništva. Leta 1981 je v 3.000 izvodih izšla zbirka nalog [1].

Leta 1980 je izšel učbenik »Osnove tehnike in proizvodnje« v okviru skupnih izobraževalnih osnov v srednjih šolah. V tem učbeniku je bilo tudi poglavje » Informatika in računalništvo« na 38 straneh [4]. Učbenik je bil še dvakrat ponatisnjen v skupnem številu 52.000 izvodov.

Leta 1981 je založba Univerzum izdala mapo s prosojnicami in diapozitivi v pomoč učiteljem pri poučevanju informatike in računalništva.

Že koncem sedemdesetih let se je začel poučevati programski jezik pascal. Temu je sledil novi učbenik Računalništvo s programskim jezikom pascal, ki je izšel 1984 [5]. Ta učbenik je bil ponatisnjen še štirikrat v skupni nakladi 24.000 izvodov. Zadnjič leta 1989.

Z razvojem programskega jezika pascal, natančneje z razširitvami turbo pascala, se je pojavila tudi potreba po ustreznem učbeniku. Ta je izšel 1990 v nakladi 5.000 izvodov [2].

Tabela 1: Rast obsega pouka po šolskih letih

Š. leto	Šol	Razredov	Dijakov	Učiteljev
1971/72	7	12	200	-
1972/73	20	30	500	25
1973/74	40	75	1800	50
1974/75	65	100	2500	75

Slika 1: Gradivo za tečaj za učitelje

Slika 2: Prvi učbenik

3 POSKUSNI POUK IN UČBENIK

Jeseni 1971 se je začel poskusni pouk računalništva na izbranih srednjih šolah. Na gimnazija Bežigrad smo učili soavtorji tega prispevka. Ta pouk nam je bil vsem trem v veliko veselje, pravzaprav tako kot skoraj vse, s čimer smo se takrat ukvarjali.

Bili smo eno leto po diplomi na Fakulteti za elektrotehniko v Ljubljani. Kar nas je posebej kvalificiralo za ta pouk, je bilo to, da smo se med študijem, pravzaprav bolj ob študiju, naučili tudi nekaj računalništva, med drugim programirati v algolu in fortranu. Prve programerske korake smo naredili na računalniku Zuse na Fakulteti za matematiko in fiziko. Toda za delo na tem računalniku si moral z našim statusom študenta vstati ob 6h zjutraj, sicer pa je bil računalnik zaseden. No, ko smo prešli na fortran in začeli programirati za nekatere znane profesorje na Univerzi in Institutu Jožef Stefan, so se nam še pred diplomo pogoji za delo na računalnikih močno popravili.

Ko smo začeli s poskusnim poukom računalništva, se nam je iztekalo prvo leto naše zaposlitve v Oddelku za elektroniko na Institutu Jožef Stefan. Ob zaposlitvi so nam dodelili skupno "pisarno", osamljeno sobo na sicer povsem neobdelanem podstrešju. Takrat, ob navdušenju nad prvo zaposlitvijo v zanimivem raziskovalnem okolju skoraj niti nismo opazili, kako neprimeren delovni prostor je bil to. Pot do naše pisarne je vodila po neobljudenem podstrešju med tramovjem in ovirami, ki so naključno ležale po podstrešju. Hoja do pisarne je zato bila svojevrstna pustolovščina, posebej v temi ponoči. Naša soba je imela le majhno strešno okno, pravzaprav strešno lino. Poletne temperature v tem prostoru so bile neznosne. Toda nič od tega nas ni posebej motilo, saj smo bili tako zaposleni s svojim raziskovalnim delom in aplikativnim delom, nenehnimi pogovori o novih in novih idejah, ves čas se je dogajalo kaj zanimivega.

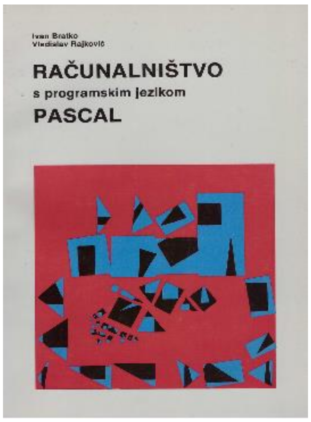
Del tega vzdušja so bile tudi naše priprave na pouk računalništva. Temu je bilo namenjeno dopoldne vsak torek v tednu, ko je imel tisto popoldne prvi od nas naslednjo uro pouka na gimnaziji. Takrat smo prediskutirali stanje pouka, izkušnje iz prejšnjega tedna ter naredili načrt, kaj bomo učili ta teden.

Vseskozi smo bili trdno odločeni, da se držimo nekaterih osnovnih načel: da bomo spodbujali aktivno delo učencev, učili reševanje problemov z računalniki z mnogimi primeri in da bomo veliko od tega dejansko sprogramirali ter kolikor bo možno tudi izvedli na računaniku. Za pouk nam je bil dosegljiv, sicer v zelo omejenem obsegu le računalnik IBM 1130 na Fakulteti za matematiko in fiziko na Jadranski cesti. Programski jezik je bil fortran. Mislim, da smo nazadnje vsi dosegli, da je vsak naš učenec napisal vsaj po en svoj program, ga spravil na luknjane kartice in izvedel na računalniku. Program na luknjanih karticah je izgledal kot paket kart, ki smo ga navadno speli z elastiko, da se kartice ne bi po nesreči pomešale. V tej zvezi se spomnimo zabavnega dogodka, ko je nek dijak v svoji raztresenosti vstavil v računalnik svoj paket lunkjanih kartic kar z elastiko vred. Čitalnik kartic je ob branju kartic elastiko takoj raztrgal in se ob tem pokvaril …

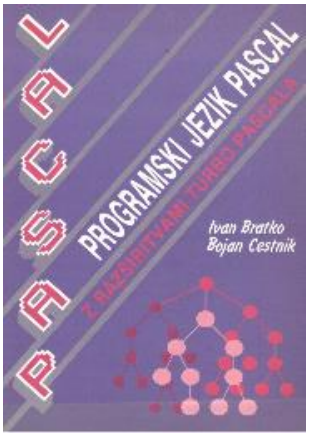
Med našimi učenci pri takratnem pouku tistega leta ali kakšno leto kasneje so bila tudi imena, ki so kasneje postala dobro prepoznavna, med drugimi: prof. dr. Matjaž Gams, dr. Marko Gričar, prof. dr. Marko Petkovšek, prof. dr. Franc Solina.

Poskusni pouk računalništva je bil deležen zelo pozitivnih odzivov in komisija za uvajanje pouka sklenila: zdaj potrebujem učbenik, kaj če bi poskusila Bratko in Rajkovič?

Slika 2: Učbenik za Osnove tehnike in proizvodnje



Slika 3: Učbenik iz l. 1984



Slika 4: Učbenik iz l. 1990

Učbenik je nastajal ob izvajanju poskusnega pouka računalništva in je bil oblikovan po našem izvedenem pouku v prvih dveh šolskih letih pouka.

Knjiga je bila razdeljena v dva dela: (I) Zgradba, delovanje in uporaba računalnika, (II) Programski jezik fortran. Poglavja v I. delu so bila: 1. Uvod, 2. Osnovni pojmi o informacijah in njih predstavitvi, (3) Zgradba računalnika, (4) Odvijanje programa v računalniku, (5) Programski jeziki, (6) Reševanje problemov z računalniki (vključno z značilnimi primeri konstruiranja algoritmov), (7) Uporaba računalnikov, (8) Računalniški sistemi. Poglavje 7 je vsebovalo daljši razdelek o umetni inteligenci. Poleg tega pa tudi razdelek »Ali računalnik ogroža človeka«. Ta razdelek se konča takole: »Morda je najbolj upravičena bojazen pred vmešavanjem računalnikov v človekove osebne stvari. Skrajno neprijetna je namreč zavest, da bi lahko obsežne datoteke z vsemi mogočimi podatki, omogočile dostop do vseh osebnih podatkov o komerkoli.«

Posebna skrb je bila v učbeniku namenjena računalniškemu izrazoslovju. Dolge so bile debate o prevodih posameznih pojmov, kot npr.: pomnilnik, računalniška beseda, naslov, adresa ipd. Marsikatero dilemo nam je pomagal razrešiti tudi jezikoslovec Tomo Korošec. Ko smo ga povpraševali, kako naj zapišemo imena programskih jezikov, je dejal takole: »Če niste pogumni, jih pišite z velikimi tiskanimi črkami. Z malo poguma jih pišite z veliko začetnico, če pa imate dovolj poguma jih pišite z malo začetnico, kot pišemo imena jezikov v slovenščini«. In tako smo zapisali fortran, pascal in druge. Razen zelo redko uprabljanih jezikov in PL1, ki je kratica.

Z veseljem lahko ugotovimo, da je skrb za slovensko računalniško izrazoslovje tudi danes zelo živa, na primer v Slovenskem društvu INFORMATIKA, kot tudi na univerzah in inštitutih. Društvo redno vzdržuje *Islovar* računalniških pojmov, ki je prosto dostopen na spletu. Številni pojmi v današnjem Islovarju so tudi v pojmovnem kazalu učbenika. Tudi programski jeziki zapisani z malo začetnico.

4 ZAKLJUČEK

Projekt pred 50 leti je potekal hitro in učinkovito. Deležen je bil pozitivne ocene tudi v mednarodnem merilu. Pozitivno ocenjujemo tudi težnjo po tem, da je v pouku bilo poudarjeno reševanje problemov z algoritmi ter razvijanje algoritmičnega razmišljanja.

Kaj se je dogajalo s poukom računalništva kasneje, ko sta postajala računalništvo in digitalizacija neprimerno bolj razširjena in pomembna in so se kazale nujne potrebe po spremembah učnih programov za računalništvo? Ne bi mogli reči, da so bile spremembe vedno posrečene in pravočasne. Posebej pa je težko razumeti, zakaj je danes veliko teže doseči spremembe učnega načrta, čeprav se o njihovi potrebnosti strinja praktično celotna računalniška stroka, doma in v svetu [7].

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[7] Andrej Brodnik s soavtorji. *Snovalci digitalne prihodnosti ali le uporabniki?* Poročilo strokovne delovne skupine za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah (RINOS). Ministrstvo za izobraževanje, 2018.

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Začetki pouka programiranja na Fakulteti za elektrotehniko UL

The beginnings of programming lessons at the Faculty of Electrical Engineering UL

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POVZETEK

Prispevek obravnava prve korake v poučevanje programiranja na takratni Fakulteti za elektrotehniko. To je vodilo v začetek študijskega programa Računalništvo in informatika. Razvoj tega študijskega programa je omogočil oblikovanje Katedre za računalništvo in informatiko in čez dolga leta razvoj samostojne Fakultete za računalništvo in informatiko.

KLJUČNE BESEDE

Programiranje, pouk, visokošolski študij

ABSTRACT

The paper discusses the first steps in teaching programming at the Faculty of Electrical Engineering. This led to the beginning of the study program Computer Science and Informatics. The development of this study program enabled the formation of the Department of Computer Science and Informatics and, over many years, the development of an independent Faculty of Computer Science and Informatics.

KEYWORDS

Programming, teaching, higher education

1 UVOD

Prispevek predstavlja le droben kamenček v pestrem mozaiku pouka programiranja v Sloveniji. Še kot študent sem doživel začetke pouka programiranja pred petdesetimi leti na takratni Fakulteti za elektrotehniko in kasnejšo vpeljavo študijskega programa Računalništvo in informatika. Ne nazadnje pa sem bil v vlogi prvega asistenta za predmet Programiranje. Glede na to, da prvega učitelja tega predmeta, prof. Hodžarja že dolgo ni več med nami, je verjetno smiselno, da spomine na takratne čase strnem jaz. Morda pa me bo še kdo dopolnil.

Danes se bo kdo pri teh spominih le prizanesljivo nasmihal. A ne pozabimo, da je od takrat minilo že več kot 50 let in verjamem, da se bodo ljudje podobno nasmihali čez naslednjih 50 let, kako se gremo računalništvo danes.

2 ZAČETKI NA FAKULTETI ZA ELEKTROTEHNIKO

V tistem času seveda še ni bilo pouka računalništva oziroma informatike. Na takratni fakulteti smo imeli takoimenovani jaki in šibki tok, ki sta se v zadnjih letnikih delila na več smeri. Še najbližje računalništvu je bila smer avtomatika, sam pa sem takrat ubiral bolj splošno smer elektrotehnike. V zadnjih letnikih je prof Skubic, ki je sicer predaval matematiko, obljubljal, da bo organiziral tečaj iz programiranja. Jeseni leta 1967 so tak tečaj v obliki enosemestrskega predmeta res izvedli in se ga je udeležilo približno 40 študentov. Po mojem bledem spominu nam je, - takrat še asistent – predaval kasnejši professor Tomšič. Učil nas je programski jezik algol (pravzaprav njegovo podmnožico alcor). Algol je bil razvit v sredini 1950tih let in je več kot 30 let služil za opis algoritmov v akademskih krogih.

Na koncu tečaja smo imeli možnost preskusa krajšega program,a na računalniku ZUSE Z-23 [2], ki so ga imeli na Inštitutu za matematiko, fiziko in mehaniko. Kolikor se spomnim, smo morali sprogramirati tabeliranje neke funkcije in ta programček vnesti v računalnik preko luknjanega traku. Kot vhodno-izhodna enota računalnika je služil v bistvu teleprinter, kakršne smo v tistem času srečali na poštah.

Pri tem prvem praktičnem preskušanju programa se mi je takrat zdelo čudno, da si v računalnik najprej vnesel program in šele nato podatke. Pri reševanju matematičnih in drugih nalog smo pač bili navajeni, da imajš najprej podan problem z vsemi podatki in šele nato se lotiš računanja.

Tako smo prišli do ocene predmeta, ki so nam ga celo vpisali v indekse, čeprav uradno sploh ni bil v učnem programu fakultete.

Marsikoga med nami je ta tečaj zaznamoval in v poletju 1968 se nas je kakšnih 30 izbrancev (po opravljenem testu) udeležilo tečaja za zbirni jezik (po domače (a nepravilno) assembler) za računalnik IBM 360, ki ga je organiziral IBM. Programiranje je

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†Author Footnote to be captured as Author Note

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potekalo v papirni obliki, večinoma z risanjem diagramov poteka in premetavanjem podatkov po računalniških registrih. Na koncu pa je sledil preskus krajšega programčka, topot pretipkanega na luknjane kartice. In ta tečaj je verjetno zaznamoval vse moje strokovno življenje.

V tistem letu sem tudi zaprosil za diplomsko temo prof. Gyergyeka. Ta me je povezal s prof. Bremšakom. Za diplomo sem moral simulirati preprost model nuklearnega reaktorja in pri tem uporabiti IBMjev simulacijski program CSMP (Continuous System Modeling Program), ki je tekel na računalniku IBM 11-30 [2]. V Ljubljani takega računalnika v letu 1968 še nismo imeli in sem moral to delati na Fakulteti za elektrotehniko v Zagrebu. Tak računalnik so nato v Ljubljani prvi dobili na Fakulteti za matematiko in fiziko in sem tako zaradi pridobljenih izkušenj imel dovoljenje, da samostojno dostopam do njihovega računalnika. To pravico so imeli le nekateri in navadnim študentom neposredno samostojno delo še ni bilo omogočeno.

Sam sem se v tistih časih prvič srečal s fortranom in kasneje razvil kar nekaj simulacijskih programskih sistemov, ki so jih nato študentje elektrotehnike uporabljali tudi v okviru različnih diplom, magisterijev in doktoratov.

Kolikor se spomnim, je imel ta računalnik 8kB pomnilnika in izmenljive diskovne pogone. Podobno, kot danes nosimo s seboj USB ključke, smo takrat prinašali v računski center kakšnih 30 cm široke magnetne diske, torej približno kot današnje torbe osebnih računalnikov. In njihova kapaciteta: kar celih 512 KB (pol megabajta). Tako zaradi njihove velikosti kot tudi cene si običajno imel le po nekaj takšnih diskov in še to na službene stroške. Celoten računalniški system je zasedal kar veliko sobo, ki je morala biti klimatizirana in z dvignjenim podom, pod katerim je bilo razvejeno kablovje. Tako si v bistvu imel računalniški center. Vsak uporabnik je moral beležiti števec, ki je kazal število porabljenega časa. Vzdrževanje sistema pač ni bilo zastonj in nekdo je to moral plačevati (in to me je včasih malo skrbelo). Programiranje je potekalo preko luknjanih kartic. Računski center je bil zato opremljen še z več luknjači. Malo si se bal, da ti tak paket kartic s tvojim programom pade na tla in se sesuje.

Za zabavo sem v tistem času napisal tudi krajši program, dolg morda 100 vrstic v zbirnem jeziku IBM-30. It to brez enega samega komentarja! Ko sem ta program spet pogledal čez kakšno leto, seveda nisem več vedel, kaj je počel. Komentarji so pač pomembni.

Čez eno leto je tak sistem dobila tudi Fakulteta za elektrotehniko, le da je bil dvakrat močnejši. Imel je za tiste čase kar spodobnih 16kB spomina. Če danes pomislim, smo ob tako skromnih zmogljivostih reševali na računalniku relativno velike probleme.

V letu 1971 (torej kar točno pred 50 leti) me je prof. Hodžar povabil, da bi bil pri njemu asistent pri več predmetih in tudi pri predmetu Programiranje. Naj zaradi ilustracije takratnih razmer najprej povem, da je bile eden od teh predmetov tudi "Numerične metode". V tistem času so študentje pri svojem računanju uporabljali danes že zdavnaj pozabljena, ravnilu podobna logaritemska računala (Rechenschieber) [1], za bolj točne izračune pa zamudne logaritemske tablice. Pri predmetu Numerične metode pa sem imel za 36 študentov na voljo en računalniški mlinček Facit. Z njim si lahko sešteval, odšteval in (če si res zelo potrudil) množil in celo delil. A predvsem za deljenje si potreboval kar "doktorat".

Kako so lahko potekale vaje z enim takim strojčkom in 36 študenti si lahko že kar težko zamišljamo. Vendar je Fakulteta k sreči že naslednje leto dobila 17 kalkulatorjev HP 35[3]. To je bil prvi žepni znanstveni kalkulator, ki je že imel tudi trigonometrične funkcije. Te napravice so bile takrat tako dragocene, da so jih priklenili na mize v učilnici. In tako smo prišli do "Laboratorija za numerične metode", ki je dejanski predhodnik današnjega Laboratorija za računalniško grafiko in multimedije. Zakaj tako, pa je že druga zgodba 😉

Povrnimo se raje k poučevanju programiranja. Seveda smo takrat že imeli na voljo IBM11-30 in njegove luknjane kartice. Vendar so študenti ta računalnik lahko gledali le skozi šipo. Prof. Hodžar je predaval fortran. Izpit je skoraj vedno potekal tako, da so študenti morali sprogramirati tabeliranje bolj ali manj zapletene funkcije. Svoj program so zapisali na posebne obrazce, te pa je nato luknjačica (poklic, ki je že davno izumrl) pretipkala na luknjane kartice. Te je nato operaterka poslala skozi računalnik. Profesor pa je prišel do tega, kar je izpisal tiskalnik računalnika. Študentje tako niso imeli neposrednega dostopa do računalnika. Ta je bil omogočen le diplomantom in osebju fakultete. In prav zanimivo je bilo ocenjevanje: Za vsako napako je študent imel oceno zmanjšano za 1. Torej si pri petih napakah prišel do nezadostne ocene. Sam se s tem načinom sicer nisem strinjal, a tako je pač bilo. V bistvu je bil študent kaznovan tudi za svoje tipkarske napake, kar je nesmisel.

3 UVAJANJE PROGRAMA RAČUNALNIŠTVO IN INFORMATIKA

Porodila se je zamisel o uvedbi študijskega programa Računalništvo in informatika, ki je bil v prvi fazi zamišljen kot enakopraven program drugim obstoječim študijskim smerem na Fakulteti za elektrotehniko oziroma na Fakulteti za Matematiko in fiziko. Torej naj bi potekal kot nadaljevalni program le v zadnjih dveh letnikih sicer 4 letnega študija. Sam sem kot asistent sodeloval v vlogi zapisnikarja pri nekaterih sestankih, ki so potekali na naši fakulteti. Tako se spomnim, da so pri pripravi prvega študijskega programa sodelovali prof. Hodžar, prof. Gyergyek, prof Virant in prof. Leskovar, seveda predvsem vsak s svojimi predmeti (Programiranje, Teorija informacij, Digitalna tehnika,..). Danes mi je zelo žal, da sem na roko napisan osnutek prvega študijskega programa sčasoma zavrgel, saj bi bil danes zelo zanimiv dokument. Seveda so se pri tem rojevali tudi novi predmeti. Tako je prof. Hodžar prevzel pripravo in izvedbo predmeta "Višje programiranje". Danes bi temu rekli kvečjemu "nižje programiranje", saj je šlo za programiranje v zbirnem jeziku (seveda za računalnik IBM1130). Prof. Hodžar je v ta namen prevedel nek priročnik IBM (in to med predavanji bral ali bolje narekoval študentom). Mene je kar malo zabavalo, ker je pri tem prevajal v slovenščini tudi mnemonike ukazov v zbirnem jeziku (LD, STA, BSC,…) . Jaz sem enkrat v šali dejal, da bi potem lahko namesto pojma "bistabilni multivibrator" (popularni flip flop) lahko uporabili kar izraz "dvoravnovesni večtresljalnik". Ni vrag, da je začel uporabljati ta prevod 😉.

V tistem času je prof. Virant predlagal, da jaz prevzamem novi predmet Računalniška grafika. Seveda pa takrat še nismo imeli na voljo kakšnih grafičnih terminalov (vsaj ne na fakulteti). Tako je predmet lahko potekal le teoretično in bil bolj omejen na to, kako bi se lahko narisali grafični primitivi, kot so črte, kvadrati in krogi. Praktično delo pa je bilo omejeno na obisk sosednjega inštituta Eles, kjer so že imeli računalnik PDP11/34 in grafični terminal DEC GT 40 [2]. Seveda so ga študenti lahko le gledali. Z današnjega zornega kota so bili takšni terminali skromni. Imeli so le vektorsko grafiko (risanje črt) in eno samo barvo.

Če se povrnem na predmet "Višje programiranje" (dejansko pa nizkonivojsko programiranje), se spomnim študenta (tudi še po imenu), ki me je vprašal, čemu tako programiranje v zbirnem jeziku sploh služi. Zato sem popeljal študente na bližnji Inštitut Jožef Stefan (tam sem v teh letih preživel večino razvojno raziskovalnega časa). Na IJS (seveda tudi v nekaterih laboratorijih fakutete) smo izkoristili pojav prvih mikroračunalnikov, ki so v začetku temeljili na legendarnem procesorju Intel 8008 [5]. Pravzaprav smo kar sami delali računalnike s tem procesorjem. V odseku, ki sem ga vodil, smo s takimi sistemi razvijali različne računalniško nadzorovane avtomatizacije. In programiralo se je seveda v zbirnem jeziku. Najprej kar na takih sistemih s pomočjo luknjanega traku, kasneje smo si pomagali s križnimi zbirniki, implementiranimi na računalnikih PDP-11. Te zgodbe so sicer prav zanimive, a presegajo fokus tega prispevka. Morda samo kot zanimivost povem, da takrat ni bilo nobenih razhroščevalnikov, napake, ki smo jih odkrili, smo pogosto odpravljali kar neposredno na strojnem nivoju v že generirani kodi. Sam sem se takrat ukvarjal s pisanjem različnih namenskih gonilnikov, pa kakšen preprost operacijski system sem tudi sprogramiral. Kakorkoli že, se spomnim, da mi je taisti študent potem odgovoril:"Sedaj pa razumem, zakaj programiranje v zbirnem jeziku". Seveda sem že takrat marsikaterega študenta pritegnil v delo na IJS. A bolelo me je srce, ker sem moral študente peljati na bližnji inštitut, namesto da bi tako delovno okolje imeli na matični fakulteti.

Kot zaključek te zgodbe naj povem, da sem programiranje v jeziku C uvedel na fakulteto šele v 1980 letih prejšnjega stoletja in to, vsaj v prvih letih kombiniral s programiranjem v zbirnem jeziku. Saj, kot tisti, ki to poznate, veste, da se marsikaterem C-jevem konstruktu kot razlog skriva prav dogajanje na strojnem nivoju (vzemimo za primer i++ ali –-j, ki imata neposredni vzrok v "post increment" oziroma "pre decrement" strojnih ukazih). Pa tudi razumevanje kazalcev, ki je marsikateremu študentu delalo preglavice, je bolj jasno, če vemo, kaj se dejansko za tem skriva.

Kar precej navezano na te tehnike programiranja je bilo sistemsko programiranje in s tem v zvezi uporabna računalnika PDP 11, ki smo ga sčasoma dobili na fakulteti. Njegov nabor strojnih ukazov (in posledično zbirni jezik) je bil didaktično čist, podobno kot na primer pri mikroprocesorju Motorola 6800, ki so ga v poznih 1970tih letih vgrajevali v mikroračunanike IskraData 1680. Operacijski system PDP11 je bil modularen in zelo lahko je bilo pisati gonilnike za zunanje naprave takih računalnikov. To je bila dobra popotnica tudi za predmet "Operacijski sistemi", ki sem ga tudi prevzel. Šele v kasnejših letih smo dobili na voljo računalnike, ki so bili opremljeni z operacijskim sistemom UNIX, predhodnikom popularnega LINUX. V bistvu pa to sega že v 1980ta leta, kar pa je za ta kratek vpogled v zgodovino pouka računalništvo predaleč. Pri poučevanju operacijskih sistemov sem poleg splošnih konceptov kasneje razlagal tudi interno zgradbo UNIXa, LINUXa in kasneje tudi Microsoftovih NT. Zaradi omejenega časa so v današnjih študijskih programih to tematiko žal izpustili.

ZAKLJUČEK

V petdesetih letih se je marsikaj spremenilo. Ne samo v silovitem razvoju računalniških in komunikacijskih tehnologij.

Veseli me, da me spomini vežejo od prvega volonterskega predmeta pa preko prvega dvoletnega študijskega programa in vseh faz razvoja popolnih študijskih programov. V prvih generacijah praktično ni bilo študenta, ki ne bi šel tudi "čez moje roke". Imel sem tudi veliko diplomantov. Po 330tem sem jih nehal beležiti. Se pa še danes prav dobro spomnim svojega prvega diplomanta in prvega doktoranta. Še danes srečujem bivše študente. Nekaterih se spomnim tudi po imenu. Vseh pač ne, saj jih je bilo na tisoče.

Na razvoj študijskega programa je nedvomno vplivalo tudi, kar se je dogajalo v srednjih šolah. Predvsem je bilo to potrebno upoštevati v prvem letniku, saj imajo še danes novopečeni študentje različno predznanje. Nekateri so popolni začetniki, nekateri pa že kar izkušeni programerji. Delno na to vpliva njihova osebna motiviranost, delno pa seveda tudi delo srednješolskih učiteljev in pa sam srednješolski študijski program.

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Začetki mariborskega računalništva (do ustanovitve univerze 1975)

The beginnings of Maribor computer science (until the founding of the university in 1975)

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POVZETEK

Prispevek obravnava prve napore za pridobitev računalnikov v mariborskem akademskem okolju in navaja zaslužne posameznike, ki so s svojo motiviranostjo in naprednim razmišljanjem pripomogli k njihovi uvedbi. Kaže tudi probleme, ki so jih pri tem morali reševati.

KLJUČNE BESEDE

Računalništvo, univerza, začetki

ABSTRACT

The article discusses the first efforts to acquire computers in the Maribor academic environment and lists deserving individuals who, with their motivation and advanced thinking, contributed to their introduction. It also shows the problems they had to solve in doing so.

KEYWORDS

Computer science, university, beginnings

1 ZAČETKI

Pred leti je naša 'etična sekcija' IFIP sestankovala v prostorih Poljske akademije znanosti v Varšavi, od koder iz sredine petdesetih izvira zanimiva anekdota: pri izdelavi domačega 'elektronskega računskega stroja' (beseda kompjutor je bila v celem vzhodnem bloku prepovedana!) ZAM1 sredi petdesetih je bil za utrjevanje kar tisočih instaliranih vakuumskih cevi zelo pripraven pripomoček iz latexa, ki se v lekarni naroči šepetaje, in zanimivo, da vsega vajeno pani magistro niti niso čudile količine,ampak, da to potrebuje metuzalemska akademija znanosti, ji pa ni šlo v glavo. Jasno, da sem hotel s tem le spomniti na čase, ko se računalnikov ni dobilo v trgovini, ampak si ga moral narediti sam. Beograjčan Aleksić je v Pupinu sestavil CER-10, najuspešnejši graditelj takih računalnikov pa je bil konec petdesetih Zagrebčan Souček (Frković in dr., 2016). Stigliceva z mariborske VTŠ sta mi povedala, da sta si prvi računalnik tudi onadva naredila sama in sta ga vse do odselitve iz Maribora ljubeče hranila v drvarnici. Iz spominov enega od očetov računalniške industrije Groscha pa sledi, da je bilo v začetku šestdesetih na zahodnem trgu že 90 tipov industrijsko izdelanih računalnikov (Grosch, 1991) in ker je State Department Jugoslavijo obravnaval enako kot Finsko v sivi coni, je lahko segala po tej ponudbi (Milivojević, Pavlov, 2012). Nekateri so to obžalovali, ker jim je bila bolj všeč sovjetska 'Strela', obravnavana kot stroga državna tajnost (Kitov, 2014).

Pogled na računalnike je bil tudi pri nas dolgo časa 'strateški', kar je takrat pomenilo centralističen in stran od oči javnosti v okrilju vojske in notranjih zadev. Prvi javni IBM 705 je direktor Dolfe Vogelnik instaliral v Zvezni zavod za statistiko za potrebe popisa prebivalstva 1961. in tja vabil tudi entuziaste iz Slovenije, saj je bil to glavni računalnik v državi in po moči (40 KB operativnega spomina) šesti v Evropi. Mimogrede, tudi njegovo zamenjavo IBM 360/50 je leta 1969 za potrebe naslednjega popisa nabavil Slovenec Ante Novak, na fotografiji z odprtja pa so še drugi pretežno slovenski 'botri' (Novak, Vogelnik, predsednik zvezne vlade Ribičič, Osolnik, Bulc), kar kaže na stopnjo zavedanja o pomenu IKT.

2 PRVI RAČUNALNIKI V SLOVENIJI

Slovenija sama je iskala poti, kako priti do zaresnega računalnika in precej presenetljivo so leta 1962 na Inštitutu za matematiko, fiziko in mehaniko izbrali 'outseiderja' Zusejev Z-23, kar si razlagam s tem, da sta se direktor inštituta Anton Kuhelj in Konrad Zuse verjetno poznala kot pomembna aeronavtika, razen tega pa so naši znanstveniki ta stroj videli na ETH in na nemških univerzah. Zuse je tovarno v Bad Hersfeldu takrat že prodal Siemensu, s katerim je sodelovala Iskra, ki je sofinancirala nakup. Z-23 torej zaznamuje začetek računalniške ere v Sloveniji, ustanovljen je bil Republiški računski center (RRC) in v Iskri Stegne so zuseju sledili vse močnejši CDC-ji do največjega na Balkanu CYBER 70, ki se je 1972. naselil v soseščini glavnega uporabnika IJS na Jadranski. Univerza je leta 1967 za svoje učne potrebe dobila IBM 1130, ki so ga instalirali na FNT (Pivec, 2008).

Slika 1: Računalnik IBM 1130

Takšen IBM 1130 si je morala mariborska Višja tehniška šola kupiti iz lastnih sredstev, nanj so morali čakati dve leti in 1969. se je okrog njega začel formirati mariborski računalniški krog. Čeprav je ta računalnik legenda, ne najdem njegove fotografije in sem si jo izposodil z Wikipedije. Še težje pa je priti do fotografije računalniškega centra TAM, ki je bil drugo gnezdo mariborskih računalnikarjev, kjer pa so veljala stroga pravila vojaške tajnosti, o čemer mi je pripovedoval Božo Kuharič, tamov štipendist in pripravnik ter kasnejši graditelj Mure, ki je smel vstopiti v sistemski prostor šele po enem letu zaposlitve.

Slika 2: Računski center

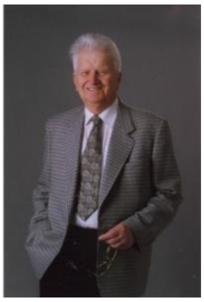
Milan Kac je bil cenjen profesor matematike na mariborski klasični gimnaziji, njegovo ime pa je bilo splošno znano po šestih izdajah logaritmov.

Odprtega duha, se je začel med prvimi zanimati za računalnike, na novoustanovljeni VTŠ pa je poleg dvajsetih matematičnih učbenikov spisal tudi prvega o računalništvu (Kac, 1970). Nedavno umrli Janez Cundrič ga je leta 1969 v Večeru predstavil skupaj z računalnikom IBM 1130. Ni presenetljivo, da ga je 13. aprila 1971. direktor Zavoda za šolstvo Lipužič povabil na čisto prvi pogovor o uvedbi računalništva v šole, kjer sta z Virantom zastopala 'praktično' linijo, da je računalnik tehnologija, s katero je treba delati, ne pa o njej teoretizirati. Z Roblekom, Trampužem, Virantom, Zakrajškom, Lesjakom, Volkovo, Hafnerjem in Rajkovičem so v naslednjih letih vodili projekt uvajanja računalnikov v srednje šole, s katerim si je Slovenija ustvarila odlično izhodišče za osvajanje IKT in velik ugled v mednarodnem šolstvu (Lipužič, 2010). Že leta 1973 so slovenske izkušnje z omenjenim projektom predstavili na simpoziju IFAC v Alžiru (Bratko, Rajkovič, Roblek, 1973).

Darinka Ferjančič Stiglic je bila v letih 1974-76 prva ženska na položaju predstojnice kakšnega tehniškega visokošolskega študija v Sloveniji. Raziskovala je digitalne signale z Walshevimi in Haarovimi funkcijami in uvajala študente v nove tehnologije z nelinearnimi elektronskimi vezji. Iz časa njenega vodenja VTŠ se spomnim zabavnega dogodka, povezanega s pogostim demonstriranjem nove računalniške tehnologije za strokovnjake iz proizvodnje, bil pa je to tudi čas za 'partijo' nesprejemljivih študentskih demonstracij. In tako je neka skupina obiskovalcev vprašala zavednega receptorja VTŠ, kje v veliki hiši je demonstracija, dobili pa so nedvoumen odgovor: »Dokler sem jaz tukaj, na VTŠ ne bo nobenih demonstracij!«

Bruno Stiglic je prišel na VTŠ leta 1961 z ljubljanskega Inštituta za komunikacijske sisteme kot strokovnjak za tranzistorje. Bil je nekakšen 'gospodar' IBM 1130, ki ga je znal izvirno uporabljati za aplikacije na različnih področjih, na Združenju visokošolskih zavodov, predhodniku univerze, pa smo se z njim odlično ujeli pri avtomatski obdelavi podatkov o vpisu, ki jo je takoj 'posvojila' Izobraževalna skupnost Slovenije. Za zgled smo imeli obširen priročnik o informatizaciji virov in dejavnosti kolidžev in univerz, ki ga je izdala National Science Foundation in sem ga nekaj let prej pritovoril iz ZDA zgolj s slutnjo, da gre za perspektivno stvar (Tyrrell, 1967).
Stiglica je za nekaj let prevzela Iskra Avtomatika in ga poslala za direktorja v svojo izpostavo Electronics v Santa Clari, njegovi razširjeni razgledi po računalniški industriji pa so bili zelo koristni pri zasnovi novih študijskih smeri in fakultet na tem področju.
Ko smo pripravljali načrt za ustanovitev univerze, smo si že leta 1971 zamislili tudi univerzitetni računski center in začeli izdajati bilten ter s tem spodbudili enako potezo v Ljubljani. Seveda sta aktivnosti vodila Kac in Stiglic. V načrt smo zapisali, da bo bodoča univerza prva kompjuterizirana univerza v Jugoslaviji in kasnejši rektor Dali Đonlagić je to jemal zelo zares.

Na VEKŠ se računalništvo začne s prihodom Ferdinanda Marna in ustanovitvijo katedre za organizacijo in informatiko, a posebnost je vzporedno nastajanje in rast Ekonomskega centra Maribor in njegovega CAOP.
Nande Marn je v začetku petdesetih diplomiral na ljubljanski Visoki tehniški šoli – takrat tehniški študiji niso spadali pod univerzo -- in že leta 1952 prišel v mariborski TAM, kjer mu je generalni direktor Perhavc zaupal zadeve v zvezi z organizacijo vodenja v ogromni firmi. Na pragu zahtevnega projekta vojaških vozil je »generalni« Stojan Perhavc na predlog vodje razvojnega inštituta Jožeta Ciglenečkega pritegnil v ekipo Antona Hauca, **Štefana Kajzerja**, Branka Crnkoviča, Jožeta Baumana, **Marjana Pivko** in druge in glej, skoraj vsi omenjeni so se v sedemdesetih znašli na VEKŠ ali na domala pridruženem Ekonomskem centru Maribor. K slednjemu je prišel še Pavel Kristan iz Intertradea, leta 1975 pa je njihov CAOP dobil močan IBM 360 in z njim podpiral informatiko skoraj vseh velikih mariborskih firm. ECM, ki je bil na isti lokaciji kot VEKŠ, je spočetka šolo razbremenil skrbi za poganjanje lastnega računalnika in Vekševa ekipa se je lahko bolj posvetila aplikativnim vidikom, kot so poslovna informatika, projektni menedžment, modeli organizacije itd.. Danes o ECM in njegovem računskem centru, ki so si ga ljudje ogledovali tako rekoč v izložbi, ni več duha ne sluha, kar kaže, da v Mariboru ni propadla le stara industrija. Marn, Kajzer in Pivka (na fotografijah) so prevzemali tudi druge naloge v razvoju mariborskega računalništva: Marn je vodil koordinacijsko telo za razvoj računalništva na UM, Pivka je pripravljal zagon univerzitetnega računskega centra, Kajzer pa je bil dolgoletni predsednik Izumovega strokovnega sveta.



ZAKLJUČEK

Morda bi moral v prikaz vključiti tudi informatike s takratne kranjske VŠOD (Vladislav Rajkovič, Miroljub Kljajić, Jože Gričar, Alenka Hudoklin Božič), ki je delovala v okviru mariborskega Združenja visokošolskih zavodov, vendar sem se v naslovu omejil na mesto Maribor. Sploh pa je namen tega zapisa, da bi se ponovno lotili zbiranja dokumentacije o zgodovini računalništva pri nas. Dvajset let bo že, kar smo v okviru Slovenskega društva Informatika organizirali dva kolokvija pod naslovom 'Računalništvo nima zgolj prihodnosti', ki smo si ga izposodili od akademika Franceta Križaniča, prvega slovenskega kibernetika. Tokrat smo se zadržali na čisto prvih korakih vstopanja IKT v mariborsko in slovensko stvarnost in vsi vemo, kako široko in globoko je segel vpliv nove tehnologije v naslednjih letih (Pivec, Rajkovič, Jus, 2004). Bolj, ko odlagamo sestavljanje zgodovinskega mozaika, več njegovih kamenčkov se nepovratno izgublja in manj je jasno, od kod prihajamo, kje smo in kam gremo?

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Slovensko računalništvo skozi pogled dijaka l. 1971

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POVZETEK

Predstavljena je zgodovina slovenskega računalništva in informatike skozi oči avtorja, dijaka leta 1971. Sledi opis nadaljnjih dogodkov predvsem skozi slovarje in leksikone računalništva, torej računalniško terminologijo. Smisel prispevka je v tem, da dokumentira dogajanja v času nastajanja računalništva. Ko bomo vse naše zgodbe sestavili skupaj, bo kot film »Rašomon« režiserja Akire Kurosave – mnogoplastna in mnogotera zgodovina opisov skozi osebne spomine, edinstvena in neprimerljiva z zgodovinsko knjigo.

KEYWORDS / KLJUČNE BESEDE

Zgodovina računalništva, poučevanje, začetki računalništva

ABSTRACT

In this paper the author retrospectively revives computing times in Slovenia starting with 1971 when he studied computing at Bežigrad high school. Later, he emphasises contacts with other pioneers of computer science in informatica, and in particular describes progress of Slovenian computer terminology. Put together with papers of other pioneers, a computer history in our country will emerge like the Rashomon movie from Akira Kurosava.

KEYWORDS

Pioneering times of computing, Slovenia

1. UVOD

Prave enolične resnice tako ali tako ni, vsaj tako pravi princip mnogoterega znanja [1], zato bo opis pionirjev računalništva začenši z letom 1971 toliko bolj zanimiv. To bo mnogoplastna, mnogotera, subjektivna, ponekod tudi bolj spominska in avtobiografska kot eksaktno dokumentirana zgodovina nastajanja slovenskega računalništva.

Prvi računalnik je verjetno Charles Babbageov mehanski stroj, ki je znal izvajati ključne komponente računalnika kot ponavljajoče se zanke. Nastal je v začetku 19. stoletja, logično pa je prve programe v pismih Babbageu pisala Ada Augusta Lovelace. Okoli druge svetovne vojne je nastalo več računalniških naprav, recimo Turingova »Bombe« za dešifriranje nacistične Enigme, ki je ključno pomagala pri razkrivanju podmorniških položajev med 2. svetovno vojno [2]. Turing je imenovan tudi »računalniški Einstein« [3], ker je zasnoval vrsto osnovnih konceptov računalništva kot Turingov stroj ali Turingov ustavitveni problem. Turingov sodobnik je bil Donald Michie, britanski znanstvenik, povezan s prof. Ivanom Bratkom. Turinga ne Bratko ne avtor tega referata nista nikoli osebno srečala, saj je umrl istega leta, ko se je avtor tega prispevka (kasneje »avtor«) rodil.

Pač pa je Donald Michie pogosto bival v Sloveniji in predvsem prof. Bratko v Veliki Britaniji, največ na Škotskem. Še danes imamo na Institutu »Jožef Stefan« Turingovo sobo (sobo avtorja) in Michiejevo sobo (nekaj vrat stran od Turingove), kjer je Michie pogosto bival, ko je bil na obisku v Sloveniji. Nekajkrat smo šli na skupno večerjo, na skupne konference, na skupne aktivnosti. Avtor je srečal tako Michiejevo ženo kot vnuka.

2. AVTORJEVA ŠOLSKA LETA

Avtor je leta 1971 obiskoval izbirni predmet računalništva, ki ga je predaval prof. Bratko. V paralelki A, kjer so bili tehnično in matematično usmerjeni dijaki, je učil prof. Bratko, v drugi paralelki pa prof. Rajkovič. V tistih leti so bili dijaki otročji kot le malokdo in šale oziroma legende o profesorjih so bile stalno na dnevnem redu. Prof. Rajkovič je slovel po tem, da je med pisanjem s kredo česal kodraste lase z lasmi in posledično je bilo na koncu ure vedno nekaj krede v frizuri. Prof. Bratko pa je »zgodovinsko« zaslovel takrat, ko so dijaki v predal mize nastavili revijo Playboy. Odprl je predal, zastal, malo zardel in pomigal z brki, nato pa zaprl predal. Malo je premišljal, nato pa odprl predal, vzel kredo in ga ponovno zaprl. Ta video bi zagotovo dobil milijon všečkov.

A predmet računalništva je bil Indija Koromandija za kreativnost. Medtem ko so morali dijaki pri večini predmetov bolj ali manj mehanično ponavljati, kar so profesorji govorili na predavanjih, morda z izjemo fizike in matematike, so računalniške naloge omogočale kreiranje množice rešitev, bolj ali manj ustvarjalnih. Če je kdo iznašel kakšno izvirno, je bil pohvaljen in to je bilo zelo stimulativno. Takrat se je programiralo v fortranu oziroma bolje rečeno – pisali smo na papir. Enkrat pa so bili programi vneseni v pravi računalnik – IBM 1130.

Že v tistih letih smo se srečevali z nekaj mlajšimi kolegi, recimo Robertom Reinhardtom, Markom Martincem, na gradbeni fakulteti je bil aktiven prof. Žiga Turk.

Po maturi se je avtor vpisal na Fakulteto za elektrotehniko po težkih debatah, na katero fakulteto naj bi šel. Elektrotehnika je bila izbrana iz dveh razlogov: ker je po dveh letih skupnega študija sledila izbira smeri, seveda računalništva; drugi razlog je bil v tem, da je na elektrotehniko šla večina sošolcev. Dostikrat

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se nas je večina posedla v isto klop. Med 300 študenti 1. letnika jih je v 2. letnih prišlo 150, kar nam je nazorno povedal prof. Virant. Na računalništvo nas je šlo okoli 20. Ker je bil avtor aktiven kot študentski predstavnik, je občasno sedel tudi v raznih fakultetnih organih. Takrat je bilo nekaj velikih debat. Ena je bila o izbiri računalnika – ali naj bo digitalen ali analogen. Digitalnega je zagovarjal prof. Virant, analognega prof. Gyergyek. Debata se je zavlekla in pregrela do točke, ko je prof. Gyergyek izgubil živce, lasje so se mu postavili pokonci, odvihral je iz dvorane, nakar se je čez 2 minuti vrnil očitno počesan in umit. Fakulteta je dobila digitalni računalnik. Pri prof. Gyergyeku sva prav dva računalničarja na njegovem predmetu po treh dneh čakanja pred vrati prišla na vrsto in vprašal naju je del svoje knjige, za katerega so nam rekli, da za računalničarje ne pride v poštev. Seveda sva odletela v nekaj minutah, a prof. Gyergyek je bil vseeno poleg prof. Bremšaka in še nekaterih legenda na elektrotehniki.

Na prvem računalniku (Cyber) je avtor programiral na Institutu »Jožef Stefan« med študijskimi leti. Ker je bil le en računalnik za cel inštitut, si prišel nanj tipično okoli 1h ali 2h ponoči in nato programiral, dokler te ni zmanjkalo. Bratkov kolega in pozneje minister dr. Peter Tancig je imel v sobi kavč in z malo sreče si se lahko malo odpočil, zadremal in nato nadaljeval. Včasih je bila kar gneča, a kavč je bil ozek in več kot dva nista mogla biti na njem. Ostali so se morali zadovoljiti s stoli.

Na fakulteti je bila vrsta zanimivih predavanj in profesorjev. Recimo pri prof. Virantu smo imeli Lisp in nekoč je na predavanjih podal nalogo zlaganja sorodnih delov drevesa. Obljubil je, da bo tisti, ki reši izpit, oproščen izpita. Avtor ga je rešil, a je vseeno pisal izpit, nekaj več kot 70%, a kakšnih 10% več kot naslednji. S prof. Vilfanom sta tudi mimo pouka reševala izbrane naloge. Zanimiva predavanja so imeli matematiki, kjer so iste predmete obiskovali računalničarji iz 4. letnika in matematiki iz 2. Tako nismo pretirano zaostajali za matematiki, ampak samo zmerno. Eden najbolj duhovitih ljudi je bil prof. Suhadolc, ki pa na izpitu ni bil navdušen, da bi imeli več tipov neskončnosti: najprej 1, potem 2 in nato neskončno neskončnosti, kar bi bila neskončnost drugega reda ter tako dalje. Zanimiv je bil prof. Hodžar, tudi rektor Univerze v Ljubljani, in njegovo numerično računalništvo. Ko je prižgal cigareto, seveda na hodnikih fakultete, se je okoli njega trlo asistentov, kdo mu jo bo prižgal. Prof. Divjak je imel zelo specifičen stil, bil je zelo prijazen in hkrati učinkovit. Ko so se nekoč profesorji na organu smeri pogovarjali, da bi veljalo narediti samostojno fakulteto za računalništvo, je po nekaj debatah rekel, da bo on to speljal, če mu pomagajo. In so jo res. Diplomirali smo med prvimi študenti računalništva, pred nami je bil le letnik ali dva.

Že med poukom je avtor sodeloval s prof. Bratkom. Tema so bili razni algoritmi, predvsem pa je prof. Bratka zanimala umetna inteligenca in zlasti šah. Prof. Bratko je še sedaj odličen šahist in avtor ga ni uspel nikoli premagati, čeprav je bil kot amater na tekmovanju na fakulteti za elektrotehniko z okoli 600 študenti tam nekje šesti. Tedaj se je mislilo, da je šah najboljše orodje za umetno inteligenco, ker je natanko definiran in ker omogoča preizkušanje raznih algoritmov v odličnem eksperimentalnem okolju. Do določene mere je to držalo, a računalniški šah je napredoval predvsem zaradi Moorovega zakona in hitre rasti računalniških sposobnosti. Krivulja rasti ratinga računalniškega šaha je konstantno in enakomerno rasla, dokler ni IBMov Deep Blue leta 1997 premagal tedaj najboljšega šahista na svetu, Garryja Kasparova. Danes bi verjetno rekli, da zaseda drugo mesto na lestvici najboljših šahistov vseh časov, medtem ko si je prvo mesto priboril Magnus Carlsen.

Ko je potekala tekma med Deep Blue in Kasparovom, smo komentirali tekme tudi s prof. Michiejem, ki se je takrat mudil v Ljubljani.

Za diplomo je avtor analiziral končnico kralj + trdnjava : kralj + konj in generiral vse možne pozicije in poteze [4]. To je bila prva tovrstna končnica na svetu. Prof. Bratko je dal idejo, izvedba je bila na avtorju in več mesecih optimiranja.

3. NEKAJ DOSEŽKOV IZ NADALJEVANJA KARIERE

Po diplomi je avtor iskal službo ali na fakulteti ali na inštitutu. Prof. Bratko je imel raziskovalni projekt, kjer je bilo kritje za plačo in raziskovanje. Vodja odseka je bil prof. Anton P. Železnikar, koroška korenina in izredno moder človek. Nasledil ga je drugi Korošec, dr. Marjan Špegel, ki je kar nekaj časa prej prebil v Ameriki. Ekstravertiran in aktiven je širil energijo med sodelavci. Dr. France Dacar je bil izjemen matematik. Govorili so, da je dobil zlato kolajno na matematični olimpijadi, nato pa odšel za eno leto v samostan, da si je ohladil možgane. Ko je nekoč prof. Milan Osredkar, direktor inštituta, preveč neposredno zahteval od njega konkretne rezultate in ne več svobodno raziskovanje, mu je na računalnik poslal odgovor v obliki – danes bi rekli šaljive figurice.

Prof. Bratka so zanimali predvsem algoritmi za preiskovanje, najraje pa jih je testiral na igranju šaha. Z avtorjem sta vrsto let raziskovala patologije in čez vrsto let se je na tem področju izkazal tudi dr. Mitja Luštrek [5]. Prva analiza in objava avtorja in prof. Bratka [6] pa je bila nadgradnja Bealove študije. Z računalniškimi modeli sta pokazala, da je patologija v preiskovalnih algoritmih AND/OR tipa pogosto prisotna. Poznejše študije so modele nadgradile in so se pokazale tudi na OR drevesih. Res nenavadno – v kar nekaj razmerah se preiskovanje v dodatno globino ne splača več. Pravzaprav je tudi v življenju tako – če preveč časa preračunavaš življenjske odločitve, recimo iščeš predvsem službo s čim večjo plačo, boš verjetno nesrečen v življenju. V tistih časih pa smo živeli za raziskovanje in odkrivanje. Ter za neskončno radost kreiranja nečesa čisto novega, kar svet še ni videl ali vedel.

Avtorjev študij se je končal z doktoratom [7], ki je uvedel princip in paradoks mnogoterega znanja, verjetno največji avtorjev dosežek. Princip pravi, da je najboljša rešitev tista, kjer sodeluje več akterjev, ki med sabo niso preveč podobni, a so čim bolj kvalitetni. Paradoks pravi, da je skladno s principom univerzalnega Turingovega stroja možno več akterjev (modelov, strojev…) nadomestiti z enim samim. Knjiga »Weak intelligence: The principle of multiple knowledge« [1] je bila dosegljiva preko Amazona, a kakšne posebne tiraže ni dosegla.

V Sloveniji pa je izšlo nekaj knjig, recimo Osnove dobrega programiranja [8], ki je bila prevedena v hrvaški jezik (Slika 1). Prinaša koristne konvencije pri programiranju v jeziku pascal, v katerem je avtor sprogramiral na deset tisoče programskih vrstic.

Slika 1: Avtorjeva knjiga »Osnove dobrega programiranja« je uvedla v slovenski prostor osnovne koncepte imenovanja spremenljivk, zamikanja teksta programov itd.

S stališča društev je bila pomembna ustanovitev SLAIS, tj. društva slovenske umetne inteligence, kjer sta bila avtor in prof. Bratko med ustanovitelji, avtor je s prof. Janezom Peklenikom ustanovil SATENO in kasneje z več sodelavci Inženirsko akademijo Slovenije, z drugimi soavtorji pa društvo za kognitivne znanosti DKZ in slovensko podružnico ACM Slovenija (Gams Informatica), kjer je bil prvi tajnik in prof. Vilfan prvi predsednik.

4. RAČUNALNIŠKO IZRAZOSLOVJE

Skupaj z nekaj 10 soavorji je avtor oblikoval slovensko računalniško izrazoslovje. Poglavitna vloga je bila koordinatorska, editorska. Že prej je prof. Vladimir Batagelj uvedel Wiki slovar, kjer so avtorji lahko vpisovali svoje izraze, a glavni urednik je imel dokaj železno roko in je pogosto uvajal pretirano lepe in izvirne izraze. Avtor je za razliko od Vlada ubral bistveno bolj nežen pristop: za vsako področje je nekdo strokovnjak in zato naj predlaga svoje izraze, dokler se mu drugi ne zoperstavijo. Čeprav so strokovnjaki pogosto močni značaji, se je ta pristop kar obnesel. Skupno je nastalo kakšnih 50.000 tiskanih izvodov slovarjev in leksikonov.

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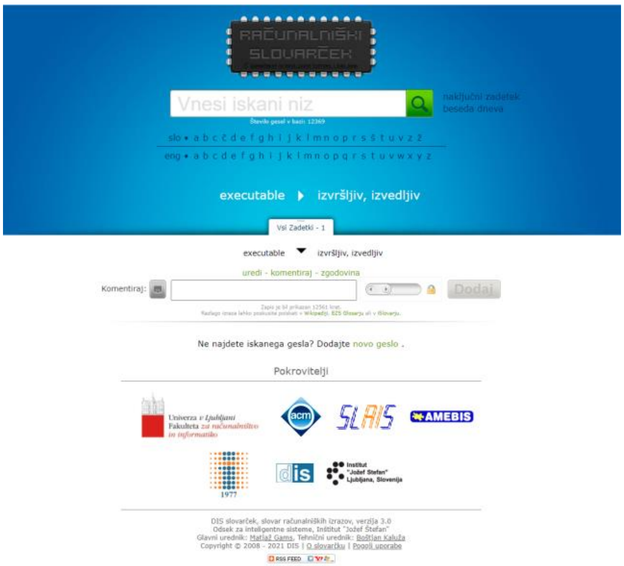
Verjetno zadnja tiskana verzija leksikona ali slovarčka.

S pojavom spletnih aktivnosti se je slovarček prenesel na splet (Slika 2). Kasneje se je pojavil še slovar informatike.



Slika 2: Spletna verzija računalniškega slovarčka.

5. ZAKLJUČEK

Zadnjih 50 let je bilo gotovo najbolj razburljivih in nadebudnih v človeški zgodovini. To obdobje so omogočile računalniške in informacijske tehnologije.

Slučajno je leta 1971 avtor tega prispevka izbral izbirni predmet računalništva na bežigrajski gimnaziji, kjer ga je učil prof. Bratko, nato življenjski mentor. Že tisto prvo leto pa je odkrilo strast in užitek pri generiranju idej v neki formalni obliki, obliki računalniškega programa. Nekaj »božanskega« je v kreaciji nove simfonije, slike, a še bolj v snovanju inovativnega programa, ki po možnosti zraven odkriva še nekaj ljudem neznanega, odkriva tančico skrivnosti, pa naj bo to nov algoritem za iskanje rešitev v grafih, analiza kovida ali študij dolgoživosti človeške civilizacije. Pri tem je vseeno, ali programirate na vikendu na mobilnem telefonu ali v službi na najnovejšem stroju. In kmalu bo prišla umetna inteligenca, ki bo prinesla novo, nesluteno revolucijo v razvoju človeške civilizacije.

Vsi, ki smo sodelovali tedaj ali še bolj mlajši, ki skupaj s seniorji sedaj kujejo bodočnost, imamo neverjetno srečo, da smo izbrali najbolj udarno in zanimivo področje, kar jih je kadar koli bilo.

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Od prve do enajste šole računalništva

Early learnings of computational thinking

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POVZETEK

Prispevek je, z ozirom na zgodovinski fokus konference, zastavljen kot "spomini ostarelega programerja"; njegov namen pa je predvsem osvetliti možnosti, ki so se proti koncu sedemdesetih prejšnjega stoletja ponujale srednješolcem za spoznavanje tedaj zelo sveže vede. Skozi osebno refleksijo, kaj sem se takrat naučil, bi želel iskati tudi navdiha za sedanje čase.

KLJUČNE BESEDE

Pouk računalništva, računalniško mišljenje, reševanje problemov, algoritem, programski jezik, pascal

ABSTRACT

Given the historical focus of the conference, I try to present, through "memoirs of an old programmer", the ways and opportunities that we had, at a secondary school level in the late 70's, to learn about programming and computer science, which was at the time a very fresh field of knowledge. From reflecting on my personal learning experience, I aim to draw some inspiration also for the modern teaching of computational thinking.

KEYWORDS

Teaching computer science, computational thinking, problem solving, algorithm, programming language, pascal

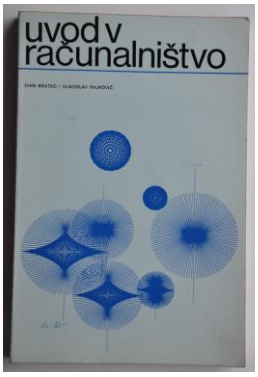
1 UVOD

V času začetkov poučevanja računalništva na Slovenskem sem še obiskoval osnovno šolo in o tem seveda nisem vedel nič. Iz tega časa se spominjam edino (izobraževalne?) oddaje na televiziji, ki je govorila o računalnikih in programerjih kot tistih ljudeh, ki računalnike polnijo s podatki in jim nekako "povedo", kaj naj delajo. Predstavljeni so bili v belih haljah v nekoliko znanstveno-fantastičnem okolju in so v moji tedanji predstavi zadobili nekakšen mitski status nečesa sicer zelo zanimivega, a praktično izven mojega dosega – tako, kot če bi na primer razmišljal o tem, ali bi rad bil astronavt. Zato me je nekaj let pozneje spoznanje, da se bom v 3. letniku srednje šole srečal s takrat še izbirnim predmetom Računalništvo in učil programiranja, navdalo s prijetnim vznemirjenjem. Še zlasti, ker nam je, radovednim nadebudnežem, že od prvega letnika zbujal občudovanje in hkrati frustracije pogled na sošolca Antona Verbovška, ki se je po šolskih avlah potikal s polnim naročjem gostih in popolnoma nerazumljivih računalniških izpisov (če se prav spomnim, je šlo za "post-mortem dump" v šestnajstiški kodi) in nam prizadevno kazal v tisto zmedo, kaj da mu računalnik s tem pove.

A zadeve so šle še na bolje. Področje se je tudi na račun entuziazma, ki ga je obdajalo, hitro razvijalo in proti koncu sedemdesetih let dvajsetega stoletja je v Sloveniji obstajal že kar živahen ekosistem, ki je ob hkratnih tehnoloških novostih ponujal obilo priložnosti mladim navdušencem, da osvojijo, pa tudi preizkusijo novo znanje. Naj mi bo torej dovoljeno v povezavi z začetki poučevanja računalništva predstaviti tudi to prelomno obdobje, ki morda ne bo dobilo tako jasne obeležitve kot leto 71', pa si jo po mojem mnenju zasluži. V prispevku poskušam orisati različne med seboj povezane dele tega ekosistema, ki je v svojem bistvu vreden posnemanja v kateremkoli času.

2 ŠOLA …

Težko ocenjujem, kolišen delež je pri tem imelo okolje in ugled takratne Bežigrajske gimnazije, a z učitelji sem imel srečo. Prvi, ki nam je – pisalo se je šolsko leto 1978/79 – za začetek pojasnil, kaj računalnik je in kako deluje, je bil Vlado Rajkovič, tudi soavtor takratnega (prvega) srednješolskega učbenika Uvod v računalništvo [1].



Slika 1: Prvi učbenik za računalništvo v srednji šoli

*Article Title Footnote needs to be captured as Title Note
†Author Footnote to be captured as Author Note

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2.1 Razumevanje tehnologije

Razumevanje samih osnov zgradbe in delovanja računalnikov – podatki v spominskih celicah, zaporedje dogodkov pri procesiranju ukazov – je učinkovito demitologiziralo naš odnos do stroja, hkrati pa pomagalo k jasnejši predstavi, kaj lahko s tem strojem, s pomočjo programiranja, naredimo - pa tudi, česa ne moremo. Kot pojasnjujejo tudi avtorji preglednega članka o razvoju predmeta računalništvo [2], je bil pouk v teh letih pretežno teoretičen, s poudarkom na algoritmih in programskih jezikih, praktične vaje na računalniških centrih pa so zahtevale precej potrpežljivosti – najprej zaradi zamudnega luknjanja kartic, ki smo jih nato zaupali operaterju – svečeniku (v beli halji, ali pač le v kavbojkah?) – ta pa jih je odnesel v nam nedostopno sobo s terminalom do računalnika, ki se je po vsem sodeč nahajal v neki drugi dimenziji. Po daljšem in nestrpnem čakanju so se vrata odprla in svečenik nam je predal računalnikov orakelj, ki je ponavadi rekel, da smo pozabili ločilo in da zato program ne deluje. Po dveh tovrstnih seansah je ponavadi že potekel skopo odmerjeni čas, ki nam je pripadal po razporedu vključenih šol.

Kakor se že ta izkušnja bere anegdotično, pa nam je dajala neposredno prvo lekcijo: da je stroj v osnovi "neumen" in da moramo biti zato toliko bolj pazljivi mi, ko mu naročamo, kaj naj opravi. Klub preprostosti takratnih orodij in računalnikov je ta osnovna lekcija aktualna tudi po desetletjih razvoja in v času, ko so komunikacijske tehnologije, umetna inteligenca in strojno učenje na ravni, ki omogoča legitimno debato o prihajajoči avtonomnosti strojev.

2.2 Reševanje problemov

Ključno dodano vrednost ostalim predmetom pa je pouk računalništva – vsaj v mojem spominu – prispeval z učenjem reševanja razmeroma vsakdanjih problemov skozi razumevanje postopkov. Tudi nekateri drugi predmeti – vsaj matematika in fizika, pa verjetno delam še kateremu krivico z ne-omembo – so nas učili analitičnega in strukturiranega pristopa k reševanju problemov; vendar je bil prav zaradi omejitev, ki jih postavlja "neumni stroj" v svojem razumevanju sveta oz. konteksta – tudi ta okvir zlahka apliciramo na današnje precej bolj komplicirane sisteme – ključni poudarek prav na razvoju sposobnosti razumevanja in razčlenjevanja reševanja posameznega problema na *postopke*, do nivoja, ki ga lahko "razume" oz. izvede celo tako preprost avtomat.

A hkrati je prišlo tudi spoznanje, da z obvladovanjem preprostih opravil, ki jih potem lahko odmislimo in prepustimo v obdelavo stroju, lahko postopoma gradimo zelo kompleksne postopke in sisteme. Skupaj je ta nauk predstavljal kar dobro osnovo tega, kar danes imenujemo "računalniško mišljenje".

Šele v drugem delu učne snovi smo se srečali s konkretnim programskim jezikom; takrat je bil to še FORTRAN, jezik, ki je bil primarno namenjen reševanju računskih problemov, manj idealen pa morda za osnovno učenje algoritmov. Pri tem je bila razmeroma pomembna lekcija tudi ta, da programski jezik, kot dejansko orodje upravljanja z računalnikom, predstavlja le formo izvršitve in je v tem smislu podrejen algoritmu – ne pa morda obratno.

2.3 Krožek in tekmovanja za navdušence

Vse zgoraj našteto se zdi morda kar ambiciozno za izbirni predmet z razmeroma malo urami. Pošteno je spomniti, da sem sam to izkušnjo doživljal v nekoliko privilegiranih okoliščinah: šlo je za dijake s smeri intenzivne matematike na "prestižni" naravoslovni gimnaziji, poleg tega smo si lahko premet izbrali, torej med nami ni bilo nikogar, ki ga vsebina ne bi zanimala – nekaj, o čemer lahko običajen učitelj oz. učiteljica matematike ali pa slovenščine na splošno le sanja…

A poglavitno za doseganje poglobljenih učinkov poučevanja, kot jih opisujem v prejšnjem razdelku, je bilo nadgrajevanje solidnih osnov, ki smo jih dobili pri predmetu računalništvo, z usmerjenim reševanjem problemov pri računalniškem krožku. Tega sta v omenjenem času na Gimnaziji Bežigrad vodila Mark Martinec in Robert Reinhardt, ki sta za zapis programov promovirala takrat še precej mlad programski jezik pascal. Pascal se je zaradi svojih struktur in sintakse, ki se je nagibala k "človeku prijaznemu" zapisu kode, izkazal za zelo uporaben "šolski jezik" in je tedaj hitro prodiral tudi v redni pouk programiranja na vseh stopnjah. Krožek je ponujal bolj poglobljeno spoznavanje podatkovnih struktur ter tehnike programiranja, a z močnejšim poudarkom na razumevanju in izgradnji postopkov, pri samem kodiranju pa smo se učili tudi pravil "dobrega" in elegantnega programiranja, pri čemer je treba "eleganco" razumeti najprej v fukciji učinkovitosti programa, šele potem v sami estetiki, katere namen je bila predvem berljivost kode.

Krožek je tudi spodbujal k udeležbi na računalniških tekmovanjih, ki so bila takrat v svojih začetkih (tu moram popraviti navedbo v [2] – republiška tekmovanja za srednješolce so se začela že leta 1977), pomenila pa so odlično spodbudo tekmovalni komisiji za sestavljanje inovativnih in duhovitih nalog, ki so utelešale in utrjevale vsa zgoraj našteta načela reševanja problemov. Obenem so mladim tekmovalcem ponudila prvi širši stik s skupnostjo, ki se je na področju računalništva medsebojno oplajala z izkušnjami, vključevala pa je vse od karizmatičnih vrhov, kakršen je bil Anton P. Železnikar, do zelo mladih zagnancev, ki so tudi nas, še odraščajoče, poskušali pritegniti v svoj krog.

3 … IN MOSTOVI

Že v uvodu je nakazano, da je bilo obdobje 1976-1980, v katerem sem obiskoval srednjo šolo, zelo živahno in je poleg omenjenega predmeta računalništvo ponujalo vedno več priložnosti, da si mladi nadebudneži (in tudi nadebudnice, že takrat so tudi dekleta odnašala nagrade na tekmovanjih v programiranju!) dodatno razširimo obzorja, pa tudi preizkusimo svoje znanje v praksi. Če je bil v prvem letniku kolega Verbovšek eksota, ker je imel dostop do svetišča IBM na FMF, smo na koncu šolanja že družno tolkli po tipkovnicah računalniških terminalov, ki so bili vsaj za nekaj časa samo naši…

3.1 IJS

Močan del te živahne skupnosti oz. ekosistema za gojenje novih računalniških znanj je bil na Inštitutu Jožef Stefan, predvsem v takratnem odseku za računalništvo in informatiko. Naši učitelji so nas kmalu povabili tudi na ogled tamkajšnjega računalniškega centra, kakor bi lahko rekli majhni sobici z dvema računalnikoma PDP 11/10 in PDP 11/34 (spominski disk, ki je takrat popolnoma ustrezal svojemu imenu in je "servisiral" celoten računalniški odsek inštituta, je po mojem spominu hranil neverjetnih 10 Mb podatkov). Za vedno se mi je vtisnil v spomin občutek, ko smo lahko lastnoročno, neposredno na prednji plošči samega računalnika, vtipkali osmiško kodo spominske celice, kjer je računalnik začel prebirati navodila za lastno prebujenje. Počutili smo se kot dajalci življenja; odtistihmal razumem, zakaj sistemski inženirji gledajo na svet nekoliko zviška.

Na IJS smo potem lahko šli opravljati tudi počitniško prakso, kjer smo programirali v STRUCTRAN-u, programskem jeziku oz. orodju, katerega namen je bil v osnovi uvajati pravila dobrega programiranja v delo z jezikom FORTRAN, pa tudi olajšati delo programerju oz. približati kodiranje človeškemu razmišljanju. Zame pa je že tisti prvi pogled na "računalniški center" in "kul modele", ki so se sprehajali skozenj, zapečatil smer mojega študija in kariere (#tudijazbitukajdelal).

3.2 Sredin seminar

Po svoje še nenavadnejši je bil vstop v zelo raznoliko skupino ljudi, ki se je vsako sredo zbirala v okvirju kultnega sredinega seminarja za numerično in računalniško matematiko, ki prav letos tudi praznuje 50-letnico. V seminarju so dobile priložnost za predstavitev zelo različne vznemirljive teme, od precej kompleksnih matematičnih, pa do elementarnih (in poglobljenih) predstavitev urejevalnikov besedil ali operacijskih sistemov, pa tudi Rubikove kocke (in seveda algoritma za njeno reševanje). Vodil ga je legendarni lik slovenskega računalniškega panteona, Egon Zakrajšek, tam pa sem srečal tudi svoje poznejše profesorje takrat mlajše matematične generacije, ki je svoje raziskovalno delo tesno prepletla z računalništvom: Vladimirja Batagelja, Tomaža Pisanskega, Bojana Moharja, Marka Petkovška… Vlado je uspel štafeto seminarja ohraniti do današnjega dne [4]. Veliko nam je pomenilo, da so samoumevno medse sprejeli tudi radovedne "smrkavce", kakršen sem bil takrat sam. Ta izkušnja pa mi je tudi zelo razširila obzorja računalništva in pokazala prepletenost te vede z ostalimi.

3.3 Iskra Delta

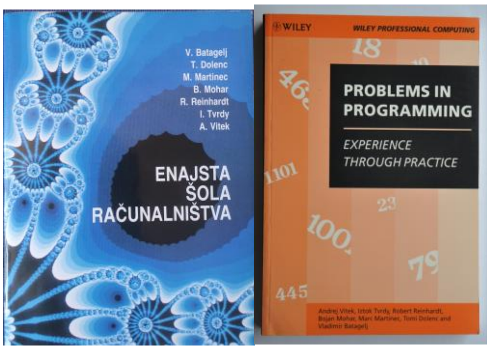
Nepričakovana dodatna priložnost za radovedne srednješolce se je ponudila, ko smo – zdi se mi, da leta 1979 – kot ponavadi poskušali vtakniti svoje prste v vsak računalnik na takrat izjemno popularnem sejmu sodobne elektronike (zlasti eden od sošolcev je imel izjemno intuicijo, da že z nekaj pritiski na tipke povzroči kak zastoj delovanja). Na razstavnem prostoru Iskre Delta nas je prijazno ogovoril Branko Lozar, ki je takrat skrbel za izobraževanje. Že po nekaj besedah smo bili domenjeni, da smo s skupino sošolcev prihajali v izobraževalni center Iskre Delta, kjer smo se spoznavali z računalniki Digital Equipment Corporation, ki so bili še dolga leta potem stalnica na univerzah inštitutih, pa tudi v podjetjih. Delta je takrat že proizvajala prve slovenske terminale KOPA in med poletjem smo tisti, ki smo bili pripravljeni nekaj počitnic zamenjati za čemenje v sicer svetli "kleti" pred zasloni, dobili povsem svojo učilnico z lastnimi terminali, kjer smo se lahko z računalniki "igrali" do onemoglosti. Ne, ne igric. Edina usmeritev podjetja je bila, "Sprogramirajte kaj zanimivega. Karkoli." Lozar je imel nalezljivo veselje do dela z mladimi (klicali smo ga "striček Branko") ter prepričanje, da je najbolje pustiti kreativnosti prosto pot – bo že kaj koristnega iz tega. Prepričanje, ki pod pritiski kapitala danes umira tudi v najresnejših raziskovalnih inštitutih.

4 ZAKLJUČEK

Zaključek teh refleksij se nakazuje že v uvodu. Po prvih začetkih poučevanja računalništva v prvi polovici sedemdesetih se je že v nekaj letih razvil živahen ekosistem znanja, ki so ga poganjali predvsem entuziastični posamezniki. Poudaril bi rad, da so nas vsi ti ljudje, ki so bili izjemno odprti in pristopni, predvsem poskušali naučiti misliti. Četudi je sodobno razvojno programiranje precej na drugačni ravni kot "uredi N števil v tabeli", pa še vedno velja, da so si programski jeziki v osnovi podobni, pa tudi temeljne zapovedi "lepega in dobrega" programiranja še vedno veljajo v časih, ko daleč nad spodnjimi nivoji procesov v računalniku, v najbolj trendovskem razvojnem okolju "zgolj" izbiramo in sestavljamo iz bogatega nabora orodij v knjižnicah, za katere ne moremo popolnoma vedeti, do katere mere lahko njihovo delovanje predvidimo.

Če pa stopimo vstran od programiranja – tudi sam nisem programer – zlahka ugotovimo, da je "algoritmični" ali računalniški pogled na reševanje problemov zelo koristno orodje v različnih vedah ali življenjskih situacijah; poznavanje vsaj osnovnih konceptov delovanja algoritmov in splošno informacijske tehnologije pa nedvomno še precej bolj pomemben del splošne izobrazbe kot pred pedtesetimi leti.

Zapomniti si velja tudi, da je šola dobra, enajsta šola (pod mostom) kot sinonim učenja ob življenjskh situacijah pa, če ne še boljša, vsaj enako potrebna. Zato želim izpostaviti, da je v času mojega šolanja bilo poučevanje računalništva vpeto v že takrat dobro delujoče okolje, ki nam je nudilo prav toliko znanja o računalništvu, kot smo si ga želeli, najbolj radovedne med nami pa kar hitro posrkalo do te mere, da smo v dveh letih v njem že začeli delovati kot njegovi promotorji; tako sem se tudi sam že čez nekaj let znašel v prijetni družbi evangelistov, ki je zgoraj opisana načela poskušala razširjati tudi s knjižico nalog, ki smo jo poimenovali kar "enajsta šola računalništva". A to je že druga zgodba.



Slika 2: Poklon enajsti šoli kot metodi učenja. Tudi v angleščini.

ZAHVALA

Zahvalil bi se rad vsem izjemnim posameznikom, ki sem jih naštel v besedilu, in tudi tistim, ki sem jih zaradi omejitev izpustil, ker so nam znali kazati pot.

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50 let računalništva v slovenskih srednjih šolah – pogled dijakinje in kasneje učiteljice ter ravnateljice na Gimnaziji Vič

50 years of teaching computer science in Slovenian secondary schools – experience of a student and later a teacher and principal of Gimnazija Vič

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POVZETEK

V prispevku predstavim svoje izkušnje in pogled na poučevajne računalništva v srednjih šolah. Pri tem izhajam iz svojih dijaških dni na Gimnaziji Vič, ki segajo v osemdeseta leta prejšnjega stoletja, nato pa podelim izkušnje, ki sem jih na tej isti šoli pridobila kot učiteljica v usmerjenem izobraževanju in na splošni gimnaziji ter zadnja leta kot ravnateljica.

KLJUČNE BESEDE

srednja šola, poučevanje računalništva in informatike

ABSTRACT

The paper presents my experiences and views on teaching Computer Science and Informatics in secondary schools. I lean on my own student days at Gimnazija Vič, which date back to the 1980s, and then I share the experience I gained at this same school as a teacher in vocational and general education programmes, and in recent years as a principal.

KEYWORDS

secondary school, teaching Computer Science and Informatics

1 UVOD

50 let poučevanja računalništva v srednjih šolah je častitljiv jubilej. Zlasti v luči "starosti" te vede. Slovenski pionirji na področju računalništva so vizionarsko in entuziastično orali ledino. S ponosom lahko rečemo, da so v začetnem obdobju tudi v mednarodnih merilih predstavljali zgleden primer.

V pričujočem prispevku predstavljam svoje videnje pouka računalništva skozi izkušnje dijakinje in učiteljice od zgodnjih osemdesetih let prejšnjega stoletja do danes.

2 GIMNAZIJA VIČ PRED USMERJENIM IZOBRAŽEVANJEM

V predmetniku gimnazije v osemdesetih letih 20. stoletja so bile tudi ure pouka, ki jih je šola razporejala sama. To so bila tako imenovana "praktična znanja". Na Gimnaziji Vič smo tako v mojem "intenzivnem razredu" imeli v prvem letniku opisno geometrijo, v drugem letniku (šol. leto 1979/1980) pa računalništvo. Takrat so računalništvo poučevali profesorji in strokovnjaki iz različnih fakultet, inštitutov in podjetij.

Pri pouku računalništva smo spoznali zgradbo računalnika, risali diagrame potekov in jih potem zapisali v Fortranu – in vse to "na tablo". Najbolj mi je ostala v spominu ena od praktičnih nalog – vsak dijak je dobil nek problem, ki ga je moral rešiti s pomočjo programa. Moj je bil, da izračunam, koliko zrn pšenice se nabere, če na prvo šahovsko polje postavim eno zrno, na vsako naslednje pa enkrat toliko zrn kot na prejšnje. Programe smo napisali na roko in potem odšli na računalniški center, ki je bil takrat na Vegovi ulici v Ljubljani. Sošolka je program pretipkala na luknjane kartice, učitelj jih je odnesel v čitalnik … in jih potem prinesel nazaj, ker … moj program ni delal … napačno sem namreč definirala podatkovni tip. "Integer" je bil celo za šahovnico 3x3 polj premalo … To je edina naloga iz nabora vseh nalog pri vseh predmetih iz srednje šole, ki sem si jo zapomnila … Kartice s programom sem dolgo hranila, še svojim dijakom sem jih kazala … Čudno, nihče od sošolcev se v tistih časih ni pritoževal, da je programiranje pretežko.

3 USMERJENO IZOBRAŽEVANJE

Že v času mojega gimnazijskega izobraževanja se je z reformo srednjega šolstva uvedlo usmerjeno izobraževanje (l. 1981) in tako so splošne srednje šole dobile strokovne usmeritve. Viška gimnazija je postala srednja šola za računalništvo. To je bila prva srednja računalniška šola. Vem, da je bilo za ravnatelja najtežje poiskati učitelje strokovnih predmetov. Pionir med učitelji računalniških predmetov je bil Franc Klopčič, sicer pa so strokovne predmete učili absolventi in študenti računalništva, pa tudi asistenti s takratne ljubljanske Fakultete za elektrotehniko in računalništvo. Enako težko je bilo z učno opremo. Pri tem si je šola veliko pomagala sama. Nabavili so ID 80, opremili učilnico z monitorji in kupili nekaj takrat popularnih Spectrumov. Šola je prosila za pomoč tudi različna podjetja; pomagal je IJS, Mladinska knjiga, tudi Iskra Delta. Stiska je bila tako z učbeniki kot tudi z učnimi gradivi, ki jih preprosto ni bilo. Pomagali smo si s skriptami in z učbeniki s fakultete ter s tujimi učbeniki.

Ko je ravnatelj po naključju izvedel, da sem zaključila študij elektrotehnike, me je preprosto povabil, naj pridem učit strokovne predmete s področja strojne opreme. Vabilo sem z veseljem sprejela, saj me je delo v razredu zanimalo. Učne načrte usmerjenega izobraževanja so leta 1989 ponovno prenovili, tako da sem za natanko eno leto še "ujela" stari program s predmetom računalniški sistemi v 4. letniku, dijake v prenovljenem programu pa sem začela poučevati predmet aparaturna oprema. Takrat je šola že razpolagala z učilnico Partnerjev z operacijskim sistemom CP/M in tudi z učilnico računalnikov PC 286, ki so bili povezani v računalniško omrežje Novell ...

4 PO USMERJENEM IZOBRAŽEVANJU

Nova reforma je leta 1990 vrnila gimnazije, srednje tehnične šole med katerimi so nekatere prevzele tudi področje računalništva in informatike s prenovljenimi učnimi načrti. Potreba časa je v srednji šoli vzpostavila obvezni splošno izobraževalni predmet računalništvo in informatika. Obvezen je bil samo v 1. letniku, v obsegu 2 uri pouka na teden, kot izbiren pa je bil na voljo tudi v višjih letnikih. Vsi obvezni gimnazijski predmeti, razen športne vzgoje, glasbe in predmeta računalništvo in informatika, so postali maturitetni predmeti in praviloma so ti zasedli t. i. izbirne ure. To je eden od ključnih razlogov, da se je razvoj predmeta računalništvo in informatika upočasnil, saj je v večini šol obtičal v prvem letniku in prevzel osnovno opismenjevanje. Sistematičnega računalniškega opismenjevanja v osnovi šoli namreč ni bilo, potreba po računalniških znanjih pa je postajala čedalje bolj očitna.

Gimnazija Vič je bila ena redkih gimnazij, ki je kljub temu, da predmet ni bil maturiteten vsa leta poučevala informatiko tudi v 2. letniku, v okviru izbirnih ur. Za dijake, ki so želeli več in bolj poglobljena znanja pa smo vodili računalniške krožke …

V tem času se je nekako zameglilo, kakšno vlogo naj ima računalnik oziroma informacijsko-komunikacijska tehnologija (IKT) v šoli, kaj je naloga šole in kaj potrebuje šola kot institucija za svoje delovanje. Pomešala so se področja vloge računalnika pri drugih predmetih, uporabe računalnika za vodenje procesov, ki se odvijajo v šoli, in poučevanja temeljnih računalniških znanj. Vzporedno s tem se je odpirala kopica specifičnih nalog za vsako od omenjenih področij uporabe informacijsko-komunikacijske tehnologije v šoli. Šole je bilo potrebno ustrezno opremiti, didaktika predmetov je terjala posodobitev, učitelje je bilo potrebno ustrezno izobraziti, pripraviti je bilo potrebno učni načrt za predmet računalništvo in informatika. Še prej pa izobraziti izobraževalce, saj ni šlo več za eksperimentalne šole ampak za vse srednje šole, ki so se jim že pridruževale tudi osnovne šole.

Pred Zavodom za šolstvo je bil velik izziv. En od prvih korakov Zavoda je bil storjen z vzpostavitvijo skupine "Učitelji inštruktorji", ki se je izobraževala na Inštitutu Jozef Stefan. To so bili izbrani učitelji matematike in računalništva na srednjih šolah. V šolah, za katere so bili zadolženi, so izvajali tečaje osnov računalništva. Skupina je delovala sedem let, nasledil pa jo je projekt Ro – računalniško opismenjevanje, ki je nadaljeval s širjenjem znanj učiteljem vseh predmetov. Vzporedno s tem projektom je potekalo v organizacij Zavoda za šolstvo tudi veliko drugih projektov, ki naj bi v šole smiselno umestili znanje in uporabo IKT. Marsikatera dobra praksa je ostala, žal pa sistemskega pristopa k poučevanju temeljnih znanj s področja računalništva še vedno ni …

Razvoj samega predmeta na gimnaziji in s tem poučevanja temeljnih znanj s področja računalništva pa se je pospešil šele, ko je predmet, ki se je za ta namen moral preimenovati v informatiko, postal maturitetni. To se je zgodilo šele leta 2005, maturo iz informatike pa so dijaki lahko izbrali šele na maturi 2007. Velik zaostanek (od leta 1990 do 2005) se počasi zmanjšuje, še vedno pa ostaja to predmet, ki je v vsej vertikali obvezen samo v 1. letniku gimnazije in nekaterih srednjih šol, sicer pa ima status izbirnega predmeta.

5 ZAKLJUČEK

Ko gledam nazaj – kot dijakinja, učiteljica računalništva, učiteljica informatike, mentorica dijakom pri raziskovalnih nalogah in krožku, pa tudi kot učiteljica inštruktorica in vodja študijske skupine za računalništvo in informatiko, sedaj pa kot ravnateljica Gimnazije Vič – se mi milo stori ob misli, koliko je bilo vloženega napora … in zaigra srce, ko vidim naše nekdanje dijake, ki uspešno razvijajo in širijo računalniška znanja na najrazličnejših področjih računalništva doma in v tujini. Svetlo bodočnost na tem področju zagotavlja tudi skupnost učiteljev računalništva, ki jo strokovno vodi dr. Andrej Brodnik.

Samo še sistemski pristop manjka ...

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Moje računalniško izobraževanje

My computer science education

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POVZETEK

V članku podajam kronološki pregled mojega izobraževanja na področju računalništva, od izbirnega predmeta na gimnaziji v zgodnjih 1970-tih letih, preko doktorskega študija v ZDA in kasnejših aktivnostih kot univerzitetni profesor.

KLJUČNE BESEDE

Gimnazija Bežigrad, Fakulteta za elektrotehniko, doktorski študij, Univerza Pensilvanije, Fakulteta za računalništvo in informatiko

ABSTRACT

The article gives a cronological overview of my education in computer science, ranging from an elective course in high school in the early 1970s up to doctoral studies in US and later activities as an university professor.

KEYWORDS

Bežigrad grammar school, Faculty of electrical engineering, doctoral studies, University of Pennsylvania, Faculty of computer and information science

1 IZOBRAŽEVALNE INSTITUCIJE

1.1 Gimnazija Bežigrad

Po osnovni šoli dr. Vita Kraigherja sem se brez veliko premišljanja vpisal na mojemu domu najbližjo gimnazijo Bežigrad. Ker me je matematika vedno veselila, sem se odločil za razred z intenzivno matematiko. Tisto leto je bilo za intenzivno matematiko veliko zanimanja in je gimnazija sestavila kar dva razreda z intenzivno matematiko. V našem razredu, paralelki *c*, nas je bila polovica z intenzivno matematiko, polovica pa z intenzivno angleščino. Matematiko nas je učil slavni Ivan Štalec. V tretjem letniku (1972/73) smo imeli možnost izbrati dodatni predmet Računalništvo. Tisto leto so se trije učitelji računalništva med seboj dokaj pogosto izmenjavali oziroma nadomeščali. Tako sem spoznal poleg prof. Rajkoviča tudi prof. Bratka in prof. Lajovica. V okviru predmeta smo tudi "obiskali" računalnik IBM 1130 na FE.

O računalništvu do takrat nisem vedel kaj dosti, še največ iz knjig o znanstveni fantastiki, ki sem jih redno prebiral. Isaac Asimov je bil eden od zgodnjih vplivov in veliko pozneje sem ga med mojim doktorskim študijem v ZDA tudi osebno srečal in dobil njegovo posvetilo v knjigo, ki jo je takrat izdal [25].

Pouk računalništva pa ni bil med takratnimi učitelji univerzalno prijazno sprejet. Spomnim se, da je celo učitelj matematike — tisti, ki je učil naše "angleže", to je drugo polovico našega razreda — trdil, da bo Slovenija v prihodnosti potrebovala največ tri do štiri računalnike in da je učenje programiranja potemtakem proč vržen čas. Mene je kljub temu računalništvo tako pritegnilo, da sem se po maturi leta 1974, sicer po nekaj premišljanja, odločil za vpis na Fakulteto za elektrotehniko. Kompromis pa je bil vzporedni vpis na študij Filozofije na Filozofski fakulteti, saj so me zanimala vprašanja, ki bi jih danes lahko bolje opredelili kot kognitivno znanost.

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1.2 Fakulteta za elektrotehniko

Univerza je seveda pomenila velik preskok od dotedanjega šolanja, čeprav na FE manj kot na FF. Na srečo nas je z gimnazije in z intenzivne matematike šlo kar nekaj sošolcev. Omenim naj Saša Tomažiča, pa Andreja Levstka, ki sta kasneje ostala na fakulteti. Spomnim se prof. dr. Keršiča (Osnove elektrotehnike), ki je na začetku predavanj pokazal na desno polovico Predavalnice 1 in rekel, "vi boste prišli naprej v 2. letnik, vi na levi pa ne!" Na srečo sem se usedel na pravo stran predavalnice ☺. Za številne profesorje smo prevzeli ali pa izumili nove nadimke. Prof. dr. GAbrielu TOmšiču smo nadeli vzdevek GATO, saj se je s svojo drobno postavo kot maček sukal pred tablo. Z dobro gimnazijsko naravoslovno osnovo sem sicer prva dva letnika na FE zlahka zaključil. V 1. letniku sem tudi dobil svoj prvi elektronski kalkulator *Texas Instruments*. Takrat sem lahko tudi dokaj redno opravil vse študijske obveznosti na FF. Študij filozofije sem opustil šele v četrtem letniku, saj takratni študijski program ni bil po mojem okusu, študij elektrotehnike pa je tudi zahteval vedno več časa. Nisem želel niti opustiti mojih prostočasnih dejavnosti, to je učenja smučanja in kasneje še potapljanja.

Slika 1: Smer Avtomatika, 4. letnik, šolsko leto 1977/78. V akademskih in znanstvenih krogih so poleg avtorja iz te generacije ostali še Jurij Šilc, Bojan Nemec in Jadran Lenarčič, vsi na IJS.

Po drugem letniku, pa se nisem odločil za smer Računalništvo ampak raje za Avtomatiko, sisteme in kibernetiko (Slika 1). Avtomatika je bila v tistem času bolj uveljavljena smer, delo s signali so me tudi bolj zanimali kot klasična umetna inteligenca. Morda me je podzavestno premamila tudi meni čarobna beseda kibernetika, ki sem jo poznal še iz knjig Asimova? Tako sem se znašel v

Slika 2: Skupina, ki se je ukvarjala z računalniško analizo signalov EKG: z desne prof. dr. Ludvik Gyergyek, dr. Marjan Vezjak, prof. dr. Krunoslav Turkulin in medicinski tehnik med posvetom v Krapinskih toplicah okoli leta 1980. Foto: Franc Solina.

laboratoriju prof. dr. Ludvika Gyergyeka, kjer sem naredil tako diplomo [23] kot znanstveni magisterij [24], takrat zaposlen že kot stažist oz. mladi raziskovalec. Moj delovni mentor je bil dr. Marjan Vezjak, delal pa sem na analizi signalov EKG (Slika 2). Takrat so bili člani laboratorija še Nikola Pavešić, France Mihelič, Franjo Pernuš, Stane Kovačič, Andrej Kuščer, Bojan Grošelj in Franc Jager, ki se še danes ukvarja z analizo EKG na FRI.

Programiral sem v jeziku C na računalniku PDP-11/34. Cela katedra si je delila ta računalnik. Takrat še ni bilo osebnih računalnikov. Zato so za mlajše člane kolektiva ostale noči kot edini možni čas za delo na računalniku. Programirali smo tako, da smo programe najprej napisali na papir in jih nato pretipkali na konzoli, nato pa poganjali program in odpravljali napake. Podatke, to je posnetke EKG, ki smo jih dobili od naših zdravnikov, smo hranili na magnetnih trakovih s pomočjo instrumentacijskega magnetofona *HP3964*. Moj glavni dobavitelj posnetkov EKG in mentor na medicinskem področju je bil dr. Japec Jakopin, ki mi je kot sin dveh eminentnih mojstrov besede celo lektoriral mojo magistrsko nalogo. Problem je bil tudi kako dokumentirati naše rezultate, to je slike signalov EKG, ki so se izpisovali na katodnem zaslonu računalnika. Razen tiskalnika TTY nismo imeli nobene druge izhodne enote. Rešitev mi je nakazal Zaviša Bjelogrlić, dve leti mlajši podiplomski študent v našem laboratoriju in navdušen fotograf. Popolna tema, fotoaparat SLR na stativu, slikanje zaslona z dolgimi časi ekspozicije na visoko kontrastni film, nato razvijanje filma in izdelava fotografij v temnici na fakulteti. Vse to sem se moral naučiti, da sem lahko fotografije z rezultati nalepil v tipkopis svojega magistrskega dela, ki sem ga natipkal na svoj mehanski pisalni stroj. Šele Zaviša je bil prvi v našem laboratoriju, ki se je lotil pisanja svojega magisterija na računalniku s programom `nroff`. Imel sem tudi eminentno komisijo za zagovor svoje magistrske naloge [24], v kateri sta bila kar dva bodoča člana SAZU, poleg mojega mentorja prof. dr. Ludvika Gyergyeka [3] še zdravnik prof. dr. Matija Horvat [32].

1.3 Hidrografski inštitut vojne mornarice

Po seriji srečnih naključij se je moje služenje obveznega vojaškega roka odvilo v računalniškem centru Hidrografskega inštituta vojne mornarice v Splitu. Inštitut je sedaj civilna ustanova [11]. V centru smo imeli na voljo računalnik iz serije PDP-11, zaposleni pa so bili praktično samo civilni uslužbenci. V centru smo obdelovali razne oceanografske podatke Jadranskega morja, ki jih je inštitut sam zbiral s svojo oceanografsko ladjo *Andrija Mohorovičić*, najvišjo stopnjo zaupnosti pa so takrat imeli podatki o deviacijah gravitacijskega pospeška g, kar je bilo pomembno za vodenje raketnih izstrelkov. Sicer pa so bili takrat komercialno najpomembnejši pomorski navigacijski zemljevidi, ki so jih tiskali v tiskarni inštituta. Prvič v življenju sem imel na voljo skoraj neskončno računalniškega časa, tako da sem programiral predvsem stvari, ki so me zanimale, med drugim tudi Conwayevo igro življenja.

1.4 Pensilvanska univerza

Za Fulbrightovo štipendijo sem kandidiral že takoj po diplomi, vendar je moja kandidatura uspela šele po zaključenem magistrskem študiju. Dobil sem Fulbrightovo potovalno štipendijo [8] in štipendijo sklada IREX [13], obenem pa še mesto gostujočega raziskovalca na Pensilvanski univerzi [31]. Moja gostiteljica in kasnejša mentorica je bila prof. dr. Ruzena Bajcsy, ki je na Oddelku za računalništvo in informatiko (CIS) vodila laboratorij GRASP (General Robotics, Automation, Sensing & Perception Lab) [9]. University of Pennsylvania, ki je zasebna univerza v Philadelphiji in članica *Ivy Leage*, je v svetu računalništva znana predvsem kot rojstni kraj računalnika ENIAC [6]. Takorekoč v predsobi našega laboratorija in moje pisarne je takrat še vedno stalo nekaj kosov (omar) originalnega ENIACa (Slika 3).

Slika 3: Člani laboratorija GRASP s prof. dr. Ruzeno Bajcsy, ustanoviteljico laboratorija na sredini, leta 1984. Na desni v ozadju stojijo še komponente računalnika ENIAC [22].

Prof. Ruzena Bajcsy [21], po rodu iz Slovaške, je svoj drugi doktorat znanosti dobila na Univerzi Stanford pod mentorstvom prof. Johna McCarthya [15], enega od pionirjev umetne inteligence. Prof. McCarthy je leta 1955 v projektnem predlogu za organizacijo konference v Darthmouthu, ki je potekala poleti leta 1956 in velja za rojstni kraj nove znanstvene discipline, tudi skoval ime za to novo disciplino — *Artificial Intelligence* [15]. Zato se lahko pohvalim, da je moj akademski “dedek” eden od začetnikov umetne inteligence [18].

Prvo leto svojega bivanja v Philadelphiji sem imel status gostujočega raziskovalca, toda moje ambicije so bile večje. Ker je bila moja mentorica zadovoljna z mojim delom, me je finančno podprla, da sem se lahko naslednje leto vpisal na doktorski program. Ker sem že prvo leto neformalno poslušal predmete na doktorskem študiju, sem lahko že v naslednjem letu opravljal rigoroz, ki je pogoj za doktorski naziv. Rigoroz (angl. preliminary exam ali candidacy) se je takrat pisal tri dni zaporedoma, vsak dan po tri oziroma štiri temeljne računalniške predmete, skupaj deset predmetov. Ker v Ljubljani nisem izbral študijske smeri računalništvo, sem moral precej snovi nadoknaditi, vse od matematične logike, teorije programskih jezikov, prevajalnikov itd. Čez pol leta je sledil še drugi del rigoroza, to sta bila dva izbirna predmeta, običajno povezana s temo doktorske disertacije. Izbral sem računalniški vid in robotiko. Robotiko nam je predaval prof. Richard P. Paul, eden od pionirjev robotske kinematike [20].

Moji sošolci iz laboratorija GRASP so se raztepli skoraj po vsem svetu: Gregory Hager (John Hopkins University) [10], ki je štiri leta bil tudi moj cimer, Peter Allen (Columbia University), David Heeger (New York University) [5], Hugh Durrant-Whyte (University of Sydney) [12], Eric Krotkov (Toyota Research Institute) [7], Stephane Mallat (Collège de France in École normale supérieure) [30], Ken Goldberg (Univerza Kalifornije, Berkeley) [16]. Moja mentorica Ruzena Bajcsy pa se je po nekaj letih kot poddirektor NSF v Washingtonu v času Clintonove administracije preselila v Kalifornijo, kjer je profesorica na Univerzi Kalifornije, Berkeley.

V času mojega bivanja v Philadelphiji sem za krajše raziskovalne obiske odprl vrata v laboratorij GRASP še več kot desetim drugim raziskovalcem s FE. Omenim naj Jasno Maver in Aleša Leonardisa, ki sta kasneje na FE pod mojim mentorstvom doktorirala in Staneta Kovačiča, ki je skupaj s prof. Bajcsy objavil prvi članek o elastični poravnavi medicinskih slik [1], ki ima na Google učenjaku več kot 1600 citatov. Za podporo slovenskim akademikom je Univerza v Ljubljani prof. Bajcsy leta 2001 podelila častni doktorat.

V svoji doktorski disertaciji sem se ukvarjal z rekonstrukcijo volumetričnih modelov iz globinskih slik [26], ki navdih išče v teoriji človeškega zaznavanja slik. Članek na osnovi mojega doktorata so sprejeli na prvi mednarodni konferenci iz računalniškega vida (ICCV), ki je bila 1987 v Londonu [2], kasneje sem to objavil tudi reviji IEEE PAMI [28]. Istega leta novembra sem še zagovarjal svojo disertacijo. Nato sem imel do avgusta 1988 status podoktoranta, ko sem se vrnil v Ljubljano na FE. Za moj povratek na FE je bil najbolj zaslužen takratni prodekan prof. dr. Tadej Bajd, ki je leta 1987 obiskal Pensilvansko univerzo. Na dolgem pogovoru ob pivu sem mu zaupal svoje želje o povratku v domovino, prof. Bajd pa je nato na fakulteti sprožil ustrezne postopke. Mojo zaposlitev je podprl tudi prof. dr. Boštjan Vilfan, takratni predstojnik Katedre za računalništvo in informatiko. Domov me je vlekla družina pa tudi velike družbene spremembe, ki so se že napovedovale. Naj še omenim, da je bilo v tistem času težje vzdrževati stike z domovino, saj pri nas še ni bilo elektronske pošte, ki sem jo v ZDA uporabljal že od leta 1983, o svetovnem spletu pa seveda še ni bilo ne duha ne sluha. Za informacije od doma so poskrbele mailing liste: *Pisma bralcev*, ki jih je urejal Andrej Brodnik in *RokPress*, ki ga je začel Rok Sosič.

1.5 Vrnitev na fakulteto

Takoj ko sem se vrnil na FE, sem začel predavati različne računalniške predmete. Nekaj sem jih nasledil od prof. Petra Tanciga, ki je bil zunanji sodelavec fakultete. Računalniške predmete sem predaval tudi na kemiji, montanistiki, tekstilni tehnologiji, matematiki in kasneje še na Fakulteti za pomorstvo in promet v Portorožu. Izstopajoči študenti v mojih prvih letih v Ljubljani so bili Andrej Bauer na matematiki, na FE pa Marko Grobelnik, Dunja Mladenić in Jerneja Gros. Čeprav so me kolegi učitelji na FE podpirali, pa kljub temu nisem imel nobenega neposrednega

Slika 4: Člani laboratorija LRV s prof. dr. Ruzeno Bajcsy leta 1995. Od leve proti desni stojita Peter Peer in Franc Solina, sedijo pa Aleš Jaklič, Bojan Kverh, Ruzena Bajcsy in Aleš Leonardis.

botra, kar pa ni bilo vedno slabo. Na samem začetku nisem imel nobene fakultetne opreme, za prvo financiranje od takratne raziskovalne skupnosti sem se moral zelo naprezati. Svoj Laboratorij za računalniški vid so mi odobrili šele leta 1991. Ustanovili smo ga celo v istih dneh, ko se je osamosvajala Slovenija. Kakšno leto kasneje smo za laboratorij dobili večji prostor. Odlično sem sodeloval s takratnim dekanom prof. dr. Baldomirjem Zajcem pri organizaciji konference *IEEE Melecon* leta 1991 v Cankarjevem domu tik pred razglasitvijo samostojnosti, kasneje pa sva začela z organizacijo konferenc ERK. Skrbel sem predvsem za urejanje konferenčnih zbornikov. Prevzel sem tudi tehniško uredništvo Elektrotehniškega vestnika. Pri vsem tem delu mi je bila na začetku v dragoceno pomoč oprema, ki sem jo prinesel s seboj iz ZDA: osebni računalnik Macintosh II in laserski tiskalni Apple Laserwriter II. Konec 80-tih let na fakulteti še ni bilo drugega laserskega tiskalnika. Za oblikovanje besedil sem tudi prvi na fakulteti uvedel LaTeX. Takoj sem tudi začel z mentoriranjem pri doktoratih [17]. Moja prva doktorica znanosti je bila že leta 1990 Tatjana Zrimec. Še posebej pa sem ponosen, da sem bil mentor pri raziskovalni nalogi Jureta Leskovca, ko je še bil gimnazijec. V doktorskih komisijah mojih kandidatov je nekajkrat sodelovala tudi prof. Ruzena Bajcsy (Slika 4). S prof. Srečom Draganom z ALUO sva začela dolgoletno plodno sodelovanje na področju umetnosti novih medijev [29].

1.6 Fakulteta za računalništvo in informatiko

Moje strokovno delo po ustanovitvi samostojne Fakultete za računalništvo in informatiko je bolj podrobno opisano v zborniku, ki je izšel ob 20-letnici fakultete [4]. Naj na kratko omenim le, da sem se kot dekan fakultete med leti 2006 in 2010 posvetil predvsem bolonjski reformi in arhitekturnim načrtom nove stavbe. Pri bolonjski reformi sem si prizadeval, da bi tudi umetna inteligenca dobila svoj zaslužen del študijskega programa na FRI, ki ga do tedaj ni imela, čeprav je umetna inteligenca prispevala največ raziskovalnih rezultatov. Pri novi stavbi pa smo od arhitektov predvsem želeli prostore, ki bodo omogočali srečevanje ljudi in spodbujali večje sodelovanje.

Po štirih letih dekanovanja se je bilo kar težko spet vrniti v raziskovalni ritem. Bolj sem se posvetil uporabniškim vmesnikom, 3D dokumentiranju v arheologiji (v sodelovanju z arheologom Miranom Eričem [14]). Vrnil sem se celo na tematiko svojega doktorata, saj skušamo isti problem danes rešiti z globokimi nevronskimi mrežami [19]. Po bolonjski reformi sem začel redno predavati tudi na ALUO, smer Video in novi mediji. Svoje umetniško ustvarjanje sem z novih medijev razširil še na kiparstvo v kamnu in lesu, kar skušam povezati s svojim računalniškim znanjem [27]. Delam na seriji kamnitih skulptur (Svetlobni vodnjak), ki sem jih virtualno obogatil z video projekcijo gibajočih se svetlobnih pik, ki se obnašajo kot vodne kapljice.

Vodenje Laboratorija za računalniški vid sem leta 2019 predal svojemu nasledniku prof. dr. Petru Peeru.

Da zaključim, izbirni predmet Računalništvo, ki sem ga imel na gimnaziji, je bil morda odločilna izhodiščna vzpodbuda za zanimivo strokovno življensko pot.

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BATMAN Project Workshop

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Sergio Crovella, Anton Gradišek

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Ljubljana, Slovenia

PREDGOVOR

Na delavnici sodelujejo partnerji projekta ERA PerMed BATMAN in drugi zainteresirani znanstveniki. BATMAN je akronim za "Biomolecular Analyses for Tailored Medicine in Acne iNversa", biomolekularne analize za personalizirano zdravljenje Acne Inversa. Cilj projekta, ki se je začel leta 2019, je priti do novih spoznanj in boljšega razumevanja mehanizmov kronične bolezni Acne Inversa, imenovane tudi Hidradenitis Suppurativa, in razviti ciljane metode zdravljenja. To bo pripomoglo k boljšemu življenju pacientov. Raznoliki konzorcij projekta sestavljajo partnerji s področij medicine, genetike, modelov tkiv in informacijskih tehnologij.

Delavnica je tudi del letnega sestanka partnerjev konzorcija.

Predsednika delavnice se distancirata od nagrad, ki so bile podeljene med Multikonferenco.

Sergio Crovella in Anton Gradišek, predsednika delavnice

FOREWORD

This Workshop brings together the partners that collaborate on the ERA PerMed project BATMAN, as well as other interested parties. BATMAN stands as the acronym for "Biomolecular Analyses for Tailored Medicine in Acne iNversa". The aim of the project that started in 2019 is to find new knowledge and better understanding of mechanisms of the chronic disease Acne Inversa, also called Hidradenitis Suppurativa, and to provide tailored treatment for the patients, thus improving their quality of life.
The consortium is heterogeneous and brings together partners with experiences in the field of medicine, genetics, tissue models, and information technologies.

This Workshop is also a part of the annual consortium meeting of the partners.

Workshop chairs distance themselves from the awards that were handed out during the Multiconference.

Sergio Crovella and Anton Gradišek, workshop chairs

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

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Anton Gradišek

Paola Maura Tricarico

Identification of novel genetic variants in Hidradenitis Suppurativa patients through the investigation of familial cases

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ABSTRACT

Hidradenitis Suppurativa (HS) familial cases represent 40% of the total cases observed. Current knowledge on the etio-pathogenesis of these cases is still poor; for this reason, we decided to investigate the genetic variants associated to this disease in 5 HS families. In 3 families we found single nucleotide variation (SNV) in genes never associated with HS: *ZNF318*, *DCD*, *DSC3*. In one family we found a new SNV in *NCSTN* gene, one of the few genes already associated with HS. In another family, due to the low number of individuals analyzed, we did not find with certainty the SNV associated with the disease but we found three SNVs in *PADI3*, *DSP* and *KRTAP10-4* genes. Deepening knowledge on the genetic variants associated with these familial HS cases is a necessary first step to unravel the disease etio-pathogenesis; in fact, to better understand the disease an integrated approach involving different OMICs is the right path to be followed.

KEYWORDS

Hidradenitis suppurativa, familial cases, genetic variants, WES analysis.

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Hidradenitis suppurativa (HS), a chronic autoinflammatory refractory disease with recurrent skin lesions and wounds of difficult resolution, currently represents an area of high-unmet clinical need. HS has multifactorial etiology that involves a strict interplay between genetic factors, immune dysregulation, hormonal influence, bacterial colonization, impaired wound healing and environmental risk factors [1, 2]. Approximately 40% of patients with HS report a family history of the condition, and amongst these only about 10% present mutations in genes involved in the gamma-secretase pathway, namely *NCSTN*, *PSENEN* and *PSEN1* genes [3].

The study of HS familial cases represents a tool identify novel genetic factors, other than the genes of the gamma-secretase pathway, involved in the etio-pathogenesis of this complex disease. Unfortunately, analyzing HS familial cases can be sometimes difficult due to delayed diagnosis, absence of personal and family health history investigation, incomplete penetrance of the disease and also unwillingness to participate in the genetic study of other family members.

Here we investigated 5 HS families aimed at identifying genetic variants associated with the disease, using whole exome sequencing (WES).

Patients with a positive family history of HS were recruited from January 2019 to May 2021 at the Dermatology Unit of the University of Milan (Italy) and at the Dermatology Service of "Hospital das Clinicas", Recife, Brazil. All study participants signed a written informed consent after the approval by the Single Regional Ethical Committee of Friuli Venezia Giulia (CEUR) (CEUR-2018-Sper-127-BURLO and CEUR-2020-Em-380) by the Area B Milan Ethics Committee (protocol no. 487_2020) and by Ethical Committee of the Federal University of Pernambuco (n. 3.048.719; 30/11/2018).

Genomic DNAs have been extracted from saliva by using the Oragene-DNA (Ottawa, Canada) kit following the manufacturer's protocols. WES, with 100X of expected coverage, has been performed in outsourcing by Macrogen

(Seoul, Korea). WES analysis has been performed using the InterOMICs Genome Pro software, as described in our previous study [4]; WES results have been validated by Sanger Sequencing.

In family 1 (11 HS patients and 36 healthy subjects) we found a rare missense single nucleotide variation (SNV) in the exon 4 of *ZNF318* gene in heterozygosis (rs767801219). The SNV was detected in heterozygosis in 17 family members comprising all of the 11 individuals who initially declared to be affected by HS and additional 6 individuals that haven't been mentioned to possess any sign of the disease (**Figure 1**). This identified SNV shows an autosomal dominant inheritance pattern with incomplete penetrance.

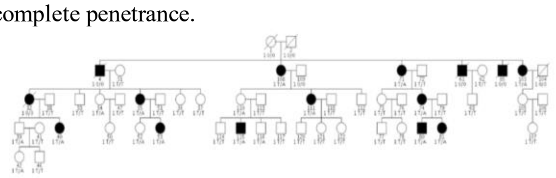

Figure 1: Pedigree of the Family 1. 47 individuals adhered to the study, 11 of which declared to be affected by HS, and the genotype of the selected variant in *ZNF318* gene (rs767801219).

ZNF318 gene encodes the zinc finger 318 (ZNF318) protein involved in the regulation of the androgen receptor by acting both as a co-repressor or co-activator in AR transactivation function. To date the effect of the SNV in the protein structure is hard to predict *in silico* due to the dimension of the protein and the lack of a clearly defined structure, but the role of androgens in HS is well known and has been explored in numerous observational and some interventional studies [5].
In family 2 (2 HS patients and 1 control and 1 child) we found a rare frameshift insertion in exon 4 of *DCD* gene in heterozygosis (rs538180888) in all 2 HS patients; this variant is also present in the daughter, an 11-year-old child who begins to manifest relapsing inguinal furuncles (**Figure 2**).

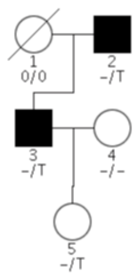

Figure 2: Pedigree of the Family 2. 4 individuals adhered to the study, 2 of which declared to be affected by HS, the genotype of the selected variant in *DCD* gene (rs538180888).

DCD gene encodes Dermcidin, the most abundant antimicrobial peptide (AMP) present in human sweat. The identified frameshift variant disrupts the ORF of *DCD* and results in a 33 amino acid peptide having a completely altered sequence, if compared to the wild- type DCD-1(L) peptide. This affects both the N-terminal and the C-terminal partitions, hence impairing the activity of DCD. This mutant is characterized by a less compact structure and by an increased solvent accessibility, particularly highlighted by the increased flexibility of its C-terminal region.
In HS, a dysbiosis-driven aberrant activation of the innate immune system leading to excessive inflammatory responses, is thought to be partially induced by a marked dysregulation in antimicrobial peptides production, in particular DCD [6, 7]. Indeed, in the skin of HS patients a significant down-regulation of DCD expression has been observed [8, 9].
In family 3 (4 HS patients and 1 control) we found a rare missense SNV at exon 10 of *DSC3* gene in heterozygosis (rs114245564) in all 4 HS patients (**Figure 3**).

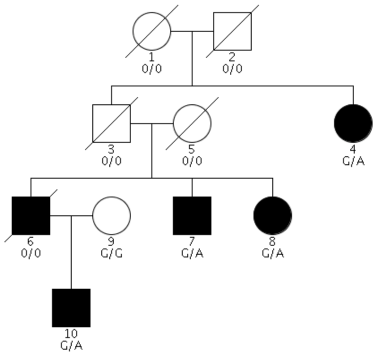

Figure 3: Pedigree of the Family 3. 5 individuals adhered to the study, 4 of which declared to be affected by HS, the genotype of the selected variant in *DSC3* gene (rs114245564)

DSC3 gene encodes Desmocollin-3 a desmosomal cadherin superfamily member, component of the transmembrane core of desmosomes required for maintaining cell adhesion in the epidermis. The critical role of these desmosomal cadherins in epithelial integrity has been illustrated by their disruption in mouse models and human diseases. Alterations in the expression and function of the desmosomal cadherins have been observed in severe autoimmune skin disease pemphigus, epidermolysis bullosa and hypotrichosis and recurrent skin vesicles [10, 11].
In family 4 (4 HS patients, 3 controls and 2 children), enrolled in Brazil, so with individuals showing a different genetic background when compared to the other Italian members of the analyzed families, we found a SNV in *NCSTN* gene exon 2 in heterozygosis (NM_015331:exon2:c.T131A) encoding a premature stop codon [NP_056146 1:p.(L44*)], in all 4 HS patients and also in the 2 children (11- and 16-year-old). To date, these 2 children do not show the disease, probably due to their young age (**Figure 4**).

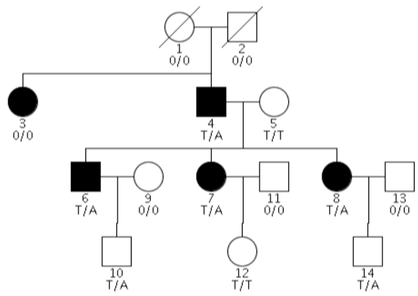

Figure 4: Pedigree of the Family 4. 9 individuals adhered to the study, 4 of which declared to be affected by HS, the genotype of the selected variant in *NCSTN* gene.

This genetic variant was not present in the Genome Aggregation Database (gnomAD) and therefore it was never associated with HS; despite this, the *NCSTN* gene is one of the few genes already associated with HS [3].
In family 5 (2 HS patients and 1 control) we found 25 SNVs in genes expressed in the skin or by the immune system (**Table 1**).

Table 1: List of single nucleotide variations (SNVs) genes expressed in the skin or by the immune system, found in 2 HS patients and not in the control of the family 5

Gene	SNV	Ref	Alt
AQP9	rs1439722664	T	C
PHYKPL	rs559406393	C	G
ACSS2	rs371982555	C	T
ARSK	rs754905227	T	A
CRIP1	rs200883038	C	A
MYH14	rs371244397	C	T
SMYD5	rs61755313	G	A
VEGFA	vi6.43777526	T	G
DHFR2	rs772191447	T	C
TRPS1	rs61745721	T	C
HSPBP1	rs150486738	G	A
MAP3K4	rs1477003192	T	C
PADI3	rs142129409	T	A
PPP1R3D	rs377580619	G	A
SYNE1	rs34028822	G	A
ZNF692	rs201441689	C	T
ADPRHL2	rs139736291	A	G
PTCD1	rs35556439	G	A
COPB2	vi3.139379091	C	T
DSP	rs78652302	A	T
KRTAP10-4	rs782312294	G	T
PRSS1	rs757111793	G	A
SCFD2	rs79025139	C	A
TRIM16	rs143877253	C	A
TTLL12	rs369903948	T	C

Among these genes, the ones considered as possibly related to dermatologic disorders based on their functions are: *PADI3*, *DSP* and *KRTAP10-4* (**Figure 5**).

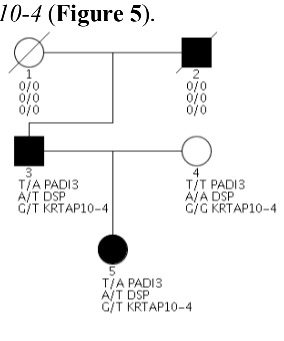

Figure 5: Pedigree of the Family 5. 3 individuals adhered to the study, 2 of which declared to be affected by HS, the genotype of the selected variants in *PADI3, DSP* and *KRTAP10-4* genes.

PADI3 encodes for a member of the peptidyl arginine deiminase family of enzymes, which catalyze the post-translational deimination of proteins by converting arginine residues into citrullines. Deimination is implicated in many physiological processes including keratinocyte biology and skin homeostasis. One example of deiminated protein is the fillagrin, a key protein in the epidermal barrier function, expressed in the hair follicle. In addition to this, *PADI3* gene may also play a role in the cornification-related autophagy process of the epidermis. Uncombable Hair Syndrome 1 and Central Centrifugal Cicatricial Alopecia are diseases associated with *PADI3* gene [12].
DSP encodes for Desmoplakin, an obligate and the most abundant component of functional highly specialized adhesive intercellular junctions known as desmosomes. Desmosomes are abundant in districts that are continuously subjected to mechanical solicitations such as the epidermis and hair follicles, because they confer strong mechanical strength to tissues and contributing to the maintenance of tissue architecture and cohesiveness [13, 14]. Alopecia, palmo-plantar keratoderma, skin fragility woolly-hair syndrome, erythrokeratodermia, dilated cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy/dysplasia are disorders also connected to alteration in the expression and function of Desmoplakin [15].
KRTAP10-4 encodes for Keratin Associated Protein 10-4, which are essential for the formation of a rigid and resistant hair shaft through their extensive disulfide bond cross-linking with abundant cysteine residues of hair keratin. This gene plays an important role in the keratinization pathway [16].
Unfortunately, perhaps due to the low number of family individuals analyzed, to date we do not have the ability to identify with certainty the SNV associated with this HS familial case.

Considering the findings obtained by analyzing some HS families, one with different genomic background with respect to the others, we can state that HS familial cases are extremely useful to investigate novel actors involved in this complex disease, so the first need is to augment the number of families to be analyzed; secondly, to more deeply and precisely evaluate the role of the identified genetic factors, at least an integration with transcriptome is needed. To this end it is important to recall that when families are diagnosed and recruited, it should be envisaged, when possible and permitted by the ethical committee, a skin biopsy of lesional, pre-lesional and healthy skin of the patients, to allow RNA extraction and consequent transcriptome analysis.
As conclusive remarks, we should bear in mind that HS is a complex disease and that the genetics by itself is not able to completely unravel the disease etio-pathogenesis; an integrated approach involving different OMICs, such as genomics, transcriptomics and microbiomics etc. is the path to be followed to better understand the disease and consequently design possible tailored treatments.

ACKNOWLEDGMENTS

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Generation of animal and human 3D models of Acne Inversa

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ABSTRACT

Acne Inversa (AI; Verneuil's Disease, Hidradenitis Suppurativa) is a chronic inflammatory condition affecting the hair follicles in moist areas of the body (inguinal folds, scrotum, pubic area). As currently understood, AI is triggered by a hair canal obstruction, leading to follicle bursting and entry of cellular debris and bacteria into the dermis, resulting in a powerful and persistent inflammation [1]. Over time, some patients develop severe scarring of the inflamed areas, leading to surgical removal of the affected skin areas. These events might be triggered or exacerbated by bacterial infection or epithelial barrier weakening. Thus far, only mutations in genes encoding the gamma-secretase) have been found to underlie familial forms of AI.

Our laboratory aims at creating ex vivo and in vivo models to better study AI pathogenesis, which are still lacking. To achieve this, we are developing full-thickness skin models built from cells of healthy donors and patients, as well as murine models bearing AI-related defects for autophagy in hair follicles. In addition, we participate in an effort to unravel the potential involvement of B cells, a specific yet poorly studied aspect of AI.

KEYWORDS

Acne inversa, human 3D skin model, mouse, hair follicle, inflammation, immunology, autophagy, B cells

1 Human reconstructed skin model with primary fibroblasts and epidermal cells from either healthy donors or immortalized cell lines (HaCaT)

Previous work from our team allowed the creation of an immunocompetent skin model based on a collagen scaffold [2, 3], monocyte-derived dendritic cells (MoDCs) and primary human skin cells. Our objective is to repurpose this skin model by either using keratinocytes from AI patients producing a defective desmoplakin, or HaCaT genetically modified through CRISPR-Cas9 to carry mutations for the gamma-secretase complex. We expect those mutated epithelial cells to produce an epidermis and influence MoDCs introduced in the scaffold. The final purpose is to induce an inflammatory response close to AI ex vivo.

We tested different scaffold seeding conditions using healthy human fibroblasts, keratinocytes and MoDCs. We also evaluated non-modified HaCaT cells instead of keratinocytes. The resulting models were frozen after up to 6 weeks of culture, sliced and stained with various epithelial and immune markers. Despite promising results, cell seeding and fibroblast proliferation were inconsistent. We assume this to result from the scaffold manufacturing process, which we are currently seeking to optimize.

2 Reproducing auto-inflammatory characteristics of acne inversa in a mouse model.

Dr. Michele Boniotto (Créteil, France) found that AI patient mutations of the gamma secretase complex results in autophagy impairment *in vitro*. This prompted us to breed a mouse model to investigate this matter further *in vivo*, by crossing Sox9creERT2 and Atg5$^{flox/-}$ strains. Since Sox9 is an important transcription factor driving hair follicle stem cells (HFSC) development and function [4, 5], the resulting strain is expected to lack functional autophagy in the infundibulum of the hair follicle. We expect that autophagy loss of function in HFSC to produce a barrier defect and a stronger immune infiltrate, as a result of impaired processing of apoptotic hair follicle cells (efferocytosis) [6].

Two consecutive depilations were performed in the course of two weeks, which may lead to hair occlusions. Skin samples were harvested and studied by flow cytometry and immunochemistry staining. Total skin digestion six hours after the second depilation showed a stronger infiltration of neutrophils and monocytes in the dermis of knock-out mice (Sox9creERT2 Atg5$^{flox/-}$) compared to wild-type (Atg5$^{flox/+}$) and littermates

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(Sox9creERT2 Atg5$^{flox/+}$). Infiltration was resolved after one week in all animals. Further interpretation requires confirmation of these preliminary results by additional experiments. Next, we plan to directly inhibit gamma secretase and autophagy function individually or simultaneously in C57BL/6 mice.

3 B cell populations in blood samples from families affected by acne inversa

Dr. Sergio Crovella (Trieste, Italy) has identified a familial mutation of the transcription factor Znf318 in AI patients of an Italian family (unpublished data). It was previously published that Znf318 is necessary for IgD expression by B cells in mouse models [7, 8]. Interestingly, AI is among the few dermatological conditions that show prominent B cell infiltrates in lesions [9, 10].

This prompted us to investigate the role of B cells in AI pathogenesis. As a preliminary work, we intend to identify variations in B cell subsets among PBMCs from patients with familial or sporadic forms of AI. Our cytometry panel allows us to study the naive, memory and plasmablast B cell populations in patient blood.

Covid-19 crisis prevented blood sampling from Italian patients, who may show B-cell related defects related to their Znf318 mutation. Yet, we analyzed healthy and diseased individuals of affected families from Innsbruck, Austria, for which whole-exon sequencing is not yet available. So far, blood B cells of 7 patients from 3 different families have been studied. Currently aggregated data identified patients that deviate from usual population percentages, although we require additional unaffected people from the same families to confirm our analyses. Raw PBMCs have also been frozen, which will be assayed for T cell responses and used to produce MoDC for our 3D skin models.

DISCUSSION

Despite significant delays related to COVID-19 for animal breeding and interruption of cell cultures for more than 3 months, we have improved our 3D scaffold production method and achieved successful seeding with human-derived cells, including MoDCs. We managed to establish protocols and produce preliminary results on the *in vivo* studies in the mice, and have plans to go more in depth in the future by studying systemic gamma-secretase inhibition. Finally, our analyses of AI patients in Austria will be interpreted in the light of their upcoming whole exome sequencing data, and extended by samples from Italian patients with Znf318 mutation.

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Development of new cellular models to identify molecular mechanisms in Hidradenitis Suppurativa

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ABSTRACT

No satisfactory in-vivo and in-vitro models to recapitulate Hidradenitis Suppurativa (HS) hallmarks have been developed so far. The first transgenic Ncstn KO mice model, engineered after the finding that g-secretase mutations were associated with HS in several families, lacked important HS features such as skin inflammation, abscess formation, fistulas, and scarring. In -vitro, the use of skin explants has helped in the identification of the IL-1 contribution to HS skin inflammation in HS, but this technique depends on skin biopsies availability.

For these reasons we have developed different models to obtain skin cells and skin organoids from Induced Pluripotent Stem cell lines carrying HS-associated mutations

KEYWORDS

CRISPR/Cas9, Induced Pluripotent Stem Cells, Outer root sheath epithelial cells, Skin Organoids, keratinocytes, sebocytes

1 INTRODUCTION AND RESULTS

Hidradenitis suppurativa (OMIM#142690; HS) is a chronic inflammatory disease involving hair follicles that presents with painful nodules, abscesses, fistulae, and hypertrophic scars, typically occurring in apocrine gland bearing skin [1]. Adequate models reflecting hallmarks of HS pathogenesis are a prerequisite to not only better characterize the molecular activity of genetic mutations in HS, but also to allow the discovery and of therapeutic targets in personalized approaches to cure the disease.

About 10% of HS patients present mutations in three of the four components of the gamma-secretase complex, namely NCSTN, PSEN1 and PSENEN with most of the mutations found in NCSTN [2]. These findings led to the analysis of the NCSTNflox/flox;K5-Cre mice that showed some HS hallmarks such as follicular hyperkeratosis and inflammation [3]. Unfortunately, mica and humans differ not only in hair distribution and hair follicle anatomy, but important genes such as *DCD* identified in a HS family by our consortium doesn't have a homologous in the mouse.

Ex vivo models using patients lesional skins have also been developed [4]. In fact, Vossen et al. [5] cultured punch biopsies from HS patients showing a major contribution of IL-1 in skin inflammation in HS. Moreover, these Authors were able to test different drugs to tame skin inflammation showing the effectiveness of the anti-TNF-a therapy.

Even if this ex-vivo model can be used to test a candidate treatment, specific limitations make this model useless for precision medicine. In fact, different genetic variants seem to cause the disease, so a skin model for each patient (or family) should be developed.

Our Team is developing new cellular models to identify the main biological pathways affected in HS and 3D models to be used to test novel candidate drugs. We are making use of hair follicle epithelial cells isolated from selected patients to build 3D reconstituted immunocompetent skins in collaboration with Dr. Flacher: these models will allow the study of the cross-talk among skin cells and immune cells

At the same time, we have developed skin organoids bearing hair follicles from Induced Pluripotent Stem cells obtained from patients with specific candidate mutations (Figure 1). By using the CRISPR/Cas9 methodology we have been able to correct the candidate mutation and obtain isogenic cell lines differing only for the selected mutation. IPSCs have been differentiated in CD200+/ITGA6+ hair follicle stem cells that could be further differentiated in TP63+/CK14+ keratinocytes or CK7+/MUC1+/PPARG+ sebocytes.

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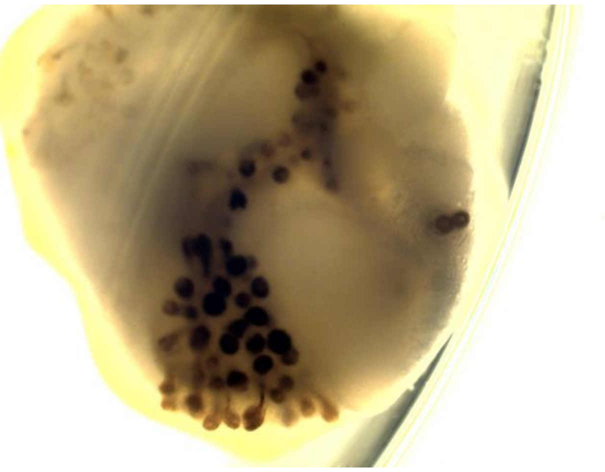

Figure 1: Skin organoids bearing hair follicles from IPSCs

IPSCs obtained from an HS patient with a novel mutation in NCSTN and presenting with HS and DDD were cultivated as described by Lee et al. [6] for 140 days and skin organoids bearing hair follicles obtained from a mutated and corrected clone.

From the skin organoids, thanks to a collaboration with StemCell Technologies, we have been able to isolate and cultivate TP63+/CK14+ keratinocytes (Figure 2)

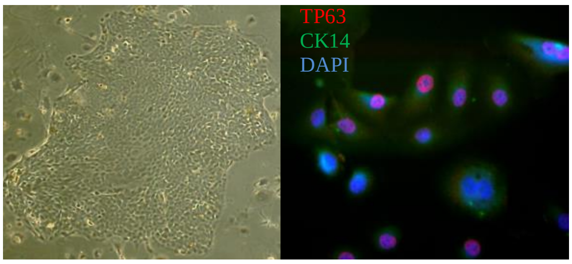

Figure 2: TP63+/CK14+ Keratinocytes isolated from skin organoids

Keratinocytes were obtained after dispase I digestion of skin organoids and cultivated in StemCell Technologies Keratinocyte Medium.

As we have already shown a defect in lysosomes in NCSTN deficient HaCaT cells, we are studying the lysosome structures in TP63+/CK14+ keratinocytes derived from mutated and corrected using lysosomal markers (Figure 3).

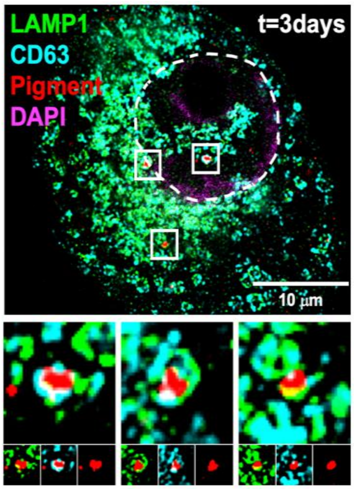

Figure 3: Lysosome distribution in KC obtained from skin organoids

Study of lysosome distribution in mutated and corrected keratinocytes using lysosomal markers CD63, LAMP1 and melanosomes degradation (Pigment)

2 OUTLOOK

Skin organoids will be analyzed by immunofluorescence and immunohistochemistry.

In addition, we plan to understand the activity of *NCSTN* mutation in skin organoids maturation by performing single cell RNA sequencing (Sc-RNAseq). Our hypothesis is that a g-secretase impaired activity skews the differentiation of hair follicle stem cells towards the epithelial keratinocytes. We do expect to see smaller or absent sebaceous glands in our skin organoids and an enlarged population of outer root and inner root sheath keratinocytes.

We plan to carry on the same experiments with IPCSs cell from a patient with a novel *ZNF318* mutation. ZNF318 is involved in Androgen Receptor (AR) signaling [7, 8], that has a major role in sebocytes differentiation [9]. We do expect that a perturbed AR signaling will skew the differentiation of hair follicle stem cells towards the keratinocyte population, still affecting sebaceous gland development.

IPSCs will be differentiated in 2D in CD200+/ITGA6+ hair follicle stem cells and treated to become CK7+/MUC1+/PPARG+ sebocytes (Figure 4) to understand what the activity of the novel ZNF318 mutation is.

IPSCs-derived keratinocytes and sebocytes will be provided to Dr. Flacher's team to build 3D immunocompetent skins.

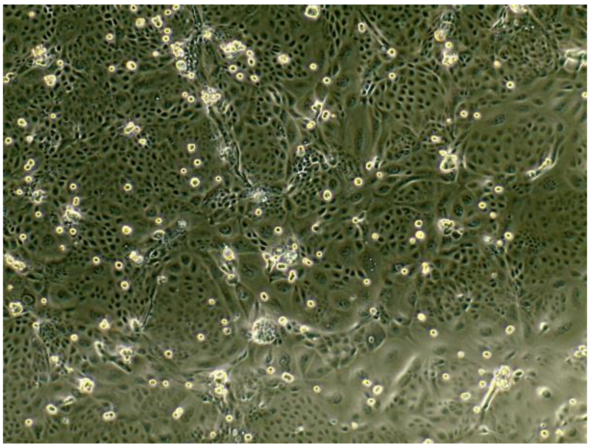

Figure 4: CK7+/MUC1+/PPARG+ sebocytes differentiated from IPSCs. Sebocytes were obtained from IPSCs after 22 days in Sebocyte Culture Medium.

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Hidradenitis suppurativa: from clinic to bench and back

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ABSTRACT

Hidradenitis suppurativa (HS) is a chronic inflammatory disease presenting with nodules, abscesses, and fistulas on the apocrine gland-bearing skin. HS may be classified as sporadic, familial or syndromic (PASH, PAPASH, PASH/SAPHO overlapping), the latter one being rare and characterized by a constellation of conditions regarded as autoinflammatory in their origin.

BAT2021 aims to bring together medical, genetic, experimental and lifestyle data to create holistic health records (HHR), which will allow us to build a tailored approach of each patient.

The inclusion criteria for patient enrollment are the compliance to the diagnostic criteria for HS; patient's demographics, clinical signs, anatomic phenotype classification, lifestyle habits, severity classification and treatment (former and current) are documented.

DNA/RNA obtained from biological samples (predominantly saliva and skin biopsies) of HS patients will be analysed by whole exome sequencing, whole genome genotyping SNPs arrays and transcriptomics. Clinical and molecular data will be stored into a special platform developed for the purpose of the project and will be analysed using advanced algorithms of artificial intelligence to propose a novel stratification method that clinicians can use in daily clinical practice.

KEYWORDS

Hidradenitis suppurativa, clinical practice, research workflow, whole-exome sequencing, whole genome genotyping SNPs arrays, transcriptomic, stratification, genotype-phenotype correlation, therapeutic outcomes

1 Clinical background

Hidradenitis suppurativa (HS), also known as acne inversa, is a chronic, inflammatory, recurrent, debilitating skin disease (of the terminal hair follicle), clinically characterized by inflammatory nodules that progress into abscesses and draining tunnels with foul smelling. Three main clinical HS phenotypes have been proposed, namely the classic or axillary- mammary, follicular and gluteal ones [1]. More recently, Van der Zee et al. proposed six different phenotypes, including the regular, frictional furuncle, scarring folliculitis, conglobata, syndromic and ectopic types [2]. Additional clinical phenotypes and cluster classifications have also been reported [3-5], but a definitive consensus has not been reached and any of these classifications addresses a prediction of therapeutic outcome. IHS4 (International Hidradenitis Suppurativa Severity Score System) is a validated tool for the severity assessment of HS and is arrived at by the number of nodules

(multiplied by 1) plus the number of abscesses (multiplied by 2) plus the number of draining tunnels (multiplied by 4). A total score of 3 or less signifies mild, 4-10 means moderate and 11 or higher correspond to severe disease [6].

HS has a profound impact on patients and their family life, leading to a high extent of emotional and physical distress, with social embarrassment, isolation, and depression [7]. With a prevalence in Europe varying between 0.3% and 1% [8], and a diagnosis often underestimated and usually delayed for 7.2 ± 8.7 years [9], HS is not a rare disease.

HS is associated with several other disorders: i) autoimmune or inflammatory comorbidities, particularly inflammatory bowel diseases, ii) rheumatologic diseases, such as seronegative spondyloarthropathies and Adamantiades– Behçet disease spondylarthritis and iii) malignancies, where the most severe complication is the development of squamous cell carcinoma in areas of chronically diseased HS skin. Other comorbidities associated with HS include obesity, dyslipidemia, diabetes mellitus, metabolic syndrome, hypertension, cardiovascular disease, secondary amyloidosis, lymphedema, polycystic ovary syndrome and sexual dysfunction. Finally, HS is also associated with mental comorbidity and psychosocial impairments [10]. HS is usually a sporadic disease but may more rarely occur as a familial disorder [11]. In a minority of patients, HS can present in combination with other diseases as a complex clinical syndrome. The main autoinflammatory syndromes characterized by the presence of HS are pyoderma gangrenosum (PG), acne and suppurative hidradenitis (PASH), pyogenic arthritis, PG, acne and suppurative hidradenitis (PAPASH), psoriatic arthritis, PG, acne and suppurative hidradenitis (PsAPASH), pustular psoriasis, arthritis, PG, synovitis, acne and suppurative hidradenitis (PsAPSASH) and PG, acne, suppurative hidradenitis, and ankylosing spondylitis (PASS) [12]. However, HS can also occur in the context of complex syndromes such as Familial Mediterranean Fever (FMF), synovitis, acne, pustulosis, hyperostosis and osteitis (SAPHO), follicular occlusion syndrome, Down syndrome, Keratitis-ichthyosis-deafness (KID) syndrome, Dowling-Degos disease and Bazex-Dupré- Christol syndrome [13].

Risk factors such as smoking, obesity and other lifestyle triggers have been linked to HS onset, while genetic factors are considered to play a crucial role in HS etiopathogenesis [14].

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30% of HS patients report a family history of HS; mutations in γ-secretase genes (NCSTN, PSENEN and PSEN1) have been identified as the most common genetic changes involved in HS familial cases and these variants lead to an impairment of Notch signaling. Notch signaling pathway dysregulation results in an alteration in the proliferation and differentiation of keratinocytes leading to disruption of the normal hair follicle cycle and the formation of follicular cysts, typical for HS [15]. Our group recently hypothesized HS as a member of neutrophilic dermatoses based on the elevated concentration of the cytokines IL-1β and IL-17 in skin lesions [16]. Moreover, some of our collaborators deeply involved in this project have also identified patients with HS occurring in the context of autoinflammatory syndromes, showing that PASH and PAPASH patients bear genetic variants in genes coding for proteins of the inflammasomes such as PSTPIP1, MEFV, NOD2 and NLRP3 [17]. Moreover, the up regulation of pro- inflammatory cytokines/chemokines in both lesional skin and serum are involved in the multifactorial HS pathogenesis [18]. With several new gene mutations coming into play, such as those involved in the keratinization pathways [19], on the background of a dysregulated innate immune response to commensal microbes and alterations in the skin microbiome as well, HS can be regarded as a multifactorial, polygenic autoinflammatory disease [18].

Medical treatments in HS are aimed at reducing incidence and flares thus improving HS patients' quality of life. Mild cases are usually treated by topical antibiotics having anti- inflammatory properties. Widespread disease is treated by systemic antibiotics and most severe cases by biologics such as adalimumab (anti-TNFα), currently the only biologic approved by the United States Food and Drug Administration [20] and by European Medicines Agency for treatment of HS [20,21].

Surgical resection of irreversibly damaged skin is often required, but often leads to functional impairments [20]. Different clinical trials for biologics targeting IL-17, IL-1 (alpha and beta), IL-36 and Janus kinase (JAK) 1 signaling response are currently ongoing, but simple outcome measures or novel biological models are demands to measure the efficacy of treatments [22].

2 Patient's enrollment and biological samples collection

Acting as one of the clinical partners of the project, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico of Milan has a large outpatient clinic with specialization in HS. The inclusion criteria for patient enrollment are the compliance to the diagnostic criteria for HS [23]. Patient's demographics, clinical signs, anatomic phenotype classification, lifestyle habits, severity classification and treatments (former and current) are documented. For the data documentation, the REDCap platform is used.

The study population include approximately 300 patients with moderate-to-severe HS, of which most are sporadic. 6% of patients have a HS positive family history and 14 patients present a HS syndromic form (4 PASH patients, 3 PAPASH, 5 PASH/SAPHO overlapping, 1 SAPHO and 1 patient with PASS).

Before biological samples collection, all patients and their relatives provide written informed consent for genomic analysis (protocol no. 487_2020) and receive pre-test genetic counselling in accordance with guidelines; indeed, the occurrence of the same condition among family members is a key factor to consider. Pedigree analysis of the families with more than one member affected is very useful for determining the patterns of disease inheritance.

All biological samples are collected, stored, and used in agreement with the ethical and research guidelines set. Currently, we have collected saliva from 200 HS patients through Oragene DNA collection Kit (for human DNA) that allows for a high-quality human DNA to assess biomarkers and genetic variants associated to HS, its severity and response to biologic therapy. In collaboration with IRCCS Burlo Garofolo of Trieste, we have analyzed through Whole Exome Sequencing, 12 syndromic patients (PASH, PAPASH, PASH/SAPHO

overlapping) and in the first report, we have demonstrated genetic variants involving genes regulating the keratinization process and vitamin D metabolism, suggesting that a dysregulation of these two pathways may contribute to the HS pathogenesis. Vitamin D has been predicted as able to regulate skin homeostasis by controlling proliferation and differentiation of hair follicle and the low levels of vitamin D observed in all studied patients support the idea that vitamin D insufficiency could be involved in PASH and PAPASH pathogenesis.

We have also recruited 9 familial cases of HS, two of which in collaboration with IRCCS Burlo Garofolo of Trieste and the Italian Association of HS patients, respectively. Genetic analyses of HS familial cases and their family members are ongoing.

Our group has collected HS skin biopsies from lesional, perilesional and unaffected tissue (approximately 2 cm from the lesional skin) from the same anatomical region. Important is i) to take biopsies from different kind of HS lesions, including abscesses, plaques and fistulae (in the same patient, if it is possible); ii) smaller lesions (up to 1 cm in diameter) such as cysts and inflammatory and non-inflammatory nodules, should be completely excised while a deep biopsy (extending to subcutaneous tissue) should be made from abscesses and fistulae and iii) typical sites, such as axillary or inguinal folds as well as anogenital area should be chosen for taking biopsy but having samples also from atypical sites, i.e. dorsum or cervical region as well as foruncles on different areas of the body, could be of interest.

Skin samples has been subdivided into two parts, one of which for conventional histology (formalin-fixed, paraffin- embedded) and the other one frozen for additional studies (immunohistochemistry, protein array, real - time PCR). An additional skin samples is taken and stored in Rna ladder for transcriptomic analyses.

For functional and validation studies, we have performed hair follicle pick up according to the following procedure: a firm pull motion with forceps must be performed at the base of the hair. Only plucked hair in the anagen phase (minimum of five from each subject) contain enough keratinocytes for a successful culture initiation. The hair has been plucked from the occipital and temporal scalp regions but facial hair types like beard, eyebrow, or hair from the nose can be used. The hair shaft has been cutted slightly behind the follicle with sterile scissors resulting in an approximate 5 mm long piece consisting mainly of the follicle. The plucked hairs were stored in a tube filled with 5 mL Defined keratinocytes-SFM medium (DKSFM; Gibco – Thermo Fisher Scientific, Switzerland) at room temperature [24].

3 Conclusions

The comparison of the results obtained from DNA/RNA sequencing between patients and controls will highlight possible causative genes and signalling pathways. Thepossible detection of genotype-phenotype correlations willallow a more exhaustive and precise clinical patient stratification which, in addition to the existing pharmacogenetic data banks, will help the development of new effective drugs and a future individualized treatment of HS patients.

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Disease burden of hidradenitis suppurativa and assessment of a non-invasive treatment option

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ABSTRACT

Hidradenitis suppurativa (HS) is a chronic inflammatory skin disease of intertriginous body areas. Due to an often delayed diagnosis and various symptoms, disease burden is often under estimated. In the present work, we summarize our results obtained from several studies aiming at a better description of disease activity and an improved assessment of patient-related symptoms.

Treatment options for HS are limited; treatment ranges from medical to surgical options. However, despite numerous treatment options for HS, efficacious and noninvasive treatment options resulting in long-term remission and management of symptoms of the disease are still needed. We present a meta-analysis of topical treatment options and discuss the need of real world data for estimation of treatment efficacy.

KEYWORDS

Acne inversa, Hidradenitis suppurativa, human, disease burden, DLQI, treatment options, topical treatment, medical device, IHS4

INTRODUCTION

Hidradenitis suppurativa (HS) as a chronic inflammatory disease of the skin characteristically manifests in inguinal, axillary and submammary body areas. HS patient suffer severely from the disease due to pain, stigmatization and often delayed diagnosis, since the disease is often misinterpreted as repeated abscesses for a long time. Consultation of a dermatologist early after disease onset is important.

Treatment of HS is often frustrating, since the options are limited. Medical treatments including antibiotics, hormones, and anti-TNFα [1]) can successfully control symptoms, but discontinuation is often associated with relapses. Surgical interventions can induce long-term symptom control, but may not be useful for all patients due to long remission times and scarring tissue.

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ASSESSMENT OF HS DISEASE BURDEN

To contribute to the development of a validated tool for the (objective, physician-based) assessment of disease severity/activity, we participated in a consensus towards the development of an International HS Severity Score System (IHS4) initiated by members of the European Hidradenitis Suppurativa Foundation (EHSF) [2]. Within the IHS4, a variety of clinical signs were rated by 11 centers including and assessing 236 patients. The resulting IHS4 score is arrived at by the number of nodules (multiplied by 1) plus the number of abscesses (multiplied by 2) plus the number of draining tunnels (multiplied by 4). A total score of 3 or less signifies mild, 4-10 signifies moderate and 11 or higher signifies severe disease. The IHS4 was developed and published in 2017 and since then, a variety of studies have utilized the score to assess disease severity both in real-life, as well as within clinical trials [3]. As such, the baseline IHS4 score has proven to be a meaningful predictor for recurrences during adalimumab therapy of HS [3].

Using a German data base with information on ~1800 HS patients, the patients' quality of life (QoL) was assessed [4]. The aim of this study was to present more robust data on patients' QoL using the Dermatology Life Quality Index (DLQI). Overall, within this large cohort, the mean DLQI was 13.2±8.1 again stressing the strong burden of HS on affected patients and a severely impaired quality of life. QoL correlated with pain, disease severity as assessed by the IHS4 sore, as well as Hurley score.

Pain is one of the important aspects affecting QoL in HS patients. Pain was assessed by a numerical rating scale (0= no pain to 10= severe pain) by affected HS patients (1,795 individuals) [5]. Pain was reported by 84% of patients with the majority reporting mild pain (78%). Interestingly, females and smokers experienced more intense pain. Pain levels correlated with the number of affected areas and disease severity, as expected.

To gain further insights into the frequency of familial cases within 1795 German patients, we performed a patient survey in 4 independent, patient network-run social media platforms within Germany. Within 7 days, a cumulative number of 642 responses was acquired. Out of these responses, 249 (38%) of the patients confirmed that at least one first-degree relative (parents, children, siblings) are also affected by the disease. This complements already existing data from the literature stating hereditary HS in 5-40% of cases [6]. Earlier reports described hereditary HS to be more severe; studies analyzing the pathomechanism in these families involving gamma-secretase and inflammasome activation are underway [6,7].

TOPICAL AND DEVICE-BASED THERAPY FOR MILD HS

Treatment options for HS are often unsatisfactory. We recently studied the effect of a combination therapy of intense pulsed light (IPL) and radiofrequency (RF). To this aim, the first study with 47 patients was performed as a prospective, monocentric, randomized, three-arm parallel-group design trial with a prior 12 weeks observation period (NICE study) [8,9]. Treatment arms were IPL and RF monotherapies or IPL + RF combination therapy. After 12 weeks, all patients received IPL + RF for additional 12 weeks (cross-over). After 12 weeks, active lesion counts of the IPL + RF group decreased by 50% in 50% of patients, in 33% even by 75% (Hurley I/II patients, less effective in Hurley III) correlating with an even better improvement in DLQI. A controlled follow up trial (RELIEVE study) compared topical clindamycin with topical clindamycin plus IPL + RF in 88 patients [10]. After 16 weeks of treatment, the IHS4 score was improved by 60% in the combination therapy group compared to 18% improvement in clindamycin-treated patients. Secondary endpoints (e.g. DLQI) showed similar results.

The aim of a follow-up study was to perform a meta-analysis on the effectiveness of local and instrument-based therapies under the prism of their efficacy and safety profile [11]. We thus performed a literature search and analyzed clinical evidence for the various therapeutic options. Effective treatments for out-patient care of HS patients exist including topical clindamycin, resorcinol, and intralesional corticosteroids. New devices such as LAight therapy (combining IPL with radiofrequency) are available, which can be used as monotherapy or adjunct therapy in combination with systemic treatment and/or surgery for the management of HS patients. All topical treatment options are best suited for mild to moderate HS and aid to control disease activity.

REQUIREMENT FOR REAL WORLD DATA ON TREATMENT EFFICACY

Publication of real world data on the results of treatment with (approved) drugs and/or medical devices is important to allow for a reasonable judgement about the efficacy of a medication, especially since due to the nature of controlled clinical studies certain patient groups, who in daily clinical routine would best benefit from such new treatments, are excluded from study inclusions. Real world data on the treatment of HS was summarized [12]. Adalimumab, the only approved biological treatment so far, represents a cost-efficient and effective therapy.

Additional publications about real world data with high(er) numbers of patients, including those with different risk factors, are required. Real world data will help to really assess the developing therapeutic spectrum of HS in our daily routine.

DISCUSSION

HS is a chronic inflammatory disease of the skin, which requires raising better awareness, good scoring tools and more (outpatient) treatment alternatives. Although the disease was previously treated using surgery, new treatment modalities allowing for an effective treatment of mild and moderate cases in an ambulatory setting are currently developed.

HS appears to present as a disease with a variety of different mutations and pathways involved in its pathogenesis. Assessing these familial cases of HS will aid in a better understanding of the disease and open avenues for therapeutic modification.

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An Overview of the BATMAN Platform

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ABSTRACT

This paper presents an overview of the platform used in the project BATMAN. We look at the architecture and at the interactions between the components, namely the website, the smartphone app, and the server, and how these components are used by the medical doctors, patients and data scientists.

KEYWORDS

BATMAN platform, web platform, smartphone application, questionnaires

1 INTRODUCTION

In recent years, the use of smartphone applications related to health has expanded substantially. Smartphones and other wearable sensors have become being daily companions for a majority of the population in developed countries. Probably the most commonly-known health-related applications focus on aspects such as exercise (i.e., fitness trackers) or nutrition and are typically independent of involvement of a medical doctor. On the other hand, there is ongoing research dealing with the use of data from the wearables to assist the clinicians in improving treatment of patients. An example of such research is the ERA PerMed project BATMAN [1] that aims at improving the understanding of the chronic dermatological condition Hidradenitis Suppurativa (HS), also called Acne Inversa. HS is a chronic inflammatory disease involving hair follicles that presents with painful nodules that release pus. Within the framework of the BATMAN project, we aim in bringing together medical, genetic, experimental, and lifestyle data to build a truly personalized model of each patient in order to tailor specific treatments.

This paper presents the overview of the platform developed within the BATMAN project. This platform collects data from patients, such as answers to questionnaires, and enable doctors to follow the patient's state and assign additional questionnaires when appropriate. The gathered data are anonymized and further processed by data scientists by building models for HS patients and seeking for new knowledge.

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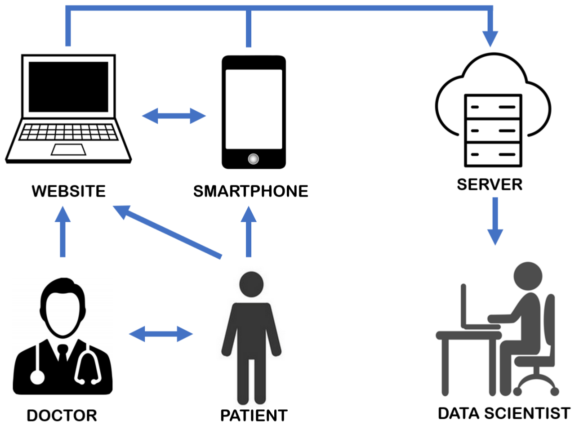

Figure 1: The basic schema showing the interactions of the platform users with the technical components.

The rest of the paper is organized as follows. Section 2 presents the BATMAN platform. The smartphone application is described in Section 3. Finally, Section 4 concludes the paper with summary and future plans.

2 THE BATMAN PLATFORM AND ITS USERS

In this section, we present an overview of the BATMAN platform, namely how its components work and how they are used by the participants in the project, i.e., medical doctors, patients, and data scientists. The basic schema of the interactions is shown in Figure 1. The patient and the doctor input the patient data through a website. Patients also use a smartphone app for activity tracking. The information collected via the website and the smartphone app are stored on a server where it is then available to data scientists.

The BATMAN platform website has a double functionality: it serves as the main information point about the BATMAN project and it is also the entry point to the platform. Users can log in with their usernames and passwords. Depending on their role, they can see different types of content. To ensure the security and to prevent any unauthorized access, the user accounts are created by the platform administrators and assigned to users.

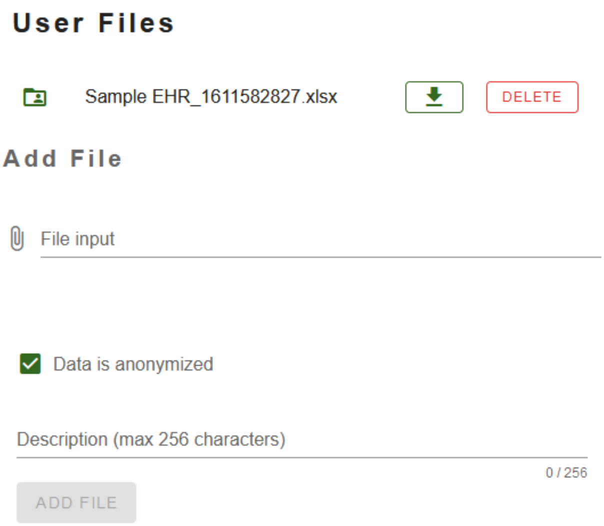

Figure 2: Online form for doctors to upload the patient's EHRs.

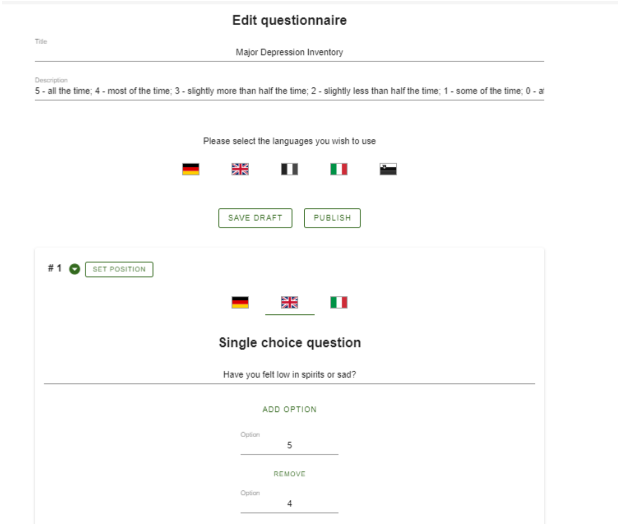

Figure 3: User interface for editing a questionnaire.

2.1 Doctors

Medical doctors can view and manage the patients' files. They are also able to manually upload the patients' medical records (see Figure 2). If convenient, patients can be assigned to different groups. The doctors have the possibility to create new questionnaires (see Figure 3) and to assign questionnaires to their patients (see Figure 4). There are three types of general questionnaires:

- Major Depression Inventory
- Dermatology Quality of Life
- Food preferences

The food preferences questionnaire has been split to several forms with a small number of questions since the list of food preferences includes around 200 items, which makes it tiresome for the patient to fill in one sitting.

Depending on the preferences, each questionnaire can be assigned to a patient more than once, which is relevant especially for the Depression and Quality of life questionnaires. On the other hand, the food preferences typically do not change frequently thus this questionnaire can be assigned only once.

The doctor gets the list of available user accounts for patients from the administrator. Then the doctor then assigns accounts to patients. This procedure enables us to keep the identity of the patients anonymous for all other participants.

2.2 Patients

Each patient obtains the user account information from his/her medical doctor. Patients interact with the platform either through the website or via the smartphone application. On the website, they can view their data (see, for example, Figure 5) and they can also use it as the interface with which they can fill in the questionnaires. In addition, they can also fill in the questionnaires through the smartphone application, which we describe in Section 3.

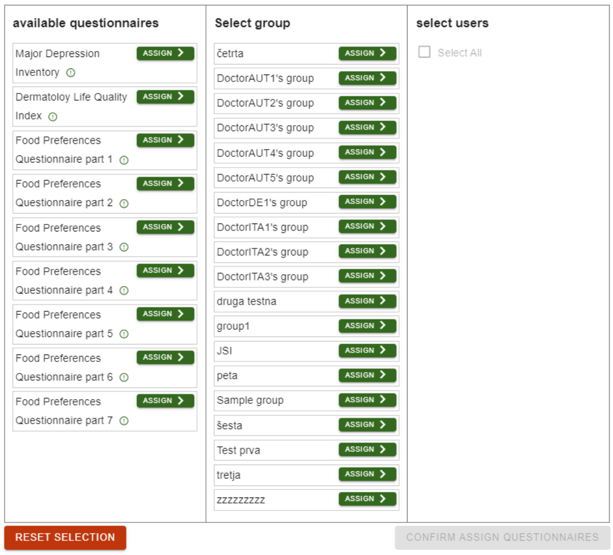

Figure 4: User interface for assigning questionnaires.

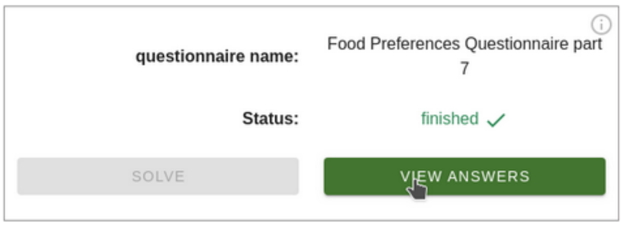

Figure 5: Patient's view of the platform to see the completed part of the food preferences questionnaire.

2.3 Data Scientists

Data scientist can access all the data that the medical doctors and the patients enter into the platform. The data available to the data scientists is anonymized.

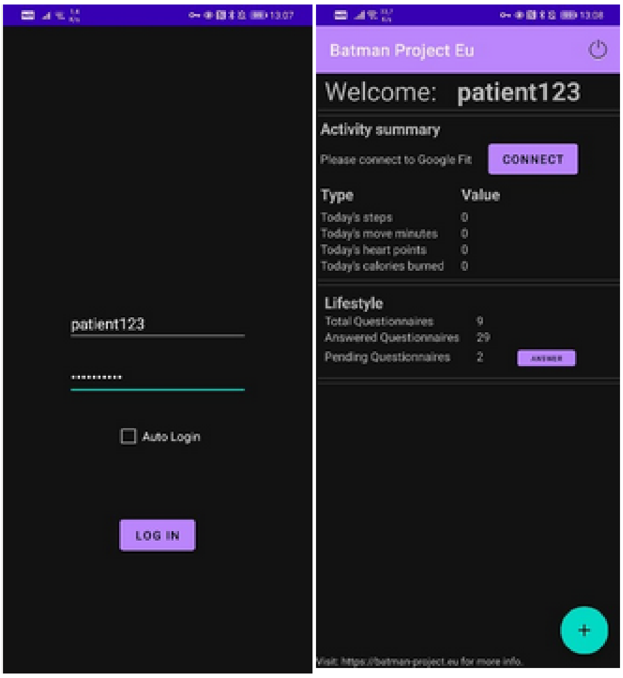

Figure 6: Login dialog and home screen of the smartphone application. The home screen shows the summary of daily activities and the pending questionnaires.

The data is currently being collected in the pilot study and will be then used to build models for HS patients and to seek for new knowledge.

2.4 Administrators

The highest level of access belongs to the administrator. Regarding the platform functionality, the administrator can access pages for managing users, groups, and for making changes on questionnaires.

3 SMARTPHONE APPLICATION

The smartphone application is available for Android-based phones only. It can be accessed through Play Store [2], or found with search for "Biomolecular Analyses for Tailored Medicine".

Patients log in the smartphone application using the same account as to the platform. The login and home screen for a sample patient are shown in Figure 6.

There are two main functionalities of the smartphone application: to monitor the daily activity of the patient, and to help them to fill in the questionnaire, which is likely easier on the smartphone than requiring to log in to a separate website just for that purpose.

The application uses the Google Fit [3] plug-in to trace the patient's steps and calories burned. The activity summary updates in real time based on the patient's activity. The collected daily activity serves as a reasonable proxy for the patient's wellbeing, e.g., if the HS condition is bad at a given time, the patient is likely to move less because of the pain, while if the patient starts moving more after a treatment, this likely implies that the treatment has been successful.

As for the questionnaires, the application allows the patient to easily fill in the forms using the screen. An example of the questionnaire is shown in Figure 7.

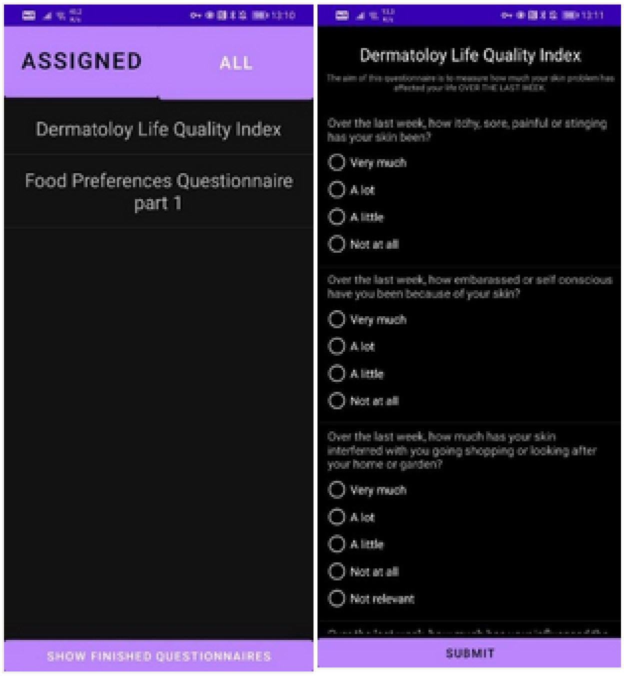

Figure 7: Questionnaire menu and an example of a questionnaire, in this case the Dermatology Quality of Life.

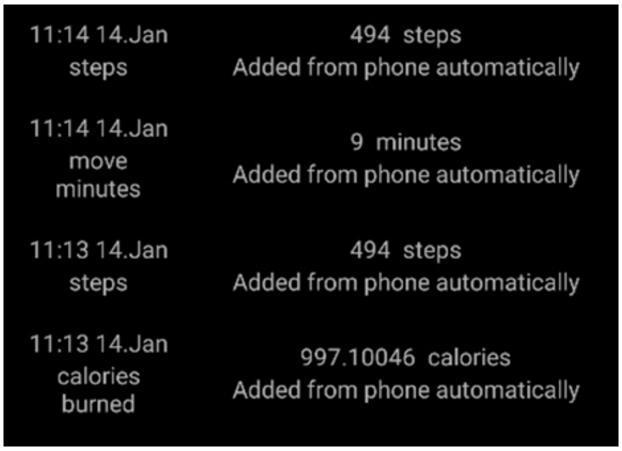

Figure 8: Example of the data that the smartphone application sends to the server.

In order to keep the application transparent to the users, the patients can access the data log showing all information that the application has communicated to the server (see Figure 8). Additional functionality of the application is a pedometer, which allows the user to track steps when activated (as opposed to the integrated step counter that tracks the steps during the entire day).

4 CONCLUSION

In this paper, we presented an overview of the components of the BATMAN platform. The platform is currently used to collect the heterogeneous patient data, including medical, genetic, activity, and self-reported data.

In the last stage of the project, the collected data will allow us to find novel knowledge about the patients suffering from HS and will allow the doctors to create personalized treatments that could turn out to be more effective. This will be specially supported by the data scientists who will develop AI-based approaches for automatic knowledge extraction.

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