C·E·P·S Journal

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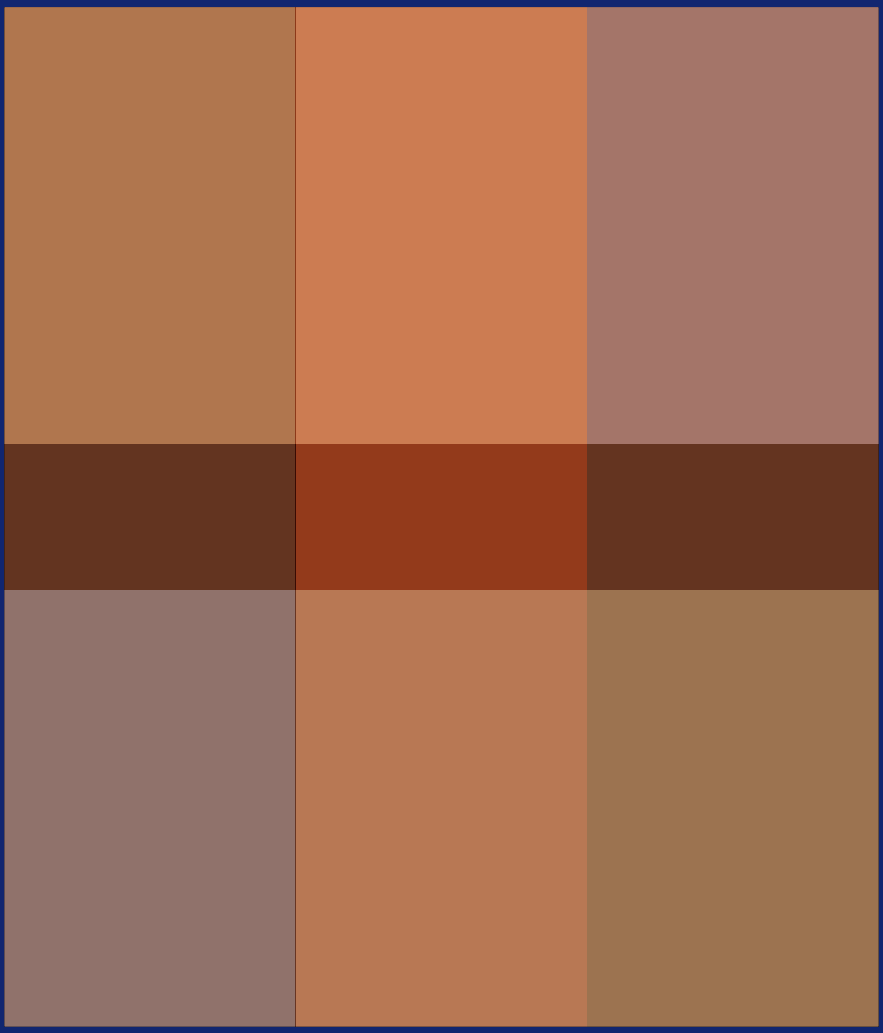

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C·E·P·S *Journal*

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The CEPS Journal is an open-access, peer-reviewed journal devoted to publishing research papers in different fields of education, including scientific.

Aims & Scope

The CEPS Journal is an international peer-reviewed journal with an international board. It publishes original empirical and theoretical studies from a wide variety of academic disciplines related to the field of Teacher Education and Educational Sciences; in particular, it will support comparative studies in the field. Regional context is stressed but the journal remains open to researchers and contributors across all European countries and worldwide. There are four issues per year. Issues are focused on specific areas but there is also space for non-focused articles and book reviews.

About the Publisher

The University of Ljubljana is one of the largest universities in the region (see www.uni-lj.si) and its Faculty of Education (see www.pef.uni-lj.si), established in 1947, has the leading role in teacher education and education sciences in Slovenia. It is well positioned in regional and European cooperation programmes in teaching and research. A publishing unit oversees the dissemination of research results and informs the interested public about new trends in the broad area of teacher education and education sciences; to date, numerous monographs and publications have been published, not just in Slovenian but also in English.

In 2001, the Centre for Educational Policy Studies (CEPS; see http://ceps.pef.uni-lj.si) was established within the Faculty of Education to build upon experience acquired in the broad reform of the national educational system during the period of social transition in the 1990s, to upgrade expertise and to strengthen international cooperation. CEPS has established a number of fruitful contacts, both in the region – particularly with similar institutions in the countries of the Western Balkans – and with interested partners in EU member states and worldwide.

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Revija Centra za študij edukacijskih strategij je mednarodno recenzirana revija z mednarodnim uredniškim odborom in s prostim dostopom. Namenjena je objavljanju člankov s področja izobraževanja učiteljev in edukacijskih ved.

Cilji in namen

Revija je namenjena obravnavanju naslednjih področij: poučevanje, učenje, vzgoja in izobraževanje, socialna pedagogika, specialna in rehabilitacijska pedagogika, predšolska pedagogika, edukacijske politike, supervizija, poučevanje slovenskega jezika in književnosti, poučevanje matematike, računalništva, naravoslovja in tehnike, poučevanje družboslovja in humanistike, poučevanje na področju umetnosti, visokošolsko izobraževanje in izobraževanje odraslih. Poseben poudarek bo namenjen izobraževanju učiteljev in spodbujanju njihovega profesionalnega razvoja.

V reviji so objavljeni znanstveni prispevki, in sicer teoretični prispevki in prispevki, v katerih so predstavljeni rezultati kvantitavnih in kvalitativnih empiričnih raziskav. Še posebej poudarjen je pomen komparativnih raziskav.

Revija izide štirikrat letno. Številke so tematsko opredeljene, v njih pa je prostor tudi za netematske prispevke in predstavitve ter recenzije novih publikacij.

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Editorial

Robotisation, Automatisation, the End of Work and the Future of Education

The present issue of the CEPS Journal invites us to consider the emerging world of the simultaneous functioning of human and artificial intelligence in the field of education.

The articles published in the focus section cover a wide spectrum of considerations related to the triangle human intelligence–artificial intelligence–teaching and learning, a triangle that is itself related to the changes in society that are taking place in parallel.

With the present issue, we as the editorial board of the journal join the already widespread and urgently needed reflective approach to an issue that we as educators should, with dedication and full responsibility towards the future of humanity and education, consider as a constitutive part of education.

We start the focus section with an article entitled *Is Machine Learning Real Learning?* written by Zdenko Kodelja. The author confronts the ambiguous question of whether machine learning is real learning. It is ambiguous because the term "real learning" can be understood in different ways. Firstly, it can be understood as learning that actually exists and is, as such, opposed to something that only appears to be learning, or is misleadingly called learning although it is something else, something that is different from learning. Secondly, it can be understood as the highest form of human learning, which presupposes that an agent understands what is learned and acquires new knowledge as a justified true belief. Just as there are contradicting conceptions, there are also opposite answers to the question of whether machine learning is real learning. Some experts in the field of machine learning, which is a subset of artificial intelligence, claim that it is in fact learning and not something different from learning, while some others – including philosophers – reject the claim that machine learning is real learning; for them, real learning means the highest form of human learning. The main aim of the author is to present and discuss, very briefly and in a simplifying manner, only some interpretations of human and machine learning, on the one hand, and the problem of real learning, on the other, in order to make it clearer that the answer to the question of whether machine learning is real learning depends on the definition of learning.

The second article, written by Ivan Ivić, addresses another topic pertinent to education: the relationship between *Printed and Digital Media: Printed and Digital Textbooks*. The aim of this paper is to sketch a framework for comparing

the educational quality and efficiency of printed and digital textbooks. Considering that digital textbooks are a relatively new phenomenon, we as teachers lack both practical experience with their use and research on their efficiency, which is why all of the results in the present article are, in the author's opinion, "only of a preliminary nature". This is also why the paper focuses on an initial definition of the theoretical framework not only for analysing the nature of digital media, but also for analysing printed and digital textbooks. The broadest theoretical framework consists of Lev Vygotsky's theory on the character of cultural-psychological tools and their influence on the functional organisation of the brain, as well as Marshall McLuhan's theory of media, concerning the general fact of the medium (and not its content). The author claims that theoretical analysis shows that media (printed and digital) have significant impacts on the functional organisation of the brain, which is based on the brain's neuroplasticity. The analysis of digital media also demonstrates that they possess a set of specific features that, despite all of their advantages, carry important risks for the organisation and functioning of the brain and for the process of learning.

In order to offer our readers a concrete example of the preparation of future educators for the shift in their working environment, we have included in the focus the article *Digital Making in Educational Projects,* written by Alejandra Bosco, Noemí Santiveri and Susanna Tesconi. *Digital Making* is a conceptualised presentation of an innovative educational experience carried out with students of the Primary Education and Social Education degrees over three consecutive years. The experience highlights digital making as an activity in which students create an object using digital technology, and in doing so learn not only about the functioning of technology, but in parallel also acquire the content and competences of the curriculum. The authors report that the innovative teaching practice presented was carried out as action research in order to improve traditional higher education practices. In this sense, the proposal puts the student at the centre of the process as the author and protagonist of his/her own learning process. The experience is based on students' own interests (they decide what to make based on a given context). Students work in groups and seek what they need to learn in order to meet the challenge, while the teacher supports the process as a facilitator, offering guidance and resources when necessary. The evaluation of the whole process is regulated by a group diary (a shared document online) and an individual diary (a blog) produced by the students. The final evaluation is not only of the printed product; the students also produce a video as storytelling in which they explain how the process evolved from the initial idea to the final impression of the object. This experience of one of the teacher training institutions in Europe was carried out in collaboration

with the Centres of Digital Fabrication of Barcelona. The results are organised so as to highlight the strengths and weaknesses of using technologies to improve higher education, by offering an approach in which students are at the centre of the whole process.

Yet another aspect of teaching and learning is addressed in the text entitled *The Use of Humanoid Robots with Multilingual Interaction Skills in Teaching a Foreign Language: Opportunities, Research Challenges, and Future Research Directions.* Authors Ayse Tuna and Gurkan Tuna start their consideration of the specific characteristics of the use of humanoid robots in teaching foreign language with the claim that a humanoid robot can be useful for many educational goals because it does not get tired regardless of how many mistakes the student makes; in addition, it can be equipped with novel teaching techniques and updated with the most current knowledge. According to the authors, robots are more useful as teaching aids than computers, as they can mimic human responses, which is one of the reasons why humans, especially children, prefer robot interaction to other interaction types. Although it may run counter to common sense, the use of humanoid robots leads to a certain type of personal connection with students, which can help overcome issues related to shyness, reluctance, frustration and lack of confidence that may emerge in dealing with a human teacher. Moreover, as humanoid robots can be programmed to know specifically what each individual student needs to learn, they can be quite useful for one-on-one speaking activities. Given the number of questions that remain open, it seems worthwhile to consider "the many possibilities that can be offered by information and communication technology tools, particularly by humanoid robots".

In their article, Don Douglas McMahon and Zachary Walker address *Universal Design for Learning (UDL)* developed by Rose and Meyer (2002) and updated by CAST (2011). While several researchers have used the UDL framework to inform their decision-making and evaluation process regarding technology interventions for students (Almond et al., 2010; Dolan, Hall, Banerjee, &Strangman, 2005; Hall, Strangman, & Meyer, 2003), the authors of the article present it as "one of many potential means of addressing the rapidly changing technology landscape and its impact on education". Their main aim is, they say, to support educators in implementing and adopting emerging technologies so that their students are prepared for a future in which we will all have more robotisation, automatisation, artificial intelligence and immersive learning tools. How are we supposed to respond to the way the future will look and what our classrooms will consequently be like?

While robotisation, automatisation, artificial intelligence and immersive

learning tools will create new challenges in both the workplace and in education, it is important that we consider how to prepare our students moving forward. Moreover, while the authors understand that certainty is safe and comfortable, they believe that it is equally important to acknowledge that we will never be fully certain of the potential or the challenges of using technology. The implication of innovation is that we will not always know what is going to happen next. The least dangerous assumption is to try to effectively implement new tools in education. The UDL framework and the propositions suggested by the authors are a viable strategy for the effective and informed implementation of these technologies in education. These emerging technologies also present *unknown opportunities for new applications supporting inclusion in society and inclusive educational environments*. In order to address making emerging technology inclusive, researchers, educators and advocates across many fields need to be informed and inclined to use it with consideration.

The last article in the focus section is entitled *Digitalisation in education, allusions and references*. In it, Marianna Vivitsou from Helsinki University addresses the metaphor of digitalisation as a phenomenon that became central to education in a period in which budget cuts, privatisation, lay-offs and outsourcing of the labour marked the ethos of twenty-first century competencies. It was precisely this context that put the metaphor in a new light. The aforementioned configuration attributed a mythical fullness to the concept, in the sense that digitalisation goes beyond the limits of a property that needs be developed so that society can successfully deal with contemporary challenges and opportunities.

In this way, digitalisation emerges as a new hegemony in education, with narratives that are more or less directly referential. Less direct references add the element of allusion to the metaphor of digitalisation, in the sense that references can be more implicit/covert or even concealed/hidden. Furthermore, as they combine with abstract terms and concepts, they make the boundaries of the technological and the educational domain blurry and educational discourse vague. In order to examine narratives of digitalisation and how they influence educational discourse, this study aims to discuss and analyse relevant policy documents in relation to research and studies on the integration of digital technologies in classroom settings and the hybrid or blended learning environments that open up. To this end, the study uses thematic analysis and discourse analysis to trace allusions and references and discuss how emergent meanings relate to current and future needs in education generated by digitalisation itself.

In line with the profile of the CEPS Journal, we have included two Varia articles in the issue.

In the article *Instructional Leadership Effects on Teachers' Work*

Engagement: Roles of School Culture, Empowerment, and Job Characteristics by Adel Zahed-Babelan, Ghodratollah Koulaei, Mahdi Moeinikia and Ali Rezaei Sharif, "the relations between the principal's instructional leadership, school culture, psychological empowerment, job characteristics, and teachers' work engagement was examined on a sample of 310 elementary school teachers".

In another Varia paper, entitled *Competence of Croatian Student-Teachers and Primary School Teachers in the Visual Arts*, authors Zlata Tomljenović and Svetlana Novaković demonstrated "the existence of a statistically significant difference between the self-assessment of the importance of specific competences in the visual arts, and the self-assessment of having these competences, both with students of the Croatian faculties of teacher education and primary school teachers".

As usual, the third section of the CEPS Journal brings a book review, in which "In Search of Safety: Confronting Inequality in Women's Imprisonment" by Barbara Owen, James Wells and Joycelyn Pollock is reviewed by Darja Tadić. The book presents a sociological look at the sources of violence and conflicts in women's prisons by focusing on unravelling the structural inequalities that shape conflict contexts in prisons.

Slavko Gaber and Veronika Tašner

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Is Machine Learning Real Learning?

Zdenko Kodelja[1]

The question of whether machine learning is real learning is ambiguous, because the term "real learning" can be understood in two different ways. Firstly, it can be understood as learning that actually exists and is, as such, opposed to something that only appears to be learning, or is misleadingly called learning despite being something else, something that is different from learning. Secondly, it can be understood as the highest form of human learning, which presupposes that an agent understands what is learned and acquires new knowledge as a justified true belief. As a result, there are also two opposite answers to the question of whether machine learning is real learning. Some experts in the field of machine learning, which is a subset of artificial intelligence, claim that machine learning is in fact learning and not something else, while some others – including philosophers – reject the claim that machine learning is real learning. For them, real learning means the highest form of human learning. The main purpose of this paper is to present and discuss, very briefly and in a simplifying manner, certain interpretations of human and machine learning, on the one hand, and the problem of real learning, on the other, in order to make it clearer that the answer to the question of whether machine learning is real learning depends on the definition of learning.

Keywords: learning, machine learning, artificial intelligence, philosophy, education

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Ali je strojno učenje pravo učenje?

Zdenko Kodelja

Vprašanje, ali je strojno učenje pravo učenje, je dvoumno, ker pojem »pravo učenje« lahko razumemo na dva različna načina. Prvič, lahko je razumljeno kot učenje, ki dejansko obstaja in je kot tako nasprotno nečemu, kar se le zdi kot učenje, ali pa je napačno poimenovano kot učenje, čeprav je nekaj drugega; nekaj, kar je drugačno od učenja. Drugič, lahko ga razumemo kot najvišjo obliko človeškega učenja, ki predpostavlja, da agent razume, kar se je naučil, in pridobi novo znanje kot upravičeno resnično verjetje. Posledično obstajata tudi dva nasprotujoča si odgovora na vprašanje, ali je strojno učenje pravo učenje. Nekateri strokovnjaki s področja strojnega učenja, ki je podpodročje umetne inteligence, trdijo, da je strojno učenje dejansko učenje in ne nekaj drugega, medtem ko nekateri drugi – vključno filozofi – zavračajo trditev, da je strojno učenje pravo učenje. Za njih je pravo učenje najvišja oblika človeškega učenja. Glavni namen prispevka je na eni strani na kratko in na preprost način predstaviti in razpravljati o določenih interpretacijah človeškega in strojnega učenja ter na drugi o problemu pravega učenja, zato da bi bilo jasneje vidno, da je odgovor na vprašanje, ali je strojno učenje pravo učenje, odvisen od opredelitve učenja.

Ključne besede: učenje, strojno učenje, umetna inteligenca, filozofija, edukacija

Introduction

There are two opposite answers to the question of whether or not machine learning is real learning. Some experts in the field of machine learning, which is a subset of artificial intelligence, claim that machine learning is in fact learning, while some others reject this claim, arguing that machine learning "is not real learning" (Bringsjord et al., 2018, p. 136). It seems, therefore, that at least one of these claims is wrong. Such a conclusion – which presumes that there is only one truth and that any judgement contrary to it is untrue, since, according to the principle of non-contradiction, two contradictory statements cannot be true at the same time – would be correct only if the term "learning" had the same meaning in both cases. Since it does not have the same meaning, however, the essential question is whether the difference between learning and real learning is the difference between learning and something that is called "learning" although it is in fact something else, or whether it is the difference between two different sorts of learning. It seems that the difference in question is not the difference between learning and non-learning, but rather the difference between machine learning and a specific form of human learning.[2] From the perspective of human learning understood in such a way, machine learning might appear to be something that is not, or is not yet, real learning. However, from the same perspective, animal learning could also be seen as something that is not real learning.[3] Despite this, almost no one argues that animal learning is not learning. In any case, the answer to the aforementioned question of whether machine learning is real learning depends on how we understand learning.

In this paper, the problem of learning will be discussed in the context of philosophy of education. If we agree with the interpretation that philosophy of education is not so much a specific corpus of knowledge, but rather a questioning – a questioning in the sense that it brings into question over and over again all that we know, or believe that we know, about education (Reboul, 1995, p. 3) – then it follows that we have to also ask questions about the concept of "learning" over and over again. Such perpetual questioning is necessary not only because we can otherwise quickly become prisoners of various dogmatisms, but also because this concept, or at least this term, is nowadays used in an entirely new context, that is, in the context of artificial

2 Real learning in the formal sciences is described as "a phenomenon that has been firmly in place in homes and schools since at least Euclid" (Bringsjord et al., p. 136).

3 Conditioning, both classical and instrumental, for instance, is commonly understood as a form of learning in psychology and in education. From the perspective of human learning, however, we can argue that "being conditioned is not a form of learning" (Hamlyn, 1987, p. 179), on condition that we presuppose "that learning must at least involve the acquisition of knowledge through experience and that changes of behaviour due to learning must be the result of knowledge" (ibid., p. 180). Even in this case, however, it seems that the claim that conditioning is not a form of learning is related only to human learning and not to animal learning, which by definition does not include the acquisition of knowledge.

intelligence, or more precisely, the theories and practice of so-called machine learning. Therefore, my intention is not to try to prove or disprove the existence of machine learning as a form of real learning. Even if I would like to do one or the other, I cannot do either, simply because I am not an expert in this field of knowledge. Instead, I will very briefly present and discuss certain interpretations of human and machine learning, on the one hand, and the problem of real learning, on the other, in order, I hope, to make it a little clearer that the answer to the aforementioned question of whether machine learning is real learning depends on the definition of learning.[4]

Human learning

Until now, learning has been discussed in philosophy of education mostly, if not exclusively, as human learning.[5] Although there are a variety of theories and concepts of such learning, for the purpose of this paper it seems to be sufficient to indicate some essential features of human learning as it is predominantly understood in philosophy of education. According to one of its basic philosophical interpretations, learning is the acquisition of knowledge. This interpretation is based on two classical theories of knowledge and mind: empiricism and rationalism.[6] In spite of their differences, rationalists mostly argue that it is possible to

4 Here, the term "definition" means a real definition of learning and not a nominal one, that is, it refers to the real essence of learning and to the meaning of the word "learning".

5 Moreover, at least in the context of Anglo-Saxon philosophy of education, and at least during the last decades of the twentieth century, philosophers of education wrote rather little – in comparison with psychologists – about learning. However, they extensively studied the concept of teaching, which "cannot be understood without some reference to 'learning'" (Peters, 1987, p. 6). In English, this distinction between learning and teaching is obvious both on a terminological and conceptual level. In some other languages, however, this distinction is not so clear, simply because the same word can mean learning and teaching at the same time. "In French, the word apprendre means both 's'instruire' (*learning*, *lernen*) and 'instruire' (teaching, lehren); we learn the algebra, we teach algebra to someone. The ambiguity is itself significant; indeed, there is perhaps no absolute opposition between the one who teaches and the one who is learning; sometimes it is the same person" (Reboul, 1980, p. 9). The same can be said for the Slovenian word "*učiti*", which can also mean both teaching (*učiti*) and learning (*učiti se*).

6 Rationalism and empiricism – which have different forms – are commonly described as opposite philosophical doctrines developed by two groups of philosophers whose most important representatives are: Descartes, Spinoza and Leibniz, on the one hand, and Locke, Berkeley and Hume, on the other. However, these doctrines are not always in conflict, and the philosophies of each and all of these philosophers could not simply be reduced to general descriptions of rationalism and empiricism. The main differences in understanding the mind can be briefly expressed as follows: "For empiricism the mind is, as Locke put it, like a great mirror which passively receives reflections from without, while for rationalism the mind is more active, involved in its own operations" (Hamlyn, 1987, p. 178). In addition to rationalism and empiricism, pragmatism – whose representatives are Peirce, James and Dewey – is sometimes discussed in philosophy of education as a third great philosophical approach to knowledge and mind. According to pragmatism, "the mind is conceived neither as a deep well of necessary truths nor as a blank slate upon which experience writes", but rather, "as a capacity for active generation of ideas whose function it is to resolve the problems posed to an organism by its environment" (Scheffler, 1965, p. 5). Looking from the pragmatic point of view, learning is an active process: "to learn something significant about the world, we must do more than operate logically upon basic truths that appear to us self-evident, and we must go beyond reasonable generalisation of observed phenomenal patterns in our past experience" (ibid., p. 4).

acquire a knowledge of the external world by reason alone. They believe that such knowledge can be acquired *a priori*, that is, independently of sense experience, by intuition and deduction. Empiricists think just the opposite, claiming that all human knowledge – except that of logical relations between our own concepts – is *a posteriori*, because it derives from sense experience.

Empiricists' theories of knowledge and mind have had a significant impact on some very influential theories of learning developed by empirically oriented psychology. According to these theories, "learning embraces any modification of behaviour in an organism as the result of experience, or even as the result of stimulation from the environment" (Hamlyn, 1987, p. 179). This is a very wide definition of learning and it better characterises animal learning than human learning. Essential for human learning is the acquisition of knowledge and understanding,[7] while "many abilities acquired by animals through learning involve little or no understanding of what is involved" (Hamlyn, 1987, p. 179). This basic interpretation of human learning as the acquisition of knowledge has been dominant in philosophy of education. In this context, knowledge means different things, and it is commonly presented and analysed in its two main forms: firstly, as propositional or factual knowledge,[8] and secondly, as practical knowledge.[9] The first form of knowledge is also known as "knowledge-that",[10] and the second as "knowledge-how".

Knowledge-that is knowledge of a fact or truth. It differs from a false belief and a lucky guess. As such, it is usually seen as rationally justified true beliefs.[11] In opposition to knowledge-that, knowledge-how is defined as knowledge of how to do something (Ryle, 1945). However, the open question remains as to whether or not knowledge-how is independent of knowledge-that. Some think that it is independent, others that it is not, and still others that it is independent to a considerable degree. Despite the fact that there is no consensus on the right answer to this

7 In human learning, the acquisition of knowledge is connected with understanding: even at the lowest level of learning, that is, "in rote-learning, it is essential to understand what is going on, and in higher forms of learning understanding is much more important still" (Hamlyn, 1987b, pp. 198–199).

8 They are called so because the object of knowledge is a proposition or a fact.

9 Practical knowledge, as opposed to theoretical knowledge, is not primarily knowledge about something, but rather knowledge about how to do something in practice: to play the piano, for instance. Knowing how to play the piano in theory is not the same as knowing how to play the piano in practice.

10 Some other important sorts of knowledge, such as "knowledge-who", "knowledge-why", "knowledge-where", and so on, are usually understood as particular kinds of "knowledge-that".

11 Knowledge is here explained it this way: *S* knows that *p* if (1) *p* is true; (2) *S* believes that *p*; (3) *S* is justified in believing that *p*. According to this interpretation of knowledge, justified true belief is necessary and sufficient for knowledge. However, some philosophers argue that it is only necessary but not sufficient, because a true belief can be inferred from a justified false belief. Since it is merely lucky that such beliefs are true, they cannot be knowledge (Gettier, 1963, pp. 121–123). In order to avoid this problem, some philosophers (who think that the definition of knowledge as a justified true belief is, in principle, correct) have tried to determine an appropriate fourth condition that would prevent deriving a true belief from a justified false belief.

question, the prevalent interpretation is that knowing-how is in some way distinct from knowing-that, and that, even if knowing how to do something requires relevant knowledge-that, knowing-how cannot be reduced to knowledge of facts or truths or theoretical knowledge about how to do something. This distinction between knowledge-that and knowledge-how is very similar to the distinction between declarative and procedural knowledge as explained in discussions of artificial intelligence and cognitive science. In this context, moreover, declarative knowledge is interpreted as explicit knowledge of particular things (facts, information, concepts, events, processes, their attributes, and their relations to each other), which are stored in the memory, whereas procedural knowledge is the knowledge of how to perform a specific skill or task, or how to operate. As such, it is related to the methods, procedures or operation of computers.

When knowledge is interpreted in this manner, it is obvious that learning as the acquisition of knowledge also has two main forms: learning-that and learning-how. Learning that *p* involves coming to know that *p*, while learning-how to do *p* involves coming to know how to do *p*. In the first case, *p* means a truth or fact; in the second case, it means skills or attainments. However, the supposition that learning-that implies knowing-that is not always true. Therefore, we cannot, as Scheffler emphasises, "generalize … that whenever a person X has learned that Q, he has come to know that Q" (Scheffler, 1965, p. 7). If Q is not true, then someone who has learned that Q, despite believing that Q is true, cannot come to know that Q; he only comes to believe that Q. Consequently, one who has learned that Q comes to know that Q if Q is true and he is able to provide adequate evidence for his belief that Q is true.[12] In the case of learning-how, the consequence of such learning is that one comes to know how to do something, but there is no agreement on what exactly this knowledge is: for some authors, it is some sort of disposition (to perform a specific skill or task), while for others, it is some sort of ability (to perform a specific skill or task). Both learning-that and learning-how are relevant to understanding machine learning, as well.

Machine learning

There are different definitions of machine learning.[13] One of those often mentioned is the definition attributed to A. Samuel, one of the pioneers

12 According to Scheffler, the educational term "learning" is related to the cognitive terms "knowing" and "believing" as follows: "learning that Q involves coming to believe that Q. Under certain further conditions (truth of 'Q' and, for the strong sense of knowing, proper backing of 'Q'), it also involves coming to know that Q" (Scheffler, 1965, p. 13).

13 The term "machine" in the expression "machine learning" refers to an algorithm and not to a piece of equipment, that is, to a computer understood as a piece of hardware.

of machine learning, who in 1959 supposedly defined machine learning as a "field of study that gives computers the ability to learn without being explicitly programmed" (Samuel, 1959, pp. 210–229).[14] In this definition, it is clearly stated that computer programs or special algorithms have the capacity to learn. As such, these programs essentially differ from traditional computer programs, which depend on rules in the form of a code written by human experts in order to instruct computers how to perform a specific task. In other words, traditional programs are not programmed *to learn* to perform a specific task, but only to perform such tasks. In addition, traditional programs are not able to perform tasks better than the human experts who programmed them, while machine-learning algorithms in some domains already can. In fact, a checkers program from 1955 included machine learning and was the first program that was successfully programmed to learn to play a better game of checkers than could "be played by the person who wrote that program" (ibid., p. 210). Since then, computers have defeated the best human players in games such as chess, Go, scrabble, Jeopardy!, and most video and other board games (Bhatnagar et al., 2018, p. 118; Bostrom, 2017, pp. 15–16;). Similar results of rapid progress in machine learning are seen in some other domains, as well. For instance, "deep learning methods – essentially many-layered neural networks – have, thanks to the combination of faster computers, larger data sets, and algorithmic refinements, begun to approach (and in some cases exceed) human performance on many perceptual tasks, including handwriting recognition, image recognition and image captioning, speech recognition, and facial recognition" (Bostrom, 2017, p. 321). Despite these and some other fascinating achievements in particularly narrow domains, however, the fact is that in many domains "we do not yet know how to make computers learn nearly as well as people learn" (Mitchell, 1997, p. 1). The question is whether it is possible at all that computers will learn as well as, or even better than, humans learn. There are two opposite answers to this question. On the one hand, there are those who believe that, in the more or less distant future, there will be algorithms capable of doing all of the tasks that the human brain does, while, on the other hand, there are those who believe just the opposite. In both cases, the answers are in the domain of belief, and we therefore do not know whether or not it will be possible that computers will learn as well as, or even better than, human beings learn. We can therefore only believe or not believe that such computers will exist in the future. We nonetheless know at least that one of these alternative predictions about the existence of such computers in the future is necessarily true, because the disjunction "p or

14 This quotation can be found in many sources, but there is no such definition of machine learning in the cited article.

non-p" is logically necessary. However, one might object that this disjunction is itself not necessary if the predicted statements refer to such computers as future contingent objects (which, as such, must neither be impossible nor inevitable), or if they are contingent statements about future computers and, as such, are neither true nor false, but undetermined. In any case, these problems are not essential for the purpose of this paper, as it simply deals with the question of whether already existing machine learning really learns. Moreover, discussing these problems might even be misleading, because arguing about the possible existence of future machine-learning machines that would learn as well as, or even better than, human beings learn presupposes that computers learn, that machine learning is real learning, which is precisely the presupposition in question. Therefore, such a presupposition is a logical fallacy, a sort of *petitio principii*: we take for granted exactly what is in dispute, or in other words, what is to be proven has already been supposed. We would have made the same mistake if we had assumed that machine learning is already by definition learning, since the word "learn" appears in "machine learning", as well.[15] For the problem is conceptual, not only terminological. If machine learning is real learning, the use of the term "learning" in the expression "machine learning" is correct; if it is not real learning, then the use of the term "learning" is wrong and misleading. To avoid the confusion, some authors write this term in quotation marks when it refers to machine learning. This means that, for them, real learning is human learning and perhaps also animal learning, but not machine learning. The view of some proponents of machine learning is just the opposite, including Samuel's seminal interpretation of machine learning as "programming of a digital computer to behave in a way which, if done by humans or animals, would be described as involving the process of learning" (Samuel, 1959, p. 210).[16] If human and animal learning are the criteria for real learning, then machine learning is, according to this interpretation, real learning. Machine learning is real learning

15 A possible answer to the paper's title "Do Machine-Learning Machines Learn?" is that a machine that machine learns *by definition* learns, since "learn" appears in "machine learn". This, however, assumes at the outset that what is called "machine learning" today *is* real learning, which that is precisely what is in question; hence the *petitio* (Bringsjord et al., 2018, p. 136).

16 In this case, the best features of two sorts of learning were combined in the computer program: rote learning and learning-by-generalisation. Rote learning is a very elementary kind of learning "in which the program only saved all of the board positions encountered during play, together with their complete scores" (Samuel, 1959, p. 214). However, "the program with rote learning soon learned to imitate master play during the opening moves. It was always quite poor during the middle game, but it easily learned how to avoid most of the obvious traps during end-game play and could usually drive on toward a win when left with a piece advantage". In contrast to the rote-learning program, "the program with the generalization procedure has never learned to play in a conventional manner and its openings are apt to be weak. On the other hand, it soon learned to play a good middle game, and with a piece advantage it usually polishes off its opponent in short order" (ibid., p. 221).

for some other experts on this issue, too, including T. Mitchell, who argues that his "definition of learning is broad enough to include most tasks that we would conventionally call 'learning' tasks, as we use the word in everyday language. It is also broad enough to encompass computer programs that improve their performance at some task through experience" (Mitchell, 1997, p. 2). According to his definition, "A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E" (ibid.). In the case of the aforementioned checkers program, this definition can be stated as follows: "a computer program that learns to play checkers might improve its performance as measured by its ability to win at the class of tasks involving playing checkers games, through experience obtained by playing games against itself" (ibid.).

Since then, more and more powerful machine learning programs have been created.[17] Not only are they able to play checkers and some other games at a superhuman level, but they also "cover a diverse set of learning tasks, from learning to classify emails as spam, to learning to recognize faces in images, to learning to control robots to achieve targeted goals" (Mitchell, 2017, p. 1); they can recognise human voices, translate text, and so on.

Nevertheless, when searching for the answer to the question of whether machine learning is real learning it is enough if we take into consideration the aforementioned basic machine learning program based on the rote-learning procedure (Samuel, 1959). For if machine learning is in this case real learning (equally as real as real human rote learning), then learning in other more developed machine learning programs, based on higher forms of human learning, is also real learning.

Real learning

The term "real" usually means that something actually exists and is, therefore, not apparent, imaginary, fictitious or merely so-called. For this reason, it seems that the expression "real learning", too, means learning that actually exists and is, as such, opposed to something that only appears to be learning or is misleadingly called learning despite being something else. The claim that

17 They have typically been based on three types of learning algorithms: *supervised learning* (the learning algorithms are trained using labelled examples that contain both the inputs and the desired output); *unsupervised learning* (the learning algorithms must explore input data that has not been labelled, classified or categorised, and find some patterns in the data); *reinforcement learning* (the learning algorithms must, through trial and error, discover which actions in an environment produce the greatest cumulative rewards).

contemporary machine learning is not real learning can also be understood in this way (Bringsjord et al., 2018, p. 136). However, this understanding of real learning seems to be wrong, because Bringsjord, Govindarajulu, Banerjee and Hummel do not argue that machine learning is not learning, but rather that it is not real learning as they conceive it. They define real learning in the context of mathematics and formal sciences by saying that an agent ***a*** has really learned a unary function **f**: N→N "only if

(c1) **a** understands the formal definition Df of **f**,

(c2) can produce both **f** (x) for all x ∈ N, and

(c3) proof of the correctness of what is supplied in (c2)" (ibid.).

Since no existing forms of machine learning satisfy these three conditions, the authors of this very demanding interpretation of real learning conclude that machine learning is not real learning.[18] Moreover, according to Bringsjord and Govindarajulu (2019, p. 2), "most of what is called 'learning' in artificial intelligence today", that is, in machine learning, does not satisfy the necessary conditions for being real learning even when real or genuine learning is defined as acquisition of new knowledge that consists of justified true belief. For real or "genuine learning of φ by an agent, …, must result in the acquisition of knowledge by the agent, and knowledge in turn consists in the holding of three conditions, to wit: (1) the agent must believe that φ holds; (2) must have cogent, expressible, surveyable justification for this belief; and (3) φ must in fact hold" (ibid).

Real learning, understood in such a way, presupposes that an agent (human or artificial) can really learn only if he, she or it has certain abilities – the abilities of reasoning and communication, for instance – on a human level or above. It is not surprising, therefore, that the authors of the discussed definition of real learning find real learning neither in the different forms of machine learning (symbol-based, connectionist, genetic and probabilistic) nor in some forms of learning in psychology and the cognitive sciences (associative learning: classical and instrumental conditioning, representational, observational, statistical, neurocentric and instructional learning).

From the assertion that machine learning is not real learning, however, the conclusion that different forms of machine learning are not learning does

18 In their opinion, this does not mean that current machine learning is not real learning only in the formal sciences; it is absent in creative writing, as well. "In order to learn to be a creative writer one must generate stories, over and over, and learn from the reaction and analysis thereof, and then generate again, and iterate the process. Such learning, which is real learning in creative writing, is not only not happening in machine learning today; it is also hard to imagine it happening in even machine learning of tomorrow" (Bringsjord et al., 2018, pp. 145–146.).

not necessarily follow. They are learning, but on a lower level than real learning. We have already seen that the first elementary form of machine learning was on the level of rote learning, while real learning – understood in the way that the aforementioned authors defined it – is on a much higher level of human learning. Nevertheless, the claim that machine learning is not real learning can also be seen from a different point of view, that is, as similar to the more known and discussed claims that artificial intelligence is not real intelligence or that intelligent machines are not intelligent. In both cases, the truthfulness of each of these claims depends on the criteria for learning and intelligence that have been used.[19]

Conclusion

In discussing the interpretation of learning in the previous section, we saw reasons to doubt whether machine learning is real learning. If we accept the interpretation of real learning that Bringsjord, Govindarajulu, Banerjee and Hummel defend, then we have to agree with their conclusion, as well; namely, that machine learning is not real learning. However, this does not mean that machine learning is not learning. Quite the opposite: it is learning, but until now it has only been on the level of animal and lower forms of human learning. Therefore, machine learning, too, can be seen as real learning in the sense that it is not something different from learning. Of course, the expression "real learning" here has another meaning than in the argumentation of the previously discussed authors who claim that machine learning is not real learning. For them, real learning is not just any kind of learning, but only the highest forms of human learning. Such an interpretation of real learning is not new. We have already seen that some philosophers of education have claimed that lower forms of learning, such as conditioning, are not learning at all. However, such understandings of learning are exceptions to the general rule, that is, they are in opposition to generally accepted interpretations of learning in scientific and philosophical theories. Therefore, arguing that machine learning is real learning is equally justified as claiming that animal and lower forms of human learning are real learning and not something different from learning. It seems that even those who claim that such forms of learning are not real learning do not think that they are not forms of learning at all, but rather that they are not real learning understood as the highest form of human learning

19 The polemics about machine intelligence reveal something interesting; namely, that the criteria for intelligence were changed when artificial intelligence outperformed human intelligence: "we stopped seeing 'winning the chess game' as a sign for intelligence in 1997, when 'Deep Blue' beat chess champion Kasparov" (Danziger, 2018, p. 170).

(which presupposes that an agent understands what is learned and acquires new knowledge as a justified true belief).

Nevertheless, even if machine learning is not real learning, there are three fundamental reasons for studying machine learning. The first one "is to understand the process" of learning itself,[20] the second is "to provide computers with the ability to learn",[21] and the third is to better understand machine learning and artificial intelligence as a constitutive part of the fourth scientific revolution that has been reshaping human reality, changing our self-understanding, our relationships, our society, our education and our employment (Floridi, 2016), and has "had a radical and widespread impact on our moral lives and on contemporary ethical debates" (Floridi, 2015).[22] At least the first and the third of these reasons are important and challenging for philosophy of education, as well.

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20 "By developing computer models of learning, psychologists have attempted to gain an understanding of the way humans learn" (Nath, 2009, p. 34).

21 "Learning research has potential for extending the range of problems to which computers can be applied. In particular, the work in machine learning is important for expert systems development, problem solving, computer vision, speech understanding, conceptual analysis of databases, and intelligent authoring systems" (ibid.).

22 These debates are on a variety of new topics, such as: artificial evil; morality of artificial agents; artificial moral agents with or without mental states; virtual artificial agents; accountability of artificial agents; robotic consciousness and self-consciousness; informational privacy, personal identity and biometrics; hate speech and online harassment; cyber terror and war; virtual community, and so on.

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Printed and Digital Media: Printed and Digital Textbooks

Ivan Ivić[1]

This paper aims to sketch a framework for comparing the efficiency of printed and digital textbooks. Considering the fact that digital textbooks are a relatively new phenomenon, they lack both practical experiences with their use, and research on their efficiency - which is why all results will only be of a preliminary nature. This is also why our paper will focus on an initial definition of not only the theoretical framework for analysing the nature of digital media, but also for analysing printed and digital textbooks. The broadest theoretical framework consists of Lev Vygotsky's theory on the character of culturally-psychological tools and their influence on the functional organisation of the brain and of Marshall McLuhan's theory of media, concerning the general fact of the medium (and not its content). The theoretical analysis shows that media (printed and digital) have significant impacts on the functional organisation of the brain, which is based on the brain's neuroplasticity. The analysis of digital media shows that they possess a set of specific features that, despite all the advantages they have, carry important risks for the organisation and functioning of the brain and for the process of learning. The production of digital textbooks also faces a significant number of challenges that the current production has not yet solved. Empirical research on the process of digital reading and understanding what has been read, indicate all the problems that still exist in digital textbook creation.

Keywords: digital and printed media, impact of digital media, comparison of digital and printed textbooks, educational effects of printed and digital textbooks

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Tiskani in digitalni mediji: tiskani in digitalni učbeniki

Ivan Ivić

Namen prispevka je skicirati okvir za primerjavo učinkovitosti tiskanih in digitalnih učbenikov. Glede na to, da so digitalni učbeniki razmeroma nov pojav, trenutno še nimamo ne praktičnih izkušenj z njihovo uporabo ne raziskav o njihovi učinkovitosti, zato so vse ugotovitve samo preliminarne. Naše delo se zato osredinja na začetno opredeljevanje teoretskega okvira za analizo narave digitalnih medijev ter vzporedno analizo tiskanih in digitalnih učbenikov. Najširši okvir teoretične analize predstavljata teorija Leva Vigotskega o značaju kulturno-psiholoških orodij in njihovega vpliva na funkcionalno organizacijo človeških možganov ter teorija medijev Marshalla McLuhana, ki zadeva splošno dejstvo medija (ne pa tudi njegove vsebine). Teoretična analiza je pokazala, da imajo mediji (tiskani in digitalni) pomemben učinek na funkcionalno organizacijo možganov, ki sloni na njihovi nevroplastičnosti. Analiza digitalnih medijev kaže, da imajo ti vrsto specifičnih značilnosti, ki – ob vseh prednosti, ki jih ta medij sicer ima – prinašajo precejšnja tveganja za organizacijo in funkcioniranje možganov ter za proces učenja. V tem okviru se tudi ustvarjanje digitalnih učbenikov srečuje s številnimi izzivi, ki v današnji produkciji digitalnih učbenikov še niso razrešeni. Empirične raziskave procesov digitalnega branja in razumevanja prebranega kažejo na vse težave, s katerimi se še vedno srečujemo pri ustvarjanju digitalnih učbenikov.

Ključne besede: digitalni in tiskani mediji, vpliv digitalnih medijev, primerjava digitalnih in tiskanih učbenikov, edukacijski učinki tiskanih in digitalnih učbenikov

Introduction

Despite differences in dynamics, all countries in the world are facing the beginning of the era of publishing digital (electronic) textbooks: some countries (Serbia among them) are only starting this process and some are already quite ahead (for example South Korea, which came to the decision years ago that they would completely switch to publishing digital textbooks only in 2015).

Parallel to this, all countries also witness contradictory attitudes regarding the value of digital textbooks, arising from the public, including the educational public (alongside the usual silent majority that is indifferent to this innovation). One type of reaction could be called »affinity for novelties« and it consists of an attitude that everything new is also good and should be embraced (sometimes with enthusiasm and excessive expectations). The other type of reaction is completely opposite to the one just mentioned and consists of a conservative attitude of rejection, often to all that is new.

However, as many authors, even those that are sceptical about digital textbooks (and electronic books generally), have noted, digital textbooks and digital media generally are already a reality and will appear more and more often on the market of school books. The true problem lies in determining the meaning of this novelty, which has to be constructed neutrally, without passionate cheering and without the pressure from the manufacturers of electronic devices (that aim to make a profit and therefore have an interest in an accelerated digitalisation of the educational field that should be implemented at all costs). What is necessary is to rationally examine and question this novelty with a serious, scientific approach based on all available knowledge and insights.

The problem of digital textbooks has to be considered as part of a broader perspective. Namely, digital textbooks are only one phenomena of a broader historical change – **the digital revolution**. We are truly faced with a revolution, the potential effects of which at least equal the revolution caused by literacy (which underlies our division of the past on pre-history and history) and the industrial revolution. As any true revolution does, the digital revolution touches upon all spheres of life (economy, society, education, science, art). A crucial factor for the issues we are concerned with in this paper is that this is a true **intellectual** revolution, since it changes the intellectual components of all human activity and this has specific consequences for activities such as learning (education), where the intellectual component comprises the essence of the activity itself.

Due to the fact that the digital revolution as well as digitalisation in the field of education (digital learning, digital classrooms, digital textbooks,

electronic diaries) are new phenomena, the basic goal of this paper is to find answers to the following questions: what are the possible positive and negative consequences and effects of such major changes; how can historical experiences with past revolutions help us to understand the meaning of this new revolution; what do these changes mean not just for education and the process of learning but also for the functioning and development of the individual (his/her intellectual, social and emotional development and their cognitive functioning); what are the effects that relate to intellectual efficiency; what consequences do exposure to the digital world and virtual reality have on the functioning of the human brain; how can we efficiently use our knowledge about the effects of printed textbooks to better understand the difference between them and the new digital textbooks?

What is important to note at the beginning is that digital textbooks in their different forms are **a new phenomenon,** not only in our country but also in countries that started using them earlier (some states in the USA, South Korea) and **we still do not have enough concrete experience with using these types of textbooks, and even less of rigorous research on their use and the effects they have**. One of the foundations for examining the value of digital textbooks is the existing knowledge and years of experience with the use of traditional, printed textbooks and the extensive research related to them. This paper is based on this knowledge of printed textbooks, that the author of the present paper and a group of his colleagues have gained.[2]

We first need to highlight two fundamental methodological principles that form the basis for comparing printed and digital textbooks: a) we will compare the best versions of printed and digital textbooks, that is the versions that make the most optimal use of the media at hand (printed or digital); b) our comparison will not focus on technical and secondary aspects of textbooks, which we can often find in so much of the literature on the topic (the technical ease of reading, that is navigating through the digital or printed textbook; accessibility of the textbook; the cost of textbooks, including the cost of equipment required for their use; student preferences for one or the other type of textbooks, since all of these will change over time, etc.). The focus of our comparison will thus be on the extent to which digital or printed textbooks contribute to achieving educational outcomes and individual forms of educational

2 There are a number of works (books, papers, masters and PhD thesis, conference presentations) detailing this research that has begun more than 40 years ago at the Institute for Pschology. Here we will only name one book that contains a synthesis of all the above mentioned work: Ivić, I., Pešikan A. i Antić S. (2008). *Vodič za dobar udžbenik.* Novi Sad: Platoneum and the updated translation in English that was initiated by the Georg Eckert Institut (Leibnitz - Institut fur internationale Schulbuchforschung) in Braunschweig, Germany: Ivić, I., Pešikan, A., & Antić, S. (2013). *Textbook Quality*. Gotingen: V and R Unipres.

achievements. Bearing the scarcity of existing knowledge in this area in mind – even in the international framework – the results of our comparison can only be preliminary.

Digital and printed media

To understand these issues, we can benefit a great deal by relying on theoretical foundations, above all media theories. In our paper we will rely on theories by the Canadian media theorist Marshall McLuhan (McLuhan, 1971, 1973) and on concepts considering the social-cultural-historical psychology of L. S. Vygotsky.[3] In several of his works Marshall McLuhan has developed a theory that – alongside other strong factors (such as the advancement in techniques and technologies used in human labour) – media (such as for example the emergence of printed books as a new media) have played and still play an enormous role in the development of societies and changes in human behaviour. McLuhan's ideas are specific while they emphasise that the essential part of media is not the **content** that is transmitted but the **nature of the medium** itself. For example, according to McLuhan the crucial point in the emergence of television as a medium is not the content transmitted by television but the nature of television itself that brings a culture of image (instead of a culture of sound and hearing, which dominates in oral speech). The fact that it is a "hot" medium, means that it builds a passive attitude in its consumers etc. At this point it should suffice to remember his famous and often cited thesis that encompasses his other ideas, that is that the "**medium is the message"**. We can conclude that this also holds true for digital media.

As for Vygotsky, his ideas, given that they were formulated almost a century ago, today seem prophetic. Vygotsky starts from the fact (confirmed by contemporary evolutionary biology and psychology) that in the last 40.000 years the human brain has not changed morphologically and yet significant changes in human behaviour, such as people's capabilities and achievements, have occurred during this time. This progress is not based on biological (morphological) change, but is based on the development of culturally-psychological tools (the so-called allomorphic development), external aids and amplifiers[4]

3 This psychological orientation (Vigotski, 1996) develops ideas on the culturally-psychological tools and allomorphic development that enfolds outside the human body as extensions and amplifiers of human capabilities. We would like to emphasise especially the work *The instrumental method in psychology* (Collected works, first edition, p. 82–86, remainding our readers also that the original work dates back to 1934).

4 Althouugh McLuhan did not know the works of Vygotsky and does not refer to him, both use almost identical terms as McLuhans term extension that can be found in the title of his book on understanding media.

of human capabilities, that is, it is based on cultural achievements that serve as an external (inorganic) support for individual human capabilities and as factors of a different functional organisation of the human brain.

In his programmatic text on the instrumental method in psychology, Vygotsky writes:

> Psychological tools are artificial formations. By their nature they are social and not organic or individual devices. They are directed toward the mastery of [mental] processes-one's own or someone else's-just as technical devices are directed toward the mastery of processes of nature. (p. 85)

By being included in the process of behavior, the psychological tool modifies the entire course and structure of mental functions by determining the structure of the new instrumental act, just as the technical tool modifies the process of natural adaptation by determining the form of labor operations. (p. 85)

> *"The application of psychological tools enhances and immensely extends the possibilities of behaviour by making the results of the works of geniuses available to everyone (cf. the history of mathematics and other sciences)".* (p. 87)

The application of these ideas imposes itself on the effects of digital technologies that are a product of culture and that develop as external supports of inner psychic functions that "expand the possibilities of behaviour infinitely" (is the internet not a gigantic extension of human memory, are the gloriously fast computations by big computers, based on a huge number of data, not a strong support for certain forms of human thought etc.). When applied to digital technologies, theoretical conceptions like these can contribute to a better understanding of their nature, their possibilities and – the factor which is extremely important for the issues we are concerned with – their consequences for education, learning, for functional changes in the human brain and thus also for individual development, and even for the fate of man in the future. This is only an indication of some serious general problems that will be further shaped and elaborated in years to come, and serves merely as an initial sketch that is necessary to define the issue of digital textbooks.

Alongside these theoretical bases we will also rely on findings about the general effects of the printed media as an older medium. Unlike the learning of speech (oral speech) that has a significant biological (genetic) basis, the human brain does not have ready-made biological mechanisms for written and printed speech. Written speech is a cultural creation and the brain must functionally organize itself in a new way. That is, the brain must functionally connect different

parts of the brain, such as the area responsible for processing the visual components of language (the graphical image of letters), the area responsible for processing speech sounds, the area for understanding and producing speech etc.

This new functional organisation of the brain is made possible by its neuroplasticity (plasticity of the brain) and leads to what McLuhan has called the »**typographic man**« and Maryanne Wolf (2008; 2016) has called the »**reading brain**«. These terms signify what Vygotsky aimed to prove a long time ago (since he was also concerned with issues of written media), namely that the literate man is not the man who has simply added the capabilities of writing and reading, but is a different man.

The conditions for the development of written speech and the general effects of its emergence have recently been studied in detail. This includes the issue of dyslexia as an inability to learn written speech, and programmes aimed at helping people with dyslexia that are based on creating new functional organisations in the brain with the help of special learning programmes (Dehaene, 2010; Willingham, 2017; Wolf, 2016; Wolf & Stoodley, 2018).

This significant research on **reprogramming** the working of the human brain with the help of media, which is created by culture, have brought about some very important findings: that it is possible for the »old brain« to form entirely new capabilities with the same anatomic characteristics but a different functional organisation of the brain; that it is culture that creates the conditions for such major changes in the organisation of the brain; that this organisation of the brain differs depending on the nature of the language that is acquired (for example, we can find significant differences in the organisation of the brain between people learning Chinese and people learning phonetic languages, that is languages where meaningful units of language can be broken down into sounds – phonemes or graphemes that do not have a meaning in themselves). Significant changes arise precisely with the emergence of phonetic written speech.

There are other, more general effects arising from the emergence of media, such as printed media (the emergence of typography and books): reading takes place in isolation, in quiet, in a process of immersing oneself in the contents of the book while being personally engaged with thoughts and emotions which leads to strengthening the individual and individualism. This in itself leads to enormous social change.

Knowledge on the ways our capabilities for written speech are formed and on the effects of this medium as a new medium (which emerged about 6000 years ago) has led to a crucial finding that **the new media forms are changing the way the human brain function** and can help us to better understand the effects of digital media.

This new mode of organisation of the work of the human brain can occur because of the brain's plasticity (this can be seen, for example, when, due to injuries in some areas of the brain, new areas of the brain - under certain conditions - take over the functions of the injured areas). The latest research on brains elaborates further on what allows for the brain's plasticity (Constandi, 2016). There are several forms of brain plasticity and they depend heavily on age (and on the individual characteristics of every brain). Plasticity is, naturally, greater at a younger age. However, recent research has shown that, contrary to previous, strongly held beliefs, there are nerve stem cells in some parts of the adult human brain and new nerve cells are created. Nonetheless, the basic mechanism of brain plasticity that is directly connected to the issue of digital media, is the mechanism for creating complex synaptic connections (chemical and electrical connections between particular nerve cells) and especially creating different **synaptic circuits** that depend on different life experiences and activity, and on the nature of the media. This is precisely what, according to Vygotsky, changes the course and structure of psychic functions (Vygotsky also uses the term »functional organ«). There are also some significant findings on the shape the organisation of the brain takes when using digital media.

Significant research, authored by a psychologist and a neuroscientist concerns the most common issues regarding the functioning of the brain in a general digital environment (when using television, smartphones, the internet, email, social networks), reading digital texts (digital books, digital newspapers) and indicates all the problems our »ancient brains in a high-tech world« face (Gazzaley & Rosen, 2016, p. xv). There also exists a more popular explanation of these issues in the book by R. Watson (2010), that is also translated into Serbian.

The human species, like all animal species, has an innate need to seek information in its environment, since this represents the condition for its survival. However, in their evolution, human beings did not have experience with such high amounts of information that we have access to in contemporary digital environments, which means that the human brain does not possess innate biological mechanisms of functioning that enable them to deal with this range of information (hence the provocative subtitle of the above-mentioned book – »ancient brains in a high-tech world«). Digital media as new media demands a new organisation of the brain that enables us to cope with, and function in, this new environment. This is possible on the basis of the already mentioned plasticity of the nervous system, especially the brain. This new functional organisation of the brain must be different than the one which was established with the emergence of printed media. However, in the process of building this new functional organisation, the brain is confronted with some serious issues.

Gazzaley and Rosen (2016) sum up the crucial problems posed by digital media in the term »**distracted mind**«. They use it to indicate the basic problems that the »ancient brains« face when in contact with new media. The distracted mind comes to be because, on one hand, the digital environment contains an enormous amount of information but, on the other hand, there is a clear limit to human attention. This results in serious **disturbances** in the reception, selection and processing of information. When receiving information, humans orient themselves with goals that they aim to achieve with the help of this information, but the digital media, constantly bombarding us with information, leads to **the constant distraction of one's attention** (to new information that arrives), to **interruptions** (in the process of monitoring relevant information), to an imposed need to **simultaneously perform several tasks** (multitasking) and to **splitting attention** which causes moving away from the goals of behaviour. To put it in other words, so much »noise« makes it hard to follow the necessary »signal«. Concrete examples from everyday life are when man distances himself from the things that matter to him, can't remember (in terms of long-term memory) what he needs, loses his capability for thinking profoundly, has a hard time making important decisions in business, in his private life or in the process of learning. Examples from the educational field are the disturbances children face when they simultaneously learn and try to follow information on their smartphones (notifications on received messages, reading messages, and exchanges on social media). These problems of the distracted mind are especially serious with certain groups. Examples of these categories of people include: developing children, adolescents, elderly, people with neurological issues. In the last part of the book, the authors describe measures that can contribute to reducing the problems expressed as a distracted mind, among which they also list »traditional education« (Gazzaley & Rosen, 2016).

Concerning the specific aspects of the digital environment, the **reading of digital contents,** and above all, **unrestrained reading on the internet**, some very interesting research already exists. A summarised overview of these results can be found in a well-known book by Nicholas Carr (2013), ***The Shallows: What the internet is doing to our brains***. The subtitle of the book and its contents provide a remarkable demonstration of McLuhan's and Vygotsky's ideas regarding the way in which media, as a cultural creation by its nature, determines the way in which the human brain is organised, the way it functions when using digital media (precisely due to their nature and not their contents), and what general effects all of this has. Namely, Carr (2013) analyses the structural characteristics of media (mostly of the internet). He analyses the characteristics that determine the specificity and essence of digital media. The basic characteristics are

the use of hyper-text or hyper-media (that is, the possibility to pass from one text to another by clicking designated places in the texts, or to pass to another website, dictionary, or an encyclopaedia, or when accessing some inserted multimedia content etc.), which means that there exists a constant connectedness with other sources of information, multimedia (the possibility of turning on audio, image or video inserts while reading the text), interactivity (the possibility that the reader inserts his/her own annotations and notes on which other people can react, commercials, notifications on received electronic messages, and – eventually – after reading these messages, suggestions from the editor or browser). All of these are essential characteristics of digital media and are sometimes remarkable in character (for example, they enable extremely fast access to a large amount of information, easily finding necessary documents or pages in a document, they provide amazing audio or video illustrations). But all of this comes at a price.

Carr (2013) summarises all of these characteristics of digital media or information technologies in a single term, when he calls these technologies **interruption technologies**. Using digital media (e.g. reading on the internet) leads to a set of inevitable effects: an overload of information, attention instability, a big cognitive load when making decisions about which options to use (e.g. hypertext or multimedia attachments), multitasking, frequent shifts of focus, fragmentation of information etc. Even a relatively short process of reading content on the internet (a few days) leads to the creation of new nervous paths and a certain reorganisation of the brain. It is extremely difficult to predict the long-term effects such reading can have on children and young people who are practicing it from a young age.

Carr (2013) summarises the overall effects of digital media use with a term that is also the title of his aforementioned work – **shallow**. In his book, this term has a very profound meaning: after a longer period of reading content on the internet, users of digital sources cannot read longer texts (not even two or three pages of continuous text) because they gain a habit of passing quickly from one piece of information to another, and cannot follow the basic thread (the basic ideas) of a longer text. What is crucial about this rapid jumping from one piece of information to another is that it disrupts a mental process that is extremely important for human memory – the **translation of short-term memory** (the so-called working memory) **into long-term memory.** Short-term memory, if it is not translated into long-term memory, lasts up to thirty seconds and then the information gets lost and is replaced by new information. Long-term memory concerns the true acquisition of experience and knowledge, that can be used in all future activities (sometimes this memory lasts for life). The

process of connecting new information with previous knowledge, which constructs the meaning of new information, unfolds in the long-term memory. This also implies that thought processes are engaged in creating long-term memory.

The mechanism of the brain, that helps creating connections, is the mechanism of creating synapses and synaptic circuits. This process can be understood better if we know that the brain does not have the kind of memory that computers have. That is, it does not have stored and unchangeable information that is recalled and used when needed, like a computer does, and information that has a clear location (although there are people who believe that the brain functions in the same way computers do and that it is just another system for processing information). Contrary to these understandings that identify computers with human brains, long-term memory does not have a »memory« that is located somewhere, or that is fixed and unchangeable. Instead, long-term memory is a dynamic process of forming synaptic circuits that are maintained as long as they are connected and used (reinforced and strengthened with every new use) and are changed as they encounter new information and incorporate it into existing circuits. It is only in this process that isolated bits of information become knowledge. This differentiation between **information** (isolated units of knowledge that is usually sought after in quizzes) and **knowledge systems** (connected units of knowledge integrated into the system) is crucial for our understanding of the process of acquiring experience and usable knowledge. This process of acquiring integrated and conceptual knowledge (unlike mere information) guarantees understanding and profound thinking, and thus eliminates the phenomena characterised by the term "shallow".

When considering the **general and fundamental effects** of digital media, one must point out two aspects in which these effects manifest themselves. The first relates to cultural media as **extensions and amplifiers** of individual human capabilities in the manner that McLuhan and Vygotsky talked about (we can remind the reader of Vygotsky's words that using the media created by culture "enhances and infinitely expands the possibilities of action", (Vygotsky, 1997, p. 87)). In these times marked by an explosion of digital media, it has already become clear how dramatically these theoretical assumptions are being confirmed: examples include the colossal expansion of individual memory in the form of the internet and strong databases, and the exceptional speed of computing by big computers that has enabled many technical and technological accomplishments (it suffices to simply remind oneself of all the things we need to execute cosmic flights or to guarantee the functioning of all those smart devices or everything that we can glimpse under the term artificial intelligence, namely the complex systems of algorithms).

Much less is known about, and also represents a lesser focus of research, the other side of digital media. This other side relates to **the risks presented by digital media generally.** Here we will only remind ourselves of everything that underlines the term **virtual reality**, where we are actually dealing with creating a parallel world that presents itself to people as a new reality that they inhabit and that is home to many human activities. However, the possibility of creating another reality is at the core of the symbolic function of man (Ivić, 2015). This possibility of constructing symbolic realities and systems is enabled by the emergence of the first symbols in anthropogenesis and ontogenesis. Printed media, based on this symbolic function, has already created an enormous parallel symbolic reality in the shape of all of those "symbolic forms" that determine the lives of men. It should suffice to mention the entire virtual (symbolical) reality created by literature (first as oral literature, that in the form of rare handwritten books and, at the end, in the explosive development of fictive reality in mass printed media). Digital media has brought the human ability of developing fictional reality to a paroxysm. Today we are still a long way from understanding the serious consequences that this creation of symbolic virtual realities in the digital media will have, how it will determine the life of present and future generations that will – from their early years – be growing up both in these virtual realities as well as in physical and socially-cultural realities.

The younger generations spend a great amount of time living in virtual realities, leaving less and less time for life in the real world and for establishing real relationships with people. It is hard to predict the long-term effects of such separation from real life. Clearly, distinguishing the virtual (fictional, symbolical) and the real is of crucial importance, since it is the condition of psychological normality. Today, virtual reality - created by digital media - is perceptually so convincing that it hinders in making this distinction. This can lead to confusing the real and the virtual, especially in certain groups of the population (e.g., psychologically unstable people).

How important the distinction between the real and the fictional (as simply a different term for virtual) is for normality, is demonstrated by the normal development in human ontogenesis. At the age of two, with the first appearance of symbolic tools (such as first forms of symbolic/pretend play, or when one pretends to sleep), the child gives clear signals to the adult that all this is pretence and not reality (with a roguish grin, making sure the adult follows his or her activities (Ivić, 2015)).

As Vygotsky already knew in his time, culturally-psychological tools (like media) primarily have a retroactive effect on the organisation of psychic life. This contrasts with tools for the cultivation of nature that have changed

the nature of man's working operations through history as they were perfected.

Research has already been conducted that concerns the ways in which digital media changes some **cognitive processes**, for example the nature of reading and understanding what was read (remember the subtitle of Carr's book: How the internet changes the way we think, read and remember; or remember the phenomena of the reading brain (or the typographic man); or the phenomena of the "distracted mind" (Gazzeley & Rosen, 2016)).

Here, we will only mention some of the research that relates to social and emotional relationships, and warn about the risks for the development of human relationships (Turkle, 2011, 2015). According to this pioneering research, there are important risks for the development of the human capability for face-to-face social interactions and real conversations (which leads to the "alone together" paradox, that is to loneliness in a time when »social networks« blossom). One of the biggest victims of long-term exposure to digital media is the loss of our capacity to empathise, which is one of the most characteristic features formed in the course of human evolution and is tightly connected to the development of capabilities for the "theory of mind". The theory of mind is a specifically socially-cognitive capability of humans that consists of the ability to recognise other people as intentional beings and enables us to "read" (mindreading) their mental states (thoughts, feelings, beliefs, intentions, attitudes). This is the capacity, developed around the age of two in ontogenesis, that underlies man's symbolic capacity, that is the capacity to create symbols, symbolic systems and symbolic realities (Ivić, 2015). Significant scientific findings (Baio et al., 2014) demonstrate that one of the sources of autism is actually the absence of this capacity to empathise and the capacity for the theory of mind. Related to this, it is of great concern that there is an inexplicable rise in the number of youths with autism in the US: a 254% increase from 2000 to 2014!). Is it possible that there is a connection between the increased use of different digital devices (in the community, by parents and by children) and the increase in the number of people with autism (for example, in the sense that people with a fragile genetical basis could develop affective relations and human relationships in normal conditions and would not have autism but, when these relationships are disturbed, some forms of autism can appear)?

It is terrifying to think about the potential changes in human relationships if the capacity to empathise would seriously be questioned as a result of an increased exposure to digital media and virtual reality.

Printed and digital textbooks

Findings on the nature of digital media are especially important for the issues that concern us in the present – issues relating to educational achievements when using printed or digital textbooks. Digital textbooks are of course only a part of the digital environment. Using and reading digital textbooks differs from reading on the internet, since there are less factors that distract the reading process. However, as a digital medium, digital textbooks also have some common characteristics with other digital tools and some of the findings of the above-mentioned analyses apply to them too.

There is a variety of types of digital textbooks depending on which of the essential features of digital media they offer. The most complex version of digital textbooks is the one that has the greatest number of digital characteristics: **the possibility of inserting new content into a digital textbook, interactivity, multimedia, using hypertext/hypermedia (hyperlinks), connections to other digital sources, the possibility of creating simulations and animations** (e.g., simulations of micro processes or phenomena that cannot be seen with a bare eye), and **all of this interrupts the linearity in the process of receiving information and enables different forms of connecting information** (from different fields, from contents in the programmes at different educational levels), **the possibility of personalising learning (including the determination of individual paths of moving through the text), the possibility to answer questions and solve assignments and get quick feedback on success in answering, the possibility to compare your achievement to certain norms.** All of these are important characteristics of digital media and could serve as valuable means of supporting the learning process. There are great opportunities for enabling a better understanding of materials if the users of digital textbooks could, for example, see a computer reconstruction of dinosaurs, or the building of Egyptian pyramids, or the process of plant growth from seed to maturity, or the simulation of chemical processes in which different colours would represent different chemical substances, or an animated presentation of the functioning of volcanoes, or quickly finding the meaning of a term, or finding a term and its description that is only mentioned in the textbook in an encyclopaedia, or getting feedback on learning success in light of further progress in learning. In principle, all of these possibilities of digital media create the opportunity for an active relationship with the contents to be acquired, they create a basis for learning as a form of research – guided by the teacher in a digital classroom or other similar research. There are few textbooks in the world, let alone in our country, that make use of all of these possibilities. We could even talk about phases in the development of digital textbooks

depending on which digital tools are built into them, from free **pdf** versions of texts, to textbooks that are close to using almost all of these tools in almost every chapter.

However, inasmuch as digital textbooks can significantly contribute to the learning process if the possibilities of the digital media are predominantly adequately used, digital textbooks also share the destiny of other digital tools with regards to the negative effects that appear due to the nature of every digital medium. The basic negative effects that could hamper efficient learning from digital textbooks are the same as those we have already mentioned when discussing other digital tools. Above all, we are talking about the effects related to **"disruptive technologies"** that are extremely difficult to avoid when creating a true digital textbook. Namely, technological disruption occurs every time a textbook uses image, audio or video inserts, since this causes an interruption in reading and eventually leads to losing the main thread of the text. The same happens in situations when you click on a certain part of the text (e.g. when you need to look for an explanation of an unknown word or are trying to expand an idea), or when you need to choose a tool to interact with the text (highlighting, underlining, note taking, erasing errors etc.), or encounter technical problems when navigating through a textbook etc. These interruptions lead to a loss of focus (especially when the content that distracts our attention is not directly or adequately connected to the course of ideas in the text), and to interruptions in the process of translating short-term memory into long-term memory and to shallow reading, which we have already discussed.

Another big problem for the creators of digital textbooks is how to avoid **cognitive overload** that appears when using digital textbooks, because different phases of using digital textbooks create moments when students have to make quick decisions (e.g. whether to use a certain insert or not, to react to the text by using one of the tools and which one to use, to use a dictionary when encountering an unknown word etc.); when student aim to complete the tasks posed by the text (answering questions, making notes etc.). These situations of cognitive overload also lead to disturbing the process of understanding. Especially significant problems in this process of understanding the message of the text occur when students' attention shifts away from the textbook to other digital tools (following the teacher in the digital classroom, public or hidden checking of messages on smartphones, reading the news etc.). Taken together, all these possible interruptions when using digital textbooks create the illusion that the information that has been received (individual isolated information) has led to true knowledge, that is, to understanding the basic ideas of a certain lesson and to integrating these ideas with existing knowledge, and consequently to

constructing conceptual knowledge. It is a fact that the internet contains a mass of individual, isolated information but not conceptual knowledge that can and should be constructed by each user of these digital tools – not by memorising this information but by fully engaging one's thinking.

When creating digital textbooks, the publishers and authors (there should be authoring teams) find themselves face to face with an enormous challenge to **use all of the potential of digital media in order to support and help gain an understanding of the content, and to maximally reduce the serious risks that digital media poses by its very nature for this process of understanding, memorising and mental engagement.** Here we only talk about reducing the risks and not about their full elimination, since some of them are inherent to digital media.

Solving these difficult *aporias* should also contribute to achieving a long-term goal in using digital media (that we are still far removed from attaining), that goal being **forming digital competences and the digital literacy of students** that will enable young generations to adequately use other digital tools as well as other digital media, in the same way that the printed media contribute in establishing a culture of reading. **Quality digital textbooks and competent management on the side of teachers** (who for now, unfortunately, do not have adequately formed digital competences and should be specifically equipped for this task) **should function as a counterweight to self-made "wild" navigation through digital media.** Some of these demanding issues should be solved by defining good **quality standards specific to digital textbooks.**

Alongside the above sketched theoretical frameworks for understanding the nature of digital media and their effects (including the effects of digital textbooks) there is another basis that could help us gain a specific understanding of the nature and effects of digital media – **our long-standing experience with printed textbooks.** Although some passionate proponents of rich informatics tools will say that textbooks are not even necessary in this digital age since all information can be found on the internet, "on google" – this represents only an extreme version of the illusion that a set of information is identical to knowledge. This other basis rests on the fact that a **digital textbook is – a textbook**, which implies that it has to comply with the highest standards of quality textbooks while also acknowledging and respecting the specifics of digital media. There is even more variety when talking about printed textbooks and there exists a long historical process of their development – from a mere text which contains the school programme[5], through to textbooks that also contain

5 The english word textbook only speaks of a text while the word *udžbenik* (derived from učiti se – to learn) found in Serbian and some other slavic languages, speaks also of the fundamental function of this specific book.

different structural components (images, tables, figures, maps, atlases etc.), to textbooks that also include digital components (CDs, DVDs).

We have already said that only the best versions of digital and printed textbooks should be compared, that is, textbooks that make optimal use of the media in question. Such digital textbooks do not yet exist, since there has not yet been enough time to create them. We have, however, much more experience with printed textbooks. There is a huge amount of research on their contents, structure and the structural components that comprise them. There also exists the production of very good printed textbooks.[6] Many countries have defined textbook quality standards as a mechanism for developing their quality (in Serbia these standards are tragically low, despite the fact that we have enough expert knowledge to create the best possible textbooks (see Pešikan, 2016)). Here, it is neither possible nor necessary to present the results of all of these experience with, and analyses of, printed textbooks. Instead, we will only present a highly summarised core by relying mostly on a book that contains a synthesis of these findings (Ivić, Pešikan, & Antić, 2008).

The textbook is a **specific book** that is first and foremost determined by its function, – it presents a fundamental resource for learning and is intended for a clearly defined circle of users, for a defined level of education, age and field of education. In this way it is distinguished from other genres of books that are related to it, like encyclopaedias, scientific monographies, popular science editions etc. In terms of contents, one of its specific characteristics is that it contains **systems of knowledge from different fields of knowledge** (which does not exclude textbooks in some interdisciplinary fields, especially in higher education) **which are adapted to the developmental and age possibilities of the intended audience.** This organisation of knowledge follows the lines of the so-called school subjects and has to be encompassed in school programmes. It presents the essence of institutional education in schools and it is in these aspects that school knowledge differs from episodic life experiences and partial information from the internet, or from any other sporadic source.

There are clearly defined textbook quality standards that pertain precisely to contents. In this respect, most digital textbooks that have been created so far are deficient, since they are often more focused on creating attractive multimedia components, aligning themselves with the apparent greater interest of children and youngsters for such digital content and for using digital tools resembling video games. There is a common illusion among passionate

6 They can be found for example in the library of the international institute for textbooks, the Georg Eckert Institute in Braunschweig, Germany. The institute is also the official Unesco institute for textbooks. It contains more than 200.000 textbooks from all over the world.

proponents of digital textbooks that children learn easily and quickly in this way, despite the fact that this is not grounded in any research or evidence.

All structural components of the textbook (the main authored text, the iconic sources, dictionaries of unknown words etc.) and all organisational units that facilitate navigating through the textbook (like clear contents, chapters and subchapters, titles and subtitles, the graphical organisation of the text - like highlighted text, text in frames etc.) are defined based on the function and the **audience** (that is for whom the textbook is intended). But the basic demand any good textbook must meet is **that all components and organisational units (chapters, lessons) must systematically lead to achieving learning goals from the textbook; that the textbook as a whole and all its components must not disperse attention but enable it by concentrating on the main ideas of the text, since this is the only way to acquire systems (or parts of systems) of knowledge that are contained in long-term memory and to enable connecting prior knowledge to new findings that will be acquired at the following levels.**

There is a great number of quality standards that relate to this organisation of the entire textbook. These are textbook quality standards that relate to the didactic design of the textbook and their adaptation to the developmental and age-related capabilities of students. When using multimedia components, the existing digital textbooks are often very well adapted to both (sometimes they even fall beneath the level of students since they simplify and banalize the multimedia components with the aim of increasing attractiveness), **but suffer from significant inadequacies in terms of didactic design that is due precisely to the nature of digital media that often leads to a distracted mind, to interruptions in the development of the basic threads of content, to information and cognitive overload – and thus disturb the construction of a system of knowledge.**

A great progress in improving the quality of textbooks was the consequence of introducing one of the most characteristic features of textbooks: meaningful and cognitively challenging questions, assignments and tasks for students' independent work. As long as textbooks contained only the explanations of materials prescribed by school programmes, learning was more or less reduced to memorising text (sometimes also learning it by heart), especially if teachers also adopted such approaches to learning. Questions, assignments and tasks for students' independent work, when constructed with consideration and when the teacher supports them, can mentally and emotionally encourage independent work, thinking about the materials, critical thinking and thinking about the possible applications of the knowledge that is being acquired. This contributes to achieving the aims of school learning that cannot be achieved simply by working on a text that is a mere explanation of material (just as a lecture in a class looks

like), and these are: developing independence in learning and work, developing problem-solving capabilities, the ability to connect materials from different fields, connecting materials to students' prior knowledge and experiences, developing the ability to apply knowledge (in part this is also examined by PISA to internationally examine school learning outcomes). Questions and assignments for students in the existing (our) digital textbooks are the worst component of these textbooks, since they resort to forms of assignments that are most easily provided in a digital environment and are easily evaluated with their results being easily statistically analysed. In most cases we are talking about questions and assignments of a reproductive nature in the form of multiple-choice answers.

A special issue relates to the way students **use textbooks.** The ways in which they use them mostly depend on teachers' attitudes towards a textbook: if teachers view textbooks as mere summarisations of prescribed school programmes and neglect all the components of the textbook that aim to lead students towards actively relating to the materials (underlining text, asking questions about contents that were not understood, or connecting knowledge in the text with life and out of school experiences etc.), then the students will also ignore these extremely important components of the textbooks. In one significant empirical research study conducted on this issue (Antić, 2014), it has been established that there are no differences in learning outcomes when learning from textbooks of different qualities because the students, under the influence of their teachers' relationships towards textbooks, don't use textbook components that activate thinking because their teachers do not do so either. The study demonstrates that the way of using textbooks is strongly connected to the way teachers work. For example, students even perceived explanations of unknown words that can be found on the page border and that are supposed to help them understand the text as a disturbance, because learning is reduced to memorising the main text of the lesson (Antić, 2014). These insights imply that one of the great challenges in introducing digital textbooks to schools will be the way in which teachers use them, and how they guide students in using textbooks. Superficial and insufficient teacher training (and most teachers possessing less competences in the digital field than students) will be a huge obstacle to introducing digital textbooks in our schools.

Empirical research on the process of reading and understanding text

Alongside the general theoretical framework for examining the facts surrounding the nature of media (which was already presented with regards to

printed media) and lessons from printed media development, there is a more direct way of assessing the educational effects of digital textbooks. **What we have in mind is the empirical research on the effects of digital media itself or comparative research of the effects of printed and digital media.** There is little research for now on the outcomes of learning from printed or digital media.

For the purpose of this paper, it will suffice to demonstrate some results of a very rigorous analysis of empirical research focusing on the processes of reading and understanding printed and digital texts (Singer & Alexander, 2017). The authors have created an overview of almost all such research that has been produced in the past 25 years (from 1992 to 2017).

The authors have conducted a very rigorous and scrupulous analysis and accomplished the following: they have systematically examined all of the relevant journals and authors, and have compiled 853 pieces of research; they have defined clearly the selection criteria for the works analysed (the work had to include reading printed and digital text, the research had to be empirical, the research did not solely concern the attitudes and experience of the reader but must include objective tests for assessing the understanding of the text read).

Based on this criteria, 36 works have been chosen for a detailed analysis in light of aspects concerning a set of parameters, such as: is a definition of the reading process provided; is reading a single text or several texts analysed; is there data on the length and genre of the text; which data about the participants was gathered (age, school level, prior knowledge on the contents of the text etc.). The authors have also analysed the changes that have occurred in relation to similar research in the past 25 years (at this point we are leaving these conclusions aside).

To understand the findings of this research it is important to note that digital reading in the works analysed referred to **reading on digital devices and reading text that contained hyperlinks (hypertext or hypermedia)**. In this sense, the authors distinguish **digital reading** (in the sense of the previous sentence) from reading digital contents (for example reading on the internet or reading contents that possess all or most of the characteristics of digital media such as: multimedia, simulation, animation, linking to other sources of information, personalisation etc.). Thus, digital reading in the works analysed is reading texts that lack some of the crucial characteristics of digital media (e.g. multimedia, constant connectedness to other sources of information etc.).

At the end of this meticulous analysis, the authors came to some significant conclusions: reading printed and digital texts gives the same results if we monitor the readers' understanding of the basic theme of the text and their ability to find individual information in the text; reading printed texts provides better understanding when reading longer texts (the authors distinguish a short

text as being up to 500 words – approximately one page – and longer texts as more than 500 words); printed media results in deeper understanding of the texts if we apply tests of understanding that seek to measure the level of understanding the whole message of the text, or if we examine whether the readers go beyond the frame of the text and evaluate it or apply critical thought to it; the process of understanding the text is hampered if readers are required to navigate through the text; understanding the text depends on individual variables (age, school level, the assignment they get prior to reading (e.g. to memorise the read content; to answer questions after reading etc.)).

Despite the fact that the works analysed focused only on digital reading as reading continuous text with the possibility to establish hyperlinks (and without any other digital media characteristics), this analysis of well-chosen empirical research clearly demonstrates the potential negative aspects of digital media that must be overcome in the future development of these textbooks. These include issues such as: **reading and understanding digital texts brings significant issues when reading longer and more complex texts (continuous texts, for example explicative text and not descriptive text), or when we aim to achieve a deeper level understanding (for example the levels 6 and 7 in reading proficiency as measured by PISA).**

It is also not hard to see that these preliminary results of empirical research are mainly in line with the theory of digital media that indicates some essential issues of the media: that it is a medium characterised by "interruption technology", a "distracted mind"; that it leads to cognitive overload that hampers achieving deeper understanding of what is being read, and that it has some serious repercussions for the functional organisation of the human brain that manifests itself in all areas of life.

One of the goals of this overview of empirical research is to gain a more precise definition of the conditions that need to be met by further research. In this sense, the authors conclude that it is of utter importance to precisely define the following : what is the aim of reading a certain text (digital or printed); what is the nature of the text and what are its effects (continuous or discontinuous, multimedia or non-multimedia); genre of text (narrative, explicative, descriptive etc.); a more precise definition of the length of the text; and, especially, the interaction of the text genre and length, the general context of reading (school, exams, research), and students' individual characteristics (capabilities, level of knowledge, values etc.).[7]

7 With regard to the nature of the text and profficiency in understanding the text some authors use (unfortunantely not completely) the clasification of texts as it is given in the PISA definition – there are 7 levels of proficiency to assess reading: from finding isolated indiviual information in the text to the level of evalution and critical attitude towards the contents and structure of the text (OECD, 2017).

It is probable that we will see increasingly more empirical research that will achieve this level of precision and it is only research of this kind that can give us trustworthy insights on the educational efficiency of the best versions of printed and digital textbooks. This research must focus rigorously on defining **which categories of educational achievements can be attained with the help of one or the other of the types of textbooks. For example, which type of textbook is better for the following educational outcomes: finding basic information; gaining insight on the basic messages of the entire text; understanding the relationships among parts of a text; connecting text content to readers' life experience; forming conceptual knowledge; forming attitudes and values; critical analysis and evaluation of text; analysis of the relationship between reading and the purpose of reading a certain text.**

It is quite certain that reading digital contents and digital textbooks will be perfected. However, considering that digital textbooks are a relative novelty, publishers are more focused on producing textbooks that give the impression of being truly digital and attractive for children, but do not consider the issues discussed above that should be dealt with when producing digital textbooks. It is very likely that publishers do not have a complete insight on how problematic it is to adequately use powerful digital tools and yet avoid the significant issues that digital media creates by its nature in the process of constructing systems of knowledge, namely long-lasting and usable knowledge. This is probably the main reason why the "digital revolution" in education has not yet occurred and why the impact of digital media on education, according to world's leading promoters of the digital revolution, has thus far remained at the level of rhetorical claims about it creating a radical change in learning and teaching (Pešikan, 2016).

We can get some useful insights on digital textbooks from the experience of those countries that have gone further in the general process of digitalisation and mass production of digital textbooks.

South Korea has probably gone the furthest in this development. It is a big producer of digital devices and one of the leading countries in digitally revolutionising all spheres of life, and has progressed immensely in creating a general digital environment for its whole society. Its inhabitants massively use digital devices and there are also strong financial incentives for digitalisation in education.

With regard to digital textbooks, in 2007 the government of South Korea came to the decision that by 2015 the nation would start using digital textbooks at all levels of pre-tertiary education in all school subjects (this decision, perhaps hasty, was probably also influenced by the interests of a strong industry of digital devices). This is why it is important to study the experience of South Korea in this area.

Here are some insights from the experience of South Korea: the process of introducing digital textbooks continues but has to be constantly improved; the plan to shift to digital textbooks only in 2015 was not achieved, which is why a new process of introducing these textbooks after 2020 applies to some subjects and levels; printed textbooks remain alongside digital textbooks; there are only printed textbooks in the first two years of schooling; digital textbooks for different fields of knowledge require different design (social sciences, maths, natural sciences); digital textbooks have different effects on different parts of the population (e.g. children from rural or urban areas, children with different capabilities).

The basic reasons for the change in politics in the field of digital media (Koreabizwire, 2018) aregiving up the illusion that digitalisation in itself will bring about progress in quality education; frequent use of digital media can negatively affect students' health, about 12 % of children between 5 and 9 years have developed a true addiction to digital media; the educational effects of using digital textbooks are not really as big as they appear to be. Based on this, some notable American newspapers have concluded that the core message from the South Korean experience is that digitalisation has to be implemented with more consideration.

Conclusion

A digital revolution is taking place all over the world. Digitalisation in education is a reality of contemporary education and will surely develop further since there is no sign of giving up on digital media in education.

In the following years, with new generations of digital textbooks, we will also have more solid evidence on what kinds of educational outcomes can be achieved with the help of digital textbooks. A particularly big problem that requires creative solutions concerns using printed and digital textbooks for achieving specific educational aims and outcomes according to the advantages of each type of textbook.

One of the most promising approaches is creating hybrids of printed and digital textbooks based on the fundamental principle to take advantage of each of the media forms to achieve learning objectives where the particular medium, because of its characteristics, takes precedence. While the principle is clear, actualising them in practice appears to be extremely difficult (which has been demonstrated with the already existing examples of these textbooks).

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Digital Making in Educational Projects

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Digital Making as an Educational Project is an innovative educational experience that has been carried out with students of the Primary Education and Social Education degrees for three consecutive years. The experience introduces digital making as an activity in which students create an object using digital technology. In the process, they not only gain an insight into how the technology works, but also learn the content and competences of the curriculum. This innovative teaching practice was carried out as action research in order to improve traditional higher education practices. In this sense, the proposal puts the student at the centre of the process as the author and protagonist of their own learning process. The experience is based on their own interests: they decide what to make based on a given context. The students work in groups and look for what they need to learn to overcome a particular challenge, while the teacher supports the process as a facilitator, offering guidance and resources when necessary. The evaluation of the whole process is regulated via a group diary (a shared online document) and an individual diary (a blog) that the students produce. The final evaluation is not only of the printed product; the students also produce a video in the form of storytelling, in which they explain how the process evolved from the initial idea to the final impression of the object. They also reflect on what they have learned, how teamwork has worked and what possibilities they believe digital making offers in the primary and non-formal educational contexts in which they will work. All of the processes are compiled in the students' blogs, as well as in the teachers' field notebooks. The experience was executed in collaboration with the Digital Fabrication Centres of Barcelona. The results were organised to highlight the strengths and weaknesses of using technologies to improve higher education offering an approach in which students are at the centre of the whole process. Strengths: strong student motivation, promotion of self-directed and collaborative learning and learning by doing, and familiarisation with

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a transforming integration of technology as protagonists. Weaknesses: hesitance and resistance to facing the challenge, management of scarce time, large time investment by the teachers, and the difficulty of achieving in-depth reflection on how digital fabrication could be introduced in educational contexts such as primary school and non-formal contexts.

Keywords: educational innovation, ICT, making, autonomous learning, collaborative learning

Digitalno ustvarjanje v izobraževalnih projektih

Alejandra Bosco, Noemí Santiveri in Susanna Tesconi

Digitalno ustvarjanje kot izobraževalni projekt je inovativna izobraževalna izkušnja, ki jo že tri leta zapored izvajamo s študenti smeri osnovnega in socialnega izobraževanja. Izkušnja uvaja digitalno ustvarjanje kot aktivnost, v okviru katere študentje ustvarijo predmet s pomočjo digitalne tehnologije. V tem procesu ne pridobijo le vpogleda v to, kako tehnologija deluje, ampak usvajajo tudi kurikularne vsebine in kompetence. Z namenom izboljševanja tradicionalnih visokošolskih izobraževalnih praks je bila ta poučevalna praksa izvedena kot akcijsko raziskovanje. V tem smislu predlog postavi študenta v središče procesa kot avtorja in nosilca lastnega učnega procesa. Izkušnja temelji na njihovem lastnem interesu: sami se odločijo, kaj bodo naredili glede na dani kontekst. Študentje delajo v skupinah in ugotavljajo, kaj se morajo naučiti, da lahko presežejo določen izziv, medtem ko učitelj postopek podpira kot spodbujevalec ter po potrebi nudi usmeritve in vire. Evalvacijo celotnega procesa usmerjata skupinski dnevnik (skupni spletni dokument) in individualni (blog) dnevnik, ki ju ustvarjajo študentje. V okviru končne evalvacije ni ocenjen le natisnjen produkt, ampak tudi videoposnetek v obliki pripovedovanja zgodbe, v kateri študentje pojasnijo, kako se je proces razvijal od začetne ideje do končnega vtisa predmeta. Študentje prav tako reflektirajo o tem, česa so se naučili, kako je potekalo skupinsko delo in o možnostih, za katere verjamejo, da jih ponuja digitalno ustvarjanje v osnovnošolskem in neformalnem izobraževalnem kontekstu, v katerem bodo delovali. Vsi procesi so zbrani v študentskih blogih pa tudi v učiteljevih terenskih zapiskih. Izkušnja je bila izpeljana v sodelovanju z Digital Fabrication Centres iz Barcelone. Rezultati so bili organizirani tako, da so poudarili prednosti in slabosti uporabe tehnologij za izboljšanje visokošolskega izobraževanja z omogočanjem pristopa, v katerem so študentje v središču celotnega procesa. Prednosti: visoka motivacija študentov, spodbujanje samousmerjajočega, skupinskega učenja in učenja z delovanjem ter seznanjanje s transformativno integracijo tehnologije kot protagonistke. Slabosti: omahovanje in odpor do spoprijemanja z izzivi, upravljanje z omejenim časom, velik časovni vložek učiteljev in težave pri doseganju poglobljenega premisleka o tem, kako

bi lahko digitalno izdelovanje vpeljali v izobraževalne kontekste, kot sta osnovnošolski in neformalni.

Ključne besede: inovativnost v izobraževanju, IKT, ustvarjanje, avtonomno učenje, skupinsko učenje

Justification of innovation: Digital making as an educational project

The integration of technology into educational contexts in Catalonia and the rest of Spain has been dictated more by the purchase and introduction of artefacts than by the development of educational innovations aimed at improving education. This has also occurred in the international context. Many studies show that, despite the increase in technological resources in schools, the pedagogical practices of teaching staff continue to be anchored in so-called traditional education. There are few experiences and projects that lead to an improvement understood as the establishment of a pedagogy linked to new ways of creating knowledge and offering students and the group greater protagonism when learning (Area, 2008, 2011; Balanskat, Blamire, & Kefala, 2006; Bosco Paniagua, Larraín Pfingsthorn, & Sancho Gil, 2008; Bosco, Sánchez-Valero, & Sancho, 2016; Condie & Munro, 2007; Cuban, 1993; Meneses, Fàbregues, Jacovkis, & Rodríguez-Gómez, 2014; Sancho, 2006; Sancho & Alonso, 2012; Sigalés, Mominó, & Meneses, 2007; Sigalés, Mominó, Meneses, & Badía, 2008).

Nevertheless, some of the technological resources that could be considered tendencies today, such as robotics and programming, increased reality, open educational resources or the social web, are perfectly compatible with supporting this type of educational innovation. This is also true of digital fabrication or making, on which the innovative educational experience presented in this paper is based.

Although making and the DIY philosophy on which it is sustained are very complex social phenomena that affect different spheres of social and economic life (Tesconi, 2018), the ideas and practices that characterise them are very significant for those interested in the creative integration of technology in educational contexts, linked to active pedagogy and promoting self-directed learning based on investigation.

More specifically, the maker movement (making or maker culture) refers to a growing number of people who mainly share an interest in making things themselves (DIY), in the use of digital tools to create objects, and in sharing and collaborating online around these questions. The maker culture emphasises learning through working in a social atmosphere, on the web and motivated by self-production (Dougherty, 2013; Halverson & Sheridan, 2014; Martin, 2015; Tesconi & Arias, 2015, Tesconi, 2015, 2017, 2018).

The basic infrastructures that enable the development of the maker culture are fablabs, makerspaces and virtual communities, together with a series of technological tools including both software (e.g., 3D design programmes) and

hardware (e.g., 3D and laser printers), which enable the design and finally the physical creation of the objects, respectively. Although digital fabrication refers more to the tools used for creating objects, and making more to the interpersonal dynamics that allow the construction of joint knowledge, both are two sides of the same coin.

In recent years, the spread of rapid prototyping tools (a technique used to manufacture articles via 3D printers) and digital manufacturing laboratories (Fab Labs: Fabrication Laboratory), which facilitate the design and construction of objects, has given rise to a movement to democratise technology. It is a movement that is also making its presence felt in formal and non-formal education through various programmes, some linked to the integration of robotics and programming, whose presence has been gradually increasing in education since at least 2012 (Acción Cultural Española -AC/E-, 2015; Orange Foundation, 2016; Informe Intef, 2018). In particular, in the last five years in the USA, educators have taken an interest due to the high failure rate in the spheres of science and technology. More specifically, in 2012, the Obama administration launched a programme to implant these spaces (fablabs or makerspaces) over the subsequent four years in more than one thousand schools, providing them with suitable tools for digital making (Orange Foundation, 2016). Initiatives based on the maker philosophy have also begun to be implemented in the Spanish State, in the spheres of both formal and non-formal education, leading to programmes aimed at diverse groups of children and young people, developed by public and private institutions. Some examples of these initiatives in the Spanish State are: 1) The fabLab of the *Liceu Politécnic of Rubí* (Province of Barcelona) of the FabLab@School initiative promoted by the Transformative Learning Technologies Lab of the University of Stanford, which proposes the creation of a FabLab in each school as a learning resource. The *Liceu Politecnic* offers digital fabrication and maker-centred learning environments for middle and high school students. Since 2014, the project has involved approximately 80 students and 4 teachers. 2) The Young Aspies Makers, a result of public-private collaboration aimed at young people with Asperger's, who develop 3D printing projects to improve the autonomy of disabled persons (Barcelona). This project, started in 2015, has had three editions of the two-week workshops, involving 30 students aged between 15 and 18. 3) The digital making workshops for young people of *Xtreme*, a non-profit association in Almendralejo (Extremadura), where an after-school programme aimed at raising the awareness of digital fabrication technology has been implemented. 4) *AuLAB*, in Asturias, the result of collaboration between the public art centre *LABoral Centro de Arte* and the local education ministry. It is the first implementation in the Spanish State

of digital fabrication and making in formal educational contexts. The project took place from 2012 to 2016 and involved 72 public schools (from primary to secondary), 45 teachers and 285 students over a nine-month period (Orange Foundation, 2016). In addition, the *Digital Fabrication Cultural Centres* in the city of Barcelona, with which we have collaborated in this experience, have a pedagogical programme aimed at bringing digital manufacturing and making to schools.

More specifically, in the words of Martin (2015, p. 31), we can say that making refers to "A class of activity focused on designing, building, modifying, and/or repurposing material objects, for playful or useful ends, oriented toward making a 'product' of some sort that can be used, interacted with, or demonstrated. Making often involves traditional craft and hobby techniques (e.g. sewing, woodworking, etc.) and it often involves the use of digital technologies, either for manufacture (e.g. laser cutters, CNC machines, 3D printers) or within the design…"

Dougherty (2013) synthesises make culture as: 1) A human activity originating from an individual interest in wanting to create an object, environment or system that is important for the person who creates it and/or for their environment. The driving force behind it is a ludic attitude, while the maker is a person who plays with technology to learn about it. 2) An activity that promotes a positive attitude towards the acquisition of knowledge. The motivation generated by personal interest and free choice encourages the learning of the skills and know-how needed to continue creating. The apprentice is responsible for and chooses his/her own learning path. 3) An activity that values mistake-making as a fundamental resource, capable of activating new learning processes; and 4) A highly collaborative activity based on sharing ideas and projects, as well as on supporting others in their creative processes.

All of these characteristics mean that making is an ideal practice for those who want to promote the educational improvement mentioned above; in other words, starting from the DIY philosophy, promoting authorship, digital competence based on production rather than the mere consumption of information, creativity, self-directed learning, and working from the genuine interests and investigations of the students themselves (Buckingham, 2003; Blikstein, 2013; Hsu, Baldwin, & Ching, 2017; Peppler, Halverson, & Kafai, 2016). On the other hand, these are actions sustained by what we know about how to learn better if we want to promote competent subjects for 21st century society (Bosco et al., 2008; Hernández, 2006; Stoll, Fink, & Earl, 2004). With this in mind, making can be considered an educational practice based on investigation (Vossoughi & Bevan, 2015), compatible with working through projects and collaboration.

This philosophy is what gives sense to the experience of teaching innovation presented in this article, for which we provide the context and the main characteristics in the following sections.

Contextualisation of the experience

The experience of innovation, *Digital Making as an Educational Project*, was undertaken in the subject *Educational Communication and Interaction II*, which is a basic training subject of the first year for teacher training degrees in Infant and Primary Education, Social Education and Pedagogy of the Faculty of Education Sciences at the Autonomous University of Barcelona. The majority of students enrolled in this subject are between 18 and 20 years old. The subject has six credits and is divided into two clearly differentiated thematic blocks: Technologies of Learning and Knowledge, and Groups and Emotions. One of its main objectives is to develop skills for the use of information and communication technologies at the service of learning and teaching, and for working in collaboration. To achieve these objectives during three consecutive academic years, in two of the eight groups in the subject we have developed a methodology inspired by the philosophy of the DIY movement, in work projects introducing 3D modelling and digital fabrication as an example of the creative integration of technology in educational contexts, based on the creation of objects. The proposal has been made possible thanks to collaboration with the Consortium of Education of Barcelona[4] by means of joint work with the *Ateneu de Fabricació Digital de Ciutat Meridiana*[5] (similar to a FabLab, but of a public nature), one of three centres in the city. Knowledge related to making and digital fabrication (process, software, approach) was new to the students, who generally deal with overall office automation and social media software.

The proposal was executed over three consecutive years – the 2015/16, 2016/17 and 2017/18 academic years – resulting in an extensive exhibition in 2017/18 to coincide with the 25th anniversary of the Faculty of Education Sciences of the Autonomous University of Barcelona, at which all of the objects created were on display, along with the learning experiences resulting from graphic resources (posters) and audiovisual media (videos). The next section details the more specific characteristics of the experience.[6]

4 For more about the Consortium, see: https://www.edubcn.cat/ca/el_consorci.

5 Barcelona currently has three centres located in different parts of the city: the districts of Les Corts, Barceloneta and Ciutat Meridiana.

6 The video at https://www.youtube.com/watch?v=tshye8BoWoI&t=4s illustrates the experience as part of the exhibition.

Figure 1. Image of the exhibition of projects on the 25th anniversary of the Faculty of Education Sciences.

Figure 2. Image of the poster for the exhibition.

The experience itself: Main features

The subject with six credits is organised around several classroom-based sessions with a total of 18 hours, involving content related to the integration of ICT for learning and collaboration work. The students must also complete another 45 hours of self-directed work outside the class. The majority of the classroom-based sessions are focused on the development of practical activities around the projects defined by the students for the production of an object with the support of the teaching staff, who act as guides. Also included are

activities supervised by the teaching staff, such as tutorials, which are not only classroom-based but also virtual (online).

The development of the experience is organised around three stages:

Introductory Stage. This stage consists of an introduction to digital manufacturing or making and its significance in current educational contexts, an initial approach to 3D design software, and a visit to the *Ateneu de Fabricació* to discover the machines and attend a 3D design workshop. This visit ends with the printing of some of the objects designed by the students. In these sessions, the work is mostly individual and deals with producing a very simple object, which enables the students to discover the field of work and to find out about the software and machines.

Design Stage. This corresponds to the design process of the object itself. It is a stage that is always undertaken in work groups, starting from the definition of the object the students want to create (work project) under the guidance of the teaching staff. Generally speaking, the object is framed within a more global educational project that gives it meaning; for example, if the idea is to create a game to promote mathematical thought, the underlying project could be to offer a more entertaining way to work with mathematics. This design stage is the most extensive stage, and is usually divided into three moments: a) definition of the object to create (and of the project in which it is framed), b) design of the object as a physical model (using paper, card or the most appropriate material) with the real measurements that it will have, and c) digital design of the object with the Tinkercad programme or similar.

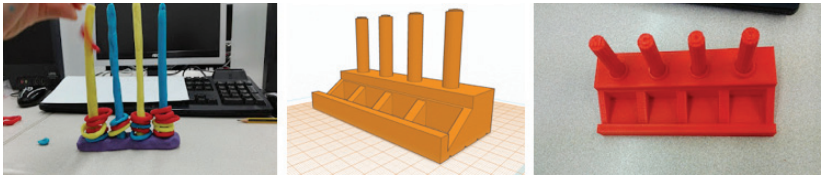

Figure 3. Image illustrating the production process from the model, through the digital design, to the final impressed object.

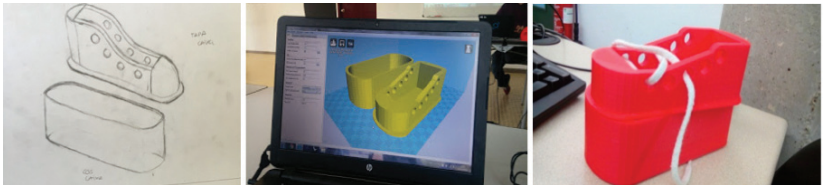

Figure 4. Image illustrating the production process from the model, through the digital design, to the final impressed object.

Production Stage. This stage represents the moment of impression, either cut or engraved depending on the machine used, in the *Ateneu de Fabricació Digital*, preceded by a study of the preliminary digital designs in order to make the final modifications to adapt each proposal to: 1) the possibilities of the hardware (the type of machine that should be used); 2) the impression time; and 3) the material available (wood, card, PLA – polylactic acid, biodegradable, derived from maize – or another). This stage takes place entirely in the *Ateneu de Fabricació Digital*, thanks to the collaboration established between the Consortium of Education of Barcelona and the university.

Figure 5. Images showing some of the impressed objects.

Final Evaluation and Diffusion Stage. This stage has two parts. 1) Development and presentation of the visual narrative that documents the whole process, from the original idea to the manufacturing fact. This narrative becomes one of the main elements of the final evaluation and takes the form of "digital storytelling" (DST) that documents and reflects on the learning process. DST or digital storytelling is a means used to tell and reflect on stories in depth using digital multimedia tools. Applied to the field of evaluation, it offers detailed information about the learning process (qualitative evaluation) as well as being a social communication tool for diffusion (Couldry, 2008). It is assumed that the student has been compiling all of the audiovisual material (videos, photographs, audio, screenshots, etc.) so as to be prepared to tell the story immediately after the process of impression of the objects. This narrative normally consists of a video of no more than three minutes and a poster. The idea is for the student to reflect on the whole process followed in terms of what they have learnt, and on the possibilities that the proposal might offer other educational contexts, especially the students' future working environments. This presentation is done in the class group. 2) Exhibition of the objects, posters and videos (in QR format from the poster) in the context of the group on completing the subject by each seminar participant (each group of the subject is divided into three seminars, each of approximately 25 students who undertake the course consecutively from September to June). For the 25th anniversary of the Faculty of Education Sciences (UAB), the exhibition was opened to the whole faculty, teaching staff and students for a period of 15 days.

Figure 6. Posters showing the objects produced.

Methodology approach

This experience of teaching innovation had the clear aim of introducing an improvement, so it was proposed as action research. As such, it represents a small-scale intervention in the functioning of the real world and an analysis of its effects. Its aim is transformation; later, when the time is right, it establishes the basis for reaching theoretical conclusions, thus generating theory from practice (Elliot, 1991). More specifically, it is a design of research-action oriented towards decision-making from a practical point of view, as the aim is to improve and transform the educational proposals.

Although this article presents the results obtained from its implementation in the teacher training degree in Primary Education, the innovation was undertaken in two groups of the subject (*Educational Communication and Interaction II*), with students from both Primary Education (178 students) and Social Education (249) throughout three consecutive courses (from 2015 to 2018) involving two teachers (full-time staff) and one assistant with experience in making, who worked in collaboration.

The data were compiled through observation of the teaching staff and through their field notes, as well as through the diaries of the students, who documented the entire process in both group and individual diaries. The former documented the work done from session to session, while the latter were used to document the learning process: what the students' needed to know, where they felt they were weaker, which resources they needed to look for, all in order to make decisions that would lead to an improvement in their individual performance and, consequently, the performance of the group. Another source of data was the self-evaluation that the students completed at the end of the subject. In addition, all of the graphic and audiovisual material produced (videos and posters) also constituted a source of data (Dussel & Gutiérrez, 2006; Van Maanen, 2011). Content analysis (Flick, 2004) was undertaken, looking for issues that helped achieve the aims of the innovative experience, as well as other issues that were obstacles. Some of the categories that emerged coincide with those that promote or hinder educational innovation and the innovative use of

technology, such as the kind of curricula (pre-established or not), the degree of student autonomy, the learning approach or the organisation of time and space (Area, 2008, 2011; Sancho & Alonso, 2012).

Results and discussion

The results are organised around the strengths and weaknesses of the experience. This enables us to visualise the issues that can be relied on to continue the project or implement another similar experience, while highlighting the aspects that require redefinition.

Strengths

We find the strengths in the motivation and involvement of the students throughout the process, and in the effects that the promotion of self-directed learning – in collaboration and through doing and research – had on the student body. Not only with regard to what was learnt, but also the way in which it was learnt. Finally, the value given to the experience as an example of the meaningful integration of technology in the educational context.

Motivation, initiative and implication

One of the main results of this experience was the high degree of motivation that the student body experienced, resulting in it undertaking all of the tasks necessary to successfully complete the process of producing the object. The main source of this motivation was the fact that the students themselves were allowed to decide what to do. They therefore worked based on their own interests, for which they were prepared to do whatever was necessary, that is, to produce an object that motivates them. This generates a different level of commitment than merely following a remote syllabus. The challenge also activates all of their potential. Both of these characteristics have been shown to be very positive in producing authentic learning (Bosco et al., 2008; Hernández, 2004, 2006; Stoll et al., 2004). Recent studies based on neuroscience also state the importance of motivation to learn, and how this is strengthened by the focuses of alternative teaching, among other factors (Calatayud Salom, 2018; Navarro, 2018). Moreover, other experiences based on DIY philosophy coincide in the positive evaluation of the students regarding working from their own interests, with digital devices, in different spaces and autonomously (Domingo, Onsés, & Sancho, 2018; Miño, Domingo, & Sancho, 2018). Some students expressed their motivation and interest in the following way:

> "Once we had finished the subject, I discovered that through technology it is also possible to learn in a very useful way, boosting the autonomy and creativity of the children so they don't always have to do what the teachers tell them, following established guidelines." (student self-evaluation)
>
> "Most important, however, is that at all times we were motivated to do the project and we ably dealt with difficulties that arose throughout it …" (student diary)
>
> "The motivation and commitment of the students is very high in this project." (field notes - teacher)

These results contrast with making experiences undertaken with teachers, who felt very uncomfortable in this type of open syllabus in which they learn what they need as they go according to the project to be developed (Tesconi, 2017, 2018).

Working based on projects: Self-directed learning and collaboration

Working collaboratively but in a self-directed process based on the development of a project was another strength of the experience. This had multiple benefits, as the students say they learned: 1) to work in a team, 2) to share interests with their colleagues, 3) to place the common interest above the individual, 4) to share knowledge more easily and support the qualities of each member, 5) to open up to the group, to listen to the proposals of colleagues and respect their opinions and ways of working, and 6) to organise themselves. All of these aspects are particularly strengthened in the proposals based on projects that prime the social nature of the learning (Hernández 2004, 2006). Moreover, these questions have already been documented in the literature about collaborative learning and project-based work (Hernández, 2004, 2006; Lobato, Apodaca, Barandiarán, & San José, 2010; Romero & Guitert, 2012; Stoll et al., 2004). They are also central to other experiences based on DIY in which students value positively self-directed learning in collaboration (Domingo et al., 2018; Miño et al., 2019; Tesconi, 2018). Finally, collective work is also highly valued from the perspective of neuroscience and neurodidactics as an element that favours learning (Navarro, 2018). This is how the students referred to collaborative work:

> "I think the fact of working in a group is a very positive aspect. The fact that there are diverse points of view and sharing knowledge always enriches you as a person. Moreover, when a member of the group had a difficulty everyone responded in order to solve it." (student self-evaluation)

> "… I'm learning to work with people I didn't know, all of us getting involved in a totally unknown world for us, since we had never worked with programmes like this. Therefore, I've been able to learn to make these programmes work, to bring cohesion to a group making the most of the strong points of each one." (student diary)

Offering an experience of the meaningful integration of technology

The experience developed enables the students to experience first-hand a project that breaks with traditional pedagogy by integrating technology. In other words, the students worked on the content of the subject in an experimental way, which, it is assumed, will help them to transfer it to their future working contexts. This is how the students express it:

> "When we finished the subject, I learnt that you can also learn in a very useful way through technology, boosting the autonomy and creativity of the children …" (student self-evaluation)
>
> "The experience in the first person that may involve, from the point of view of learning, a significant integration of technology in educational contexts." (field notes – teacher reflections)

Weaknesses to address

We see the main weaknesses in the caution and resistance shown when designing projects and thinking of objects to create, and in the short duration of the experience. Another weakness is the difficulty that the students had documenting their learning process and reflecting on it personally and deeply.

Caution, resistance and frustration

Despite having a motivating effect, the fact that the students themselves decided which project they were going to develop also caused a certain blockage and concern. In reality, having to decide places the students in a new situation, which is not free of tensions. Consequently, they initially tried to adopt simpler ideas, something that Blikstein (2013) calls the "keychain syndrome".[7]

These tensions have also been experienced in other DIY activities, and result from placing the student in an active role. Making their own decisions

7 "The *keychain syndrome*… revealed two of the crucial elements of learning environments based on digital fabrication. First, the equipment is capable of easily generating aesthetically attractive objects and products. Second, this generates an incentive system in which there is a disproportionate payoff in staying a 'local minimum' where the projects are very simple but at the same time highly admired by external observers. Settling for simple projects is a temptation that educators have to avoid at all cost." (Blikstein, 2013, p. 10)

produces a certain insecurity in students (Miño et al., 2019; Tesconi, 2017, 2018):

> "Choosing the object we would make was not as easy as we had initially thought …" (student diary)

Another moment of insecurity and frustration occurred in the production stage, when the students had to modify the prototypes (the first version of the objects designed) to adjust them to the printing time or the materials available, and when, occasionally, the product did not turn out as expected. Some students experienced an error as failure rather than as a normal step in the process:

> "Then, the technicians told us that we had to separate the whole structure, to print it with laser, and add some fittings to each part so that it could be properly joined together. Hearing this the first time was quite stressful for us, since we had spent many hours of work making the structure and now it couldn't be printed. But with patience and effort, gradually between everyone we tried separating the whole structure and placing the fittings." (student diary)
>
> "Today, the teacher brought us the printed object, since on the last day we ran out of time in the Ateneu. Personally, I really enjoyed seeing the object physically, but there had been a problem with the measurements and it came out smaller than we had expected and we had to reprint the images of the puzzle. In any case, we were very happy to have arrived at the final point of this project." (student diary)

Management of scarce time and different spaces

Organising the times in the university and the production centre had its difficulties, given that we had to connect two institutional spaces with different logics of functioning. However, the main problem was the scarce and fragmented working time that we had for the project. This problem is extensively documented in the bibliography, which refers to school grammar (Tyack & Tobin, 1994) as the main drawback to developing innovative educational projects of whatever type (Bosco, 2005, 2013; Sancho & Alonso, 2012). It does not calculate the time required to learn in accordance with the tasks to be undertaken, but based on what the institution offers us. This question is as difficult to solve as how to organise the time in the university:

> "Finally, as a summary of the whole process, I think that all of the members of the group have worked really well… the only inconvenience I have had is time. I think that a project like this one, in order to be efficient and for it to be a more useful project in our everyday life, requires

more time, so that it can be executed better, with more attention paid to small details." (group diary).

"What I think has lacked in the learning of the subject is the time factor; due to the lack of time, we have not been able to study the questions in depth." (student self-evaluation).

Investment of time by the teachers and other tensions

As with the students, the change of perspective also produced a certain tension among the teachers, who became the guides for the project decided upon by the students. On the one hand, this guide requires instructions tailor-made for each group, which involves a major time investment, seeking out the appropriate resources and materials that can help the students to take the proposal forward. On the other hand, it involves entering a new world, that of digital fabrication, in terms of knowing the suitable programmes and the possibilities of the machines. All of this requires a major time investment, which is only reduced by the experience accumulated year after year:

"I have already explored three different programmes to meet the needs of the different projects, I don't know if the project will be sustainable in the long term." (field notes - teacher)

The new role requires overseeing a process in which not all of the answers are known. Sometimes it involves inquiring jointly with the student. In this particular situation, the first year of the experience was difficult to deal with, but the experience of the three years has allowed us to create strategies to guide the process in order to achieve success.

Difficulties in documenting the experience

Teaching processes that promote metacognitive processes are very positive in terms of learning (Calatayud Salom, 2018; Hernández, 2006; Bosco et al., 2008; Navarro, 2018; Stoll et al., 2004). An important part of this experience is therefore dedicated to documenting the processes undertaken through diaries and graphic documents such as storytelling. However, it is not easy for the students to document the process in depth. Many of them focused more on the technical and factual knowledge they acquired, such as the computer programmes they had learnt to use or the occasional work with a tool, rather than on the problems they had in their approach, or how they had been affected when their ideas were accepted or rejected:

"…We have finished today's session with all of the preparations for having the object and the exhibition ready for the next class. We have made

> the video explaining the whole procedure of the project with Moviemaker, and we have also made the poster…" (individual student diary).

It is more towards the end of the whole process that the participants are capable of undertaking deeper reflection on what has happened, what they have learnt and how. This is due to the small amount of experience they have in participating in more thoughtful teaching and learning processes. Once they have this experience, they are capable of evaluating it in another way:

> "Nevertheless, I liked it very much that we didn't just do the physical project and that was that; we also had to write a diary of creation, make a video explaining the process, make a poster… It has been quite a complete subject." (student self-evaluation)
>
> "It has also been very useful doing this personal blog in order to explain everything we have been learning. I have liked this format of evaluation very much." (student self-evaluation)

This difficulty is also evident in similar experiences with teachers, who were not able to recognise the usefulness of the documentation, viewing it more as a tool of control (Tesconi, 2017, 2018).

Little reflection on how making could be introduced into educational contexts

The experience is undertaken in a short and fragmented time, with the addition of the necessary coordination with the production centre. Nearly all of the efforts are concentrated in the production of the object, and only at the end is there space for pedagogical reflection, as future teachers, about the possibilities of integrating making into educational contexts. Such integration would be aimed at developing projects that, through making and production, would enhance the development of competences and enable the future teachers to approach different educational and curricular objectives. This reflection rarely occurs, and usually not until the end, without the possibility of going deeper into the experience or testing how a project of this nature could be designed. Nevertheless, some students, albeit very generally, questioned the specifics:

> "Personally, I think that all of these new concepts that I have acquired have enabled me to know much more about the digital world. Today, technology is a very important factor in our lives, and so it will be in education, too. This is why I consider that all of the knowledge I have gained after completing the subject will be good for me as a future teacher." (student self-evaluation)

> "Throughout this process of the creation of the project, I have asked myself diverse questions, most of which have been in relation to the functioning of the Tinkercad programme. But I have also asked myself how a subject related to the creation of digital making could be applied to primary school classrooms." (student self-evaluation)

Conclusions

The experience developed shows the possibilities that making and digital fabrication can offer to innovation, and exemplifies the meaningful integration of technology in educational contexts in terms of learning. The experience is strong due to the motivation produced in the students by working on a project based on their own interest. This is also true of the challenge represented by the development of the project, although it produces tensions, too. The setting of the group in which the project develops helps achieve the objectives and increases the possibility of success, while also enabling students to learn how to work together. As with innovations, however, there are barriers related to the fragmented organisation of time that make the realisation of the project difficult, as it requires more time of both students and teachers, given that the roles to be carried out are distinct. A much more reflexive teaching and learning subject is sought, in an undertaking that must adapt to each situation, and where there are no written rules about exactly how and where it is going. The sustainability of the proposal lies in being able to solve these difficulties in order to multiply the benefits, making it extensive to other groups of the subject and in other contexts. In summary, the results contribute to acquiring the ability to manage this kind of innovative project and to use information and communication technologies in a university where content-centred and teacher-centred teaching approaches are predominant.

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Leveraging Emerging Technology to Design an Inclusive Future with Universal Design for Learning

Don Douglas McMahon*[1] and Zachary Walker[2]

The aim of this article is to explore the opportunities and challenges that arise with the proliferation of new technology, to provide an understanding of why it is important to try new strategies in education, and to provide an inclusive framework for experimentation using tools such as robotisation, automatisation, artificial intelligence and immersive learning. Significant challenges exist in implementing transformative technologies with a limited or non-existent evidence base for their use, and designing inclusive educational experiences with a limited evidence base is even more challenging. In order to address this need, the article presents some ways in which educators can make informed implementation decisions around these new tools. First, we examine the rule of the least dangerous assumption, which supports trying new technologies even if the evidence base is lacking. Next, we present a strategy that educators can use to apply the research-based framework of UDL in order to make informed implementation choices with new technologies. Finally, based on information gained from experience in providing professional development, school level implementation, individual student interventions and teacher focus groups, we offer some recommendations for practice. We present several fun propositions that can help create a culture to support educators as they endeavour to create inclusive educational experiences with emerging technologies. We also explore current trends in technology use, describing and providing practical examples of implementation and integration to support a more inclusive future with emerging technologies.

Keywords: educational technology, universal design for learning, accessibility, immersive technology

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Izkoriščanje porajajoče se tehnologije za oblikovanje vključujoče prihodnosti z univerzalnim modelom za učenje

Don Douglas McMahon in Zachary Walker

Namen prispevka je raziskati priložnosti in izzive, ki vznikajo z množitvijo novih tehnologij, ponuditi vpogled v razloge, zakaj je pomembno preizkušati nove strategije v izobraževanju, in ponuditi vključujoč okvir za eksperimentiranje z uporabo orodij, kot so: robotizacija, avtomatizacija, umetna inteligenca in potopitveno učenje. Pri implementaciji transformativnih tehnologij, za uporabo katerih stoji le malo ali nič podpore v dejstvih, obstajajo številni izzivi, še toliko večji izziv pa predstavlja oblikovanje vključujočih izobraževalnih izkušenj, za katere prav tako obstaja le omejena podpora v dejstvih. Da bi naslovili to potrebo, v prispevku predstavljamo nekaj načinov, na katere lahko izobraževalci opravljajo informirane odločitve glede implementacije teh novih orodij. Najprej bomo preučili pravila najmanj nevarne predpostavke, ki podpira preizkušanje novih tehnologij, tudi če manjka podpora dejstev. V nadaljevanju bomo predstavili strategijo, ki jo izobraževalci lahko uporabljajo za implementacijo na raziskovanju utemeljenega okvira UDL, ki omogoča sprejemanje informiranih odločitev o implementaciji novih tehnologij. V sklepnem delu bomo na podlagi informacij, ki smo jih pridobili iz izkušenj v izvajanju strokovnega razvoja, implementacij na ravni šol, posegov na ravni posameznih učencev in fokusnih skupin z učitelji ponudili nekaj predlogov za prakso. Predstavili bomo nekaj zabavnih predlogov, ki lahko prispevajo k ustvarjanju kulture, ki izobraževalce podpira v njihovih poskusih ustvarjanja vključujočih izobraževalnih izkušenj s porajajočimi se tehnologijami. Prav tako bomo raziskali trenutne smernice v rabi tehnologije ter opisali in ponudili praktične primere implementacije pa tudi integracije, ki s porajajočo se tehnologijo podpirajo bolj vključujočo prihodnost.

Ključne besede: izobraževalna tehnologija, univerzalni model za učenje, dostopnost, potopitvena tehnologija

Introduction

If an education revolution is going to occur through the adoption of new technologies, now is the time to begin the design process in order to make this new educational paradigm as inclusive as possible. Robotisation, automatisation, artificial intelligence and immersive learning tools will lead to new opportunities in education with wide-ranging implications, as we prepare learners for this shift in employment opportunities, social activities and broader engagement with the world. The aim of this article is to explore the opportunities and challenges that arise from using new technologies in education, and to provide a path to implementation. This implementation path is based on the following elements: One Rule, a research-based framework, and five propositions to guide educators seeking to effectively use emerging technologies in education.

In addition to certain challenges that new technologies may create, it is also important to recognise the potential for positive applications of these new tools to empower a more inclusive world. In 1988, Mary Pat Radabaugh, a director at IBM, stated, "For most people technology makes things easier. For people with disabilities, however, technology makes things possible. In some cases, especially in the workplace, technology becomes the great equalizer and provides the person with a disability a level playing field on which to compete". It is important that we design technology with this in mind: for individuals with disabilities, technology is not a luxury but a necessity. The current exponential rate of technology development presents educators, students and other stakeholders with some unprecedented challenges. A simple example of this challenge is how quickly new technologies become widespread. Consider that the telephone took 75 years to reach an audience of 50 million users, while the mobile app Angry Birds only needed 35 days to reach 50 million users (Aeppel, 2015). While Angry Birds is just a mobile game app not focused on education (but still really fun), it is a prime example of the challenges educators face connecting rapidly emerging technology to curriculum and instructional strategies.

This exponential rate of technology adoption is partially made possible by the changing way software and devices have allowed users to individualise their devices with the tools available on mobile app stores. Individuals with disabilities report that the introduction in 2008 of the Apple app store, which has apps that can customise the phone for their personal use, was life altering for them and their families (Aquino, 2018). One common example of this is the augmentative and assistive communication (AAC) app Proloquo2go and its benefits for individuals with complex communication needs (Flores et al., 2012). This mobile app allowed families to customise their own mobile devices to support the communication

needs of students with complex communication needs. This combination of mobile devices and a mobile app allowed families to have access to high quality AAC tools at a fraction of the cost of previous specialised AAC devices (Edyburn, 2013).

The Rule (The Least Dangerous Assumption)

While in many cases it is difficult to determine what will work best when using a new technology, educators have to use their best judgement, which must be based on the premise of the *least dangerous assumption*. The least dangerous assumption is a rule that specifies "in the absence of conclusive data, educational decisions ought to be based on assumptions which, if incorrect, will have the least dangerous effect on the likelihood that students will be able to function independently as adults" (Donnellan, 1984, p. 141). For example, the proliferation of the iPad in schools took place before evidence-based practices for their use had been established (Ayres, Mechling, & Sansosti, 2013), probably because educators perceived its usage to be non-detrimental. Prior to the release of the iPad, tablet computers had already been in use in classrooms as an educational tool. The iPad, however, facilitated both the creation of new educational material (digital books, magazines, etc.) and the installation of educational software available in the form of mobile apps (Ireland & Woollerton, 2010), thus proving to be a flexible and significant classroom aid for both teachers and students. The same is likely to be true of other emerging educational technologies.

If we are going to take advantage of new technologies to create an inclusive world, however, it is important that we strive for inclusion and accessibility, so that all people can benefit from these new learning resources. We view this as a Prime Directive for educators: when in doubt about using a new technology, return to the least dangerous assumption. In a time of rapid technology adoption and innovation, we need to apply the least dangerous assumption to empower our students with these new tools. Fortunately, we have the research-based framework of Universal Design for Learning, which can help us to effectively implement these tools in powerful learning experiences.

Learning with Emerging Technology Informed by Universal Design for Learning

Emerging technologies such as robotisation, automatisation and artificial intelligence, as well as immersive learning platforms like augmented reality, virtual reality and wearable devices, are potentially powerful educational tools that can benefit diverse groups of learners, including learners with disabilities. Educators interested in

implementing these tools face a variety of implementation challenges, including the lack of an evidence base for the effectiveness of a new technology and clear strategies on how to best implement these technologies in educational settings. Based on Donnellan's (1984) least dangerous assumption, however, educators can begin to implement new technologies with the goal of helping students to be as familiar with the use of these tools as adults. We believe that the Universal Design for Learning framework is an ideal strategy for the effective implementation of these emerging technologies.

We cannot expect an emerging technology to have a strong evidence base of peer-reviewed articles supporting its effectiveness early in its implementation. However, we can implement emerging technologies using a research-informed strategy by connecting these tools to the framework of Universal Design for Learning (CAST, 2018). Universal Design for Learning (UDL) is a theoretical framework connected to neuroscience, learning sciences and cognitive psychology (CAST, 2011). It identifies affective, recognition and strategic networks that correspond to the three broad principles of UDL:

- Provide Multiple Means of Representation
- Provide Multiple Means of Action and Expression
- Provide Multiple Means of Engagement

Each principle includes specific guidelines and checkpoints to support implementation, as shown in Figure 1 below.

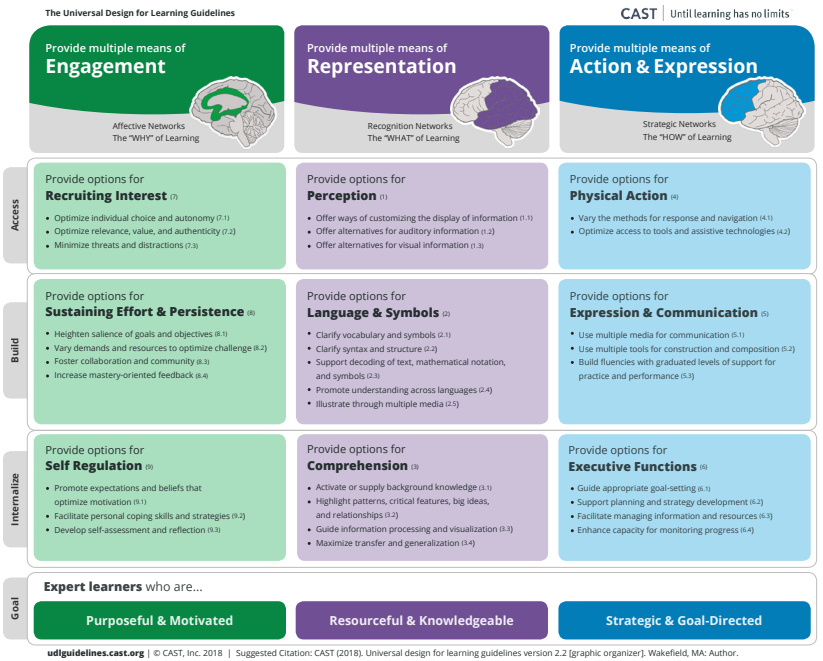

Figure 1. UDL Guidelines and Checkpoints Graphic by CAST (2018).

In the United States Higher Education Opportunity Act 2008, UDL is defined as "a scientifically valid framework for guiding educational practices that:

(A) provide flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and

(B) reduce barriers in instruction, provide appropriate accommodations, supports, and challenges, and maintain high achievement expectations for all students, including students with disabilities and students who have limited English proficiency." (HEOA, 2008, p. 110)

This policy definition supports the definition of UDL established by Rose and Meyer (2002) and updated by CAST (2011). According to Rose and Meyer (2006), the nine guidelines in the UDL framework, three for each major principle, can be used to scaffold instructional practices in ways that are similar to the scaffolding of learning described by Vygotsky. Turnbull, Wehmeyer and Turnbull (2007) described how the UDL framework also applies as a cognitive taxonomy that provides lists of cognitive skills or activities similar to the Cognitive Taxonomy developed by Bloom (1956). By building on the work of researchers in cognitive theory, UDL provides a scientific framework for designing curricula that articulates a method of teaching for learning based on planning to include learners with diverse strengths. Employing this strategy, several researchers have used the UDL framework to inform their decision-making and evaluation process regarding technology interventions for students (Almond et al., 2010; Dolan, Hall, Banerjee, Chun, & Strangman, 2005; Hall, Strangman, & Meyer, 2003).

UDL is a complex topic that can be challenging to implement at scale while measuring outcomes (Edyburn, 2010, p. 40). As we near a decade since Edyburn's article "*Would you recognize universal design for learning if you saw it? Ten propositions for new directions for the second decade of UDL*" there has been some significant progress. In his article, Edyburn presented ten propositions challenging the current state of UDL implementation. In the United States, UDL is now supported and endorsed in the Every Student Succeeds Act (2015) as a valuable research-based framework for supporting all learners. The National Educational Technology Plan (2016) builds on this support for UDL throughout the report.

> Education stakeholders should develop a born accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. … Using the principles and research-base of UD and UDL, this standard would serve as a commonly accepted framework and language around design for accessibility and offer guidance to vendors and third-party technology

> developers in interactions with states, districts, and institutions of higher education. National Education Technology Plan. (2016, p. 22)

Beyond the United States, UDL is also gaining support for implementation and research internationally. In New Zealand, the Ministry of Education has implemented a UDL initiative to reduce barriers and create more inclusive educational communities (Ministry of Education, 2018). In Europe, there are several UDL implementation projects, including locations in Belgium (SIHO, 2015), Spain (ONCE, 2014) and Norway (Zero Project, 2014).

Although there has been progress since Edyburn's (2010) ten propositions for the second decade of UDL, many of the challenges identified by Edyburn still remain. For example, Scott (2018) examined special education teachers' interest in UDL and barriers to implementation. Several barriers were identified, including (a) general education teacher support for inclusion, (b) the need for administrative support, (c) the need to improve general education teacher knowledge of UDL, (d) more preservice field-based training on UDL, and (e) additional inservice training on UDL. These findings support the need for increased professional development and implementation support for UDL. In addition to the need for more resources to support UDL school implementation, there is a need to expand UDL research, especially internationally. For example, in a review of UDL research from 2012 to 2015, 75 percent of the studies identified were conducted in the United States, and most of the international UDL studies were from countries that the authors identified as being culturally similar to the U.S. (Al-Azawei, Serenelli, & Lundqvist, 2016). While, internationally, UDL is increasingly an educational framework of choice, there is a strong need for additional research on UDL implementation across multiple cultures and countries.

In order to address these challenges to relating implementation and research, the Universal Design for Learning Implementation and Research Network (UDL-IRN.org) was created. Through work groups, an annual summit and professional development, the UDL-IRN is working to support the establishment of more inclusive education for all learners. One of these work groups has established and published UDL reporting criteria for focused research (Rao, Smith, Edyburn, Grima-Farrell, Van Horn, & Yalom-Chamowitz, 2018). These guidelines help researchers and practitioners to establish a common UDL vocabulary and an understanding of how to design inclusive education environments. The UDL Guidelines (CAST, 2018) and the UDL reporting criteria (Rao et al., 2018) are resources ideally designed to support thoughtful and inclusive implementation of new technologies that have a limited or nonexistent evidence base.

As we enter the third decade of UDL, all ten of Edyburn's (2010) propositions remain relevant, but to address the implementation of new technologies, we are going to focus on just one of them. The sixth proposition identified was "Technology is Essential for Implementing UDL" (2010, p. 38). We strongly agree with this belief that technology is critical for creating an education environment that is accessible from the start; UDL has a strong emphasis on designing instruction from the start to be inclusive of a diverse range of learner abilities and needs.

The UDL guidelines provide a research-based instructional framework for examining the many ways that educators can implement a new technology to systematically plan for and support diverse learners. Educators can design this implementation by clearly connecting the capabilities of a new technology to a specific UDL guideline or checkpoint. McMahon and Walker (2014) examined both built-in features and third-party apps, linking them to nine UDL guidelines. This examination demonstrated that there are multiple ways that mobile phones and tablet computers are examples of how new technology tools can be connected as resources to provide UDL features for diverse learners. Walker, McMahon and Rosenblatt (2017) examined how augmented reality was a classroom-ready means of supporting UDL. This same type of strategy could be applied to emerging classroom technologies and future new technologies. For example, an educator interested in using virtual reality in the classroom might connect it to the UDL guideline of recruiting interest by having students use Google Earth in VR to "walk the streets" of a country they are studying. This strategy of directly connecting capabilities and features of lesson design (i.e., a new technology tool) and a UDL guideline is also one of the recommended reporting criteria for UDL research and implementation (Rao, et al., 2018).

Five Fun Educational Technology Propositions

One rule, the least dangerous assumption, and a strategy of connecting capabilities to the UDL framework may not be enough for some educators to take the risks and implement emerging technologies. Based on our experiences of providing professional development, school level implementation, individual student interventions and teacher focus groups, we have some recommendations for teacher practice. If a teacher needs an answer about why they are using a new classroom technology, the least dangerous assumption is a rule they can use to justify their decision. This rule supports the idea of implementation even if there is a lack of strong peer-reviewed research providing an evidence base. The UDL guidelines can provide educators with a research-based strategy to

implement novel technologies by clearly connecting the capabilities of these technologies to a specific guideline or checkpoint. In addition, educators also need a culture around technology implementation that allows them to effectively design inclusive educational experiences with new technologies. If we are to effectively leverage emerging technologies, education systems need to develop a culture of exploration and innovation grounded in existing education frameworks and the concept of the least dangerous assumption. In order to help create this culture, the authors offer the following five fun propositions to guide the implementation process in schools and educational communities.

Proposition 1. Don't (Techno) Panic

Our first proposition is borrowed and slightly amended from the original "Don't Panic" in the Hitchhiker's Guide to the Galaxy (Adams, 1980). The motto of the book, which helps sentient beings travel the universe much like a current European travel guide, is simply "don't panic". "Don't Techno Panic" is a reminder that, while new technologies may cause disruption, the best- and worst-case predictions often never come to pass. The term technopanic (Thierer, 2013) is commonly used to describe negative reactions, predictions and fear-based arguments about the dangers of a new technology. The history of technology is filled with bold predictions and technopanics warning that {insert technology here} is going to ruin {insert something loved here}. Many of these technopanics have revolved around children, school and education. Technopanics are not just an issue in recent history. One of the first technopanics was connected to the ill effects of the printing press. Some people believed that mass printing would lead to chaos because the proliferation of reading material and literacy would lead to confusion, as people would not have to listen to authority as much (Bell, 2010). This example is important because it shows that the human reaction to technology is not so much about the technology as it is about the human, as has been proven time and time again throughout history.

Designing the inclusive future will require us not to engage in technopanics, but to instead explore the benefits and potential of technologies as new tools. While it is often *en vogue* to complain about these innovations, it is important to recognise that these technologies are just tools and it is how they are used that has benefits or challenges for society. Radio, television, the computer, the Internet, wireless data, video games and mobile phones all experienced significant technopanics. Today, televisions help people learn about the world, computers have increased productivity so we can save time on many tasks, the Internet has created new industries and learning opportunities, mobile devices

allow us to use GPS to guide our way, video games can help engage learners, and mobile devices provide built-in accessibility tools.

While new technologies will present significant challenges as society adapts, they also provide new opportunities. It is easy to be intimidated by new technologies or reminisce about what may be extinguished; our first proposition "Don't Panic" is a caution to stay grounded and not overplay the potential perils of a new technology. In order to address making emerging technologies inclusive, researchers, educators and advocates across many fields need to be engaged in bringing them into the mainstream.

Proposition 2. Don't Believe (All of) the Hype (Cycle)

Our second proposition "Don't believe the hype" is a caution to not let our educational technology expectations get carried away. Technology trends usually grow along predictable lines of public interest and development. Gartner (2013) described this process as the Hype Cycle, as shown in Figure 2. In brief, this cycle includes the introduction of a new technology, the new technology exploding in popular knowledge and interest, and the new technology dramatically losing public interest before the last part of the cycle, where the technology slowly increases in use as it is systematically perfected and practical applications using it expand. After this slow increase based on effective use, research and support interest, as well as expectations, plateau at a consistent level of productivity and usage.

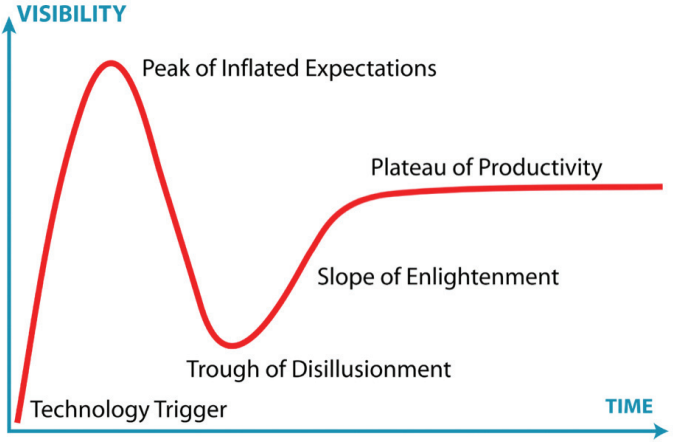

Figure 2. The Gartner Hype Cycle of New Technology. Adapted from Gartner Inc. (2013).

This cycle occurs repeatedly in technology implementation. Lloyd, Moni and Jobling (2006) demonstrated how the cycle is represented in educational technology in their review of effective computer use for students with intellectual disabilities. For example, when people started reading books on their mobile phones and tablets, many worried that libraries would disappear and that hardcopy books would be lost forever. Instead, paperback novels are again outselling digital copies (Wood, 2017). In this case, the hype of digital books killing off print was overblown. Both digital books and print books remain in wide use. For individuals with disabilities, however, these new digital tools are opening new doors. For example, digital text allows readers with dyslexia to enjoy speech-to-text features that are built into most mobile devices.

Proposition 3. Swish and Flick (and Click)

Our third proposition is an enthusiastic endorsement to explore and practise new technologies. Just like the students at a certain school of witchcraft and wizardry, the only way to learn is to practise and see what happens. Our first two propositions were mild cautions to remind us that new technologies are not likely to fulfil all the negative or positive outcomes initially imagined. Swish, Flick and Click is the proposition that we just have to try new tools and discover their capabilities and potential first hand. Our belief is that we as educators should be actively engaged with new technologies and encourage our students to do so as well. It is important to realise that technologies can be a panacea for many things, but we still have to do the work. As one of the authors of this paper stated so eloquently, "I am wearing a FitBit on my wrist but my abs have not shown up yet". New immersive learning tools have great potential to support learning, but it is up to us to get in there and work, experiment, adapt, evaluate and try again. In this exponential technology cycle, the only way to effectively bring some of these new technologies to the classroom in a timely way is to build cultures in our schools that embrace taking risks. Unfortunately, multiple studies of teachers' attitudes towards technology show that, while teachers have positive attitudes toward technology, they have significant concerns about their self-efficacy in using these tools and implementing them to support teaching and learning (Teo, Lee, & Chai, 2008; Teo, 2010).

When we play and explore and allow our students to do the same, strong pedagogies can emerge. Mobile phones can be used for curating notes in class, taking photos of teacher notes written on the board or presented on a slide, recording the teacher's lecture so it can be watched again, reviewing videos on the public transport ride home, and so on. There are many uses for mobile devices in

education that were not developed by the engineers who created the device. Instead, educators and their students adapted a technology to fit a pedagogical need.

Designing for accessibility from the beginning is an important goal. Consider how the built-in accessibility features of iOS devices helped to propel them to widespread use. Text to Speech and Speech to Text were both once dedicated assistive technologies, but are just now common features of most mobile devices. While a particular option or feature may start as an accessibility option, in time it can become a preferred option for many other users without disabilities, just as many people utilise Text to Speech and AI digital assistants (Siri, Google Now, Cortana) to make appointments.

We can engage with designers, educators, students and other stakeholders to think about creating tools and settings according to user needs. A good example of this in current use are the often little-known aspects of iOS accessibility settings. The text-to-speech and speech-to-text accessibility features are widely used by people without disabilities because of convenience and personal preferences. A similar approach could work in immersive tech. In immersive technology such as AR and VR, which are often very visual heavy, there are still options for designing for accessibility. While you as a designer may find them challenging to implement and plan for, these options for being more inclusive can have unknown benefits. The thought-based controller and haptic feedback prompts that are just prototypes today might develop to become the preferred option for other users without disabilities in the future. Designing for inclusive technology use will always be an ongoing process and dialogue. Assembling a diverse and inclusive set of educational technology superheroes (stakeholders) is a critical part of building an inclusive future with new technologies.

Proposition 4. Super Heroes Assemble

If we are going to effectively leverage new technologies to design an inclusive future, we must start by being more inclusive educational designers. It is important that we gather a diverse group of developers, teachers, administrators and students to create meaningful learning experiences together. This should embrace marginalised groups, including those with disabilities, in the process. The more opportunities technology experts have to work with and assist educational futurists, students with real needs to run prototypes through, and those in industry to communicate which skills are needed in specific industries, the more able we will be to design curricula that meet all of our students' needs.

We need to look no further than two tech titans, Apple and Google, for examples of how to improve the design process for those with disabilities. In

addition to including individuals with disabilities in their design and engineering teams, the inclusion of accessibility features in the first iPhone was a game-changer for individuals with disabilities (Mechling, 2011; McMahon & Walker, 2014). In 2018, Google introduced a dedicated disability support team to not only take questions from those with disabilities, but also to hear their suggestions for use in future development (Google, 2018). In addition, Google's accessibility blog features stories and examples of how accessibility has been successful in supporting inclusive technology use. Apple and Google were able to do this because they were forward thinking and *planned forward* rather than trying to retroactively fit features onto technology after the design was complete. They chose to be inclusive voices for those who needed these accessibility features.

The need for interdisciplinary research teams for emerging technologies in education is based on the same principles of bringing diverse groups of stakeholders together. A leading example of this is the creation of the TeachLivE live mixed-reality platform. Mixed reality, which combines elements of VR virtual environments and avatars with real-world interactions, is one example of technology that we know has proven benefits for individuals with disabilities (Walker, in press). Developed at the University of Central Florida, TLE TeachLivE has been shown to improve performance in teacher preparation (Dieker, Hynes, Hughes, & Smith, 2008). The project involved collaboration between computer scientists, special education technology researchers, 3D modellers and live actors to create a new platform for simulated practice for teachers, students and other stakeholders to engage in targeted practice of discrete skills. The TLE TeachLivE system is a prime example of the potential of broader interdisciplinary teams to develop new immersive technology interventions.

Proposition 5. Are You Ready for the Remix? (Build on What We Have)

Our fifth and final proposition "Are you ready for the remix" is a call to connect new technologies to existing education practices. Just like in music, where a remix will take part of the original song that is well established and use it to create a new composition, this is an approach to implementing new technologies.

When new technologies are introduced, we should start by connecting them to existing evidence-based practices and established pedagogical strategies. Research is clear about what works in education, so let us use technology to make those evidence-based practices more efficient, faster and more accessible. We do not have to reinvent the wheel each time a new technology arrives.

Educators can start with a practice they feel comfortable with and know is important (e.g., formative feedback) and figure out ways to connect technology to the practice (e.g., using voice notes to provide feedback on written work). For individuals with disabilities, immersive technologies have already proven to be important when using evidence-based practices such as video modelling (Cihak et al., 2016) and job coaching (Walker, Vasquez, & Wienke, 2016). Video modelling on a new technology platform, such as AR, should still be supported as an evidence-based practice that is now being extended to a new platform. Learning communities and educators can create a culture in which remixing old established pedagogical strategies can quickly be adapted to take advantage of a new educational technology tool. Educators can use this remix-friendly culture to bring existing evidence-based practices and pedagogical strategies to successfully implement emerging technologies.

Leveraging Emerging Technology to Design the Inclusive Future

Emerging technologies are potentially powerful educational tools that can benefit diverse groups of learners, including learners with disabilities. One of the best cases we can make for the use of new technologies in education is that these tools are the technologies that the students will be using when they become adults and join the work force and participate in society as adults. Certainly, these technologies will continue to change and improve, but helping children to discover the current capabilities of these technologies will help them to be more prepared for whatever future forms the technologies may take.

Educational technology researchers are also an important part of this process of responsibly implementing new and potentially disruptive technologies in the classroom. In many cases, peer-reviewed research supporting a new technology will lag far behind the adoption of the technology, but research is still a critical part of the process of new educational technology implementation. If new software can go mainstream in just over a month, like Angry Birds did, obviously conducting a research study, writing it up and publishing it in a peer-reviewed journal is going to take significantly longer. It is also important to remember that, for obvious reasons, research is often undertaken after the peak of the hype cycle. As educational technology researchers, it is often difficult to get into schools to conduct research, because teachers and schools can be very resistant to trying new things in an assessment-based culture. The authors of the present article wrote a manuscript on classroom uses of AR more than five years ago, but it was continually rejected by professional journals because

there was a lack of evidence. However, schools were unwilling to try the novel technologies even when provided with explicit instructions on how these immersive technologies could benefit instruction. It was not until Pokèmon Go became popular that interest in the article soared and it was published immediately. The hype of AR had finally gone mainstream and the current body of AR in education research is growing (Akçayır & Akçayır, 2017).

This article presents one of many potential means of addressing the rapidly changing technology landscape and its impact on education. We selected these ideas because they are based on educational research such as the UDL framework, and on our experiences helping educators, families and students adopt new technologies. Future research can either build on or disprove these ideas as effective strategies for using emerging technologies; either way, we need to support educators who are implementing and adopting emerging technologies so that their students are prepared for a future that will have more robotisation, automatisation, artificial intelligence and immersive learning tools.

Conclusion

Designing the Inclusive Future can be supported by applying these propositions to our lessons and curriculum in order to include new technologies and address new challenges. These emerging technologies can lay the groundwork for a more representative and empowered workforce. What does the future look like? What do our classrooms look like? While robotisation, automatisation, artificial intelligence and immersive learning tools will create new challenges in both the workplace and in education, it is important that we consider how we can prepare our students moving forward. We understand that certainty is safe and comfortable, but it is also important to acknowledge that we will never be fully certain of the potential of technology or the challenges of its use. The implication of innovation is that we will not always know what is going to happen next. The least dangerous assumption is to try to effectively implement new tools in education. The UDL framework and the above propositions are a viable strategy for effective and informed implementation of these technologies in education. While robotisation, automatisation, artificial intelligence and immersive learning technologies will present significant challenges as society adapts, these emerging technologies also present unknown opportunities for new applications supporting inclusion in society and inclusive education environments. In order to address making emerging technologies inclusive, researchers, educators and advocates across many fields need to be engaged in bringing these new technologies into the mainstream.

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The Use of Humanoid Robots with Multilingual Interaction Skills in Teaching a Foreign Language: Opportunities, Research Challenges and Future Research Directions

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Since a humanoid robot does not get tired regardless of how many mistakes a student makes, and because it can be equipped with novel teaching techniques and updated with the most current knowledge, it can be useful for achieving many educational goals. The rationale behind this is that it has been shown in the literature that robots are more useful as teaching aids than computers or other instructional tools, as they can mimic human responses. Furthermore, humans, especially children, prefer robot interaction to other interaction types. Adults generally struggle to learn a foreign language, but this is true of some students, too. With their multilingual interaction capabilities, their ability to provide real-time feedback, and their humanlike physical shape, some types of humanoid robots can be of great assistance to students in learning a foreign language. The use of humanoid robots leads to a personal connection with the students, and this can help overcome issues related to shyness, reluctance, frustration and lack of confidence that may emerge in dealing with a human teacher. Moreover, as humanoid robots can be programmed to know specifically what each individual student needs to learn, they can be quite useful for one-on-one speaking activities. Considering the many possibilities that can be offered by information and communication technology tools, particularly by humanoid robots, this paper reviews the roles and functions of humanoid robots in teaching a foreign language, presents novel approaches in this domain, provides research challenges, and finally outlines future research directions.

Keywords: humanoid robots, real-time feedback, repeatability, multilingual interaction skills, foreign language teaching

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Uporaba humanoidnih robotov z večjezičnimi interakcijskimi veščinami pri poučevanju tujega jezika: priložnosti, raziskovalni izzivi in prihodnje raziskovalne usmeritve

Ayse Tuna in Gurkan Tuna

Ker se humanoidni robot ne utrudi ne glede na to, koliko napak učenec naredi, in ker je opremljen z novimi učnimi tehnikami ter posodobljen z najnovejšim znanjem, je lahko koristen za doseganje številnih izobraževalnih ciljev. Razlogi za to izhajajo iz literature, ki dokazuje, da so roboti kot učni pripomoček uporabnejši kot računalniki in druga izobraževalna orodja, saj lahko posnemajo človeške odzive. Še več, ljudje, posebej otroci, imajo interakcije z roboti raje od drugih oblik interakcije. Odrasli se na splošno težje naučijo tujega jezika, vendar pa to velja tudi za nekatere učence. Nekatere vrste humanoidnih robotov so lahko s svojimi večjezičnimi interakcijskimi sposobnostmi, z zmožnostjo podajanja povratne informacije v realnem času ter s svojim, človeku podobnim videzom v veliko pomoč učencem pri učenju tujega jezika. Uporaba humanoidnih robotov vodi v osebno povezanost z učencem, kar lahko pomaga pri premagovanju težav, povezanih s sramežljivostjo, z odporom, s frustracijo in pomankanjem samozavesti, ki se lahko pojavijo pri učenju s človeškim učiteljem. Poleg tega so lahko koristni pri govornih aktivnostih »ena-na-ena«, saj so humanoidni roboti lahko sprogramirani tako, da točno vedo, kaj se mora določen učenec naučiti. Upoštevaje številne možnosti, ki jih lahko ponudijo orodja informacijsko-komunikacijske tehnologije, še zlasti humanoidni roboti, ta prispevek preučuje vloge in funkcije humanoidnih robotov pri poučevanju tujega jezika, predstavlja nove pristope na tem področju in raziskovalne izzive, na koncu pa nakazuje prihodnje raziskovalne usmeritve.

Ključne besede: humanoidni roboti, realnočasovna povratna informacija, ponovljivost, večjezične interakcijske veščine, poučevanje tujega jezika

Introduction

Due to its benefits, the idea of personalised learning has gained popularity in recent years and the use of technology and computer-based solutions has moved to the centre of personalised learning. Personalised learning is a way of teaching centred on the interests and needs of each student instead of the class as a whole. It includes flexible learning environments and specially designed education plans. Currently, computer programmes supported by artificial intelligence and machine learning techniques are able to learn students' individual learning styles and tailor lessons to suit their precise needs. As a result, each student can work at his/her own pace and benefit from customised lesson plans personalised to suit his/her exact level in each lesson.

Although novel instructional tools can assist in foreign language learning in different ways (Yang & Chen, 2007), they are difficult to customise and time-consuming and impractical to interact with (Chang et al., 2010). Moreover, if the learning content carried by them does not match the students' level, adopting these tools alone does not significantly improve learning (Hegarty, 2004). Unlike these tools, humanoid robots have body shapes that are built to resemble the human body and have social interaction skills. They can be designed for a range of purposes, including interaction with human tools and environments, the study of locomotion, and many others. Although humanoid robots are currently mainly used for a few specific repetitive tasks in foreign language teaching, many other possibilities exist. For instance, it has been shown that children treat humanoid robots as important players in the classroom setting; most children are willing to listen to the instructions they receive from humanoid robots and answer the humanoid robots' questions. The success of humanoid robots in the classroom setting lies in the fact that they do not punish children if they make a mistake (Kwok, 2015). If a teacher uses a humanoid robot in learning activities, the role of the teacher is directly linked to the role that the robot plays (Mubin et al., 2013). For instance, if the humanoid robot acts as the main focal entity in a learning activity, the teacher takes on the role of a facilitator (Alimisis, 2012). On the other hand, if the robot takes on a passive role, the teacher should transfer the base knowledge. The major problem with the humanoid robot acting as the main focal entity is that, in some situations in the classroom setting, humanoid robots may not be able to fully understand and interpret children's intentions due to inaccurate speech or emotion recognition, and this may result in a loss of interaction (Honig & Oron-Gilad, 2018).

Some humanoid robots, such as NAO, can be programmed to have multilingual interaction skills ("Available languages – Aldebaran 2.1.4.13 documentation", 2019), so they can help build a positive and productive learning environment

for students to practise real-life conversations in foreign language teaching programmes. These robots can also play a key role in enhancing cross-cultural communication, as long as they are able to behave and respond in a culturally appropriate manner. Although English is widely accepted for social interaction, integration in society in general and especially in the job market is very dependent on the native language of a country. Many societal agencies therefore arrange a language cafe, an open gathering at which native and non-native speakers spontaneously gather to engage in open-topic social conversations with the goal of maintaining the conversation in the target language, in order to help learners practise conversation to complement traditional classroom teaching (Lopes, Engwall, & Skantze, 2017). In language cafes, although native speakers have the role of equal conversational partners, they are given the extra responsibility of initiating the conversations and assisting the target language learners. The present study focuses on the use of humanoid robots in foreign language teaching and presents novel approaches to their roles for this purpose. Moreover, research challenges are presented and future research directions are stated.

The use of humanoid robots in education

It is known that, compared to a robot, a computer offers fewer opportunities to interact, and that interacting with a robot activates social areas of the brain that are not activated when using a computer (Dautenhahn, 2007). Since humans have evolved to be a social species, we are naturally programmed to pay more attention to human-like robots, i.e., humanoid robots, than to computer screens (ibid.). The social stimuli and the greater response to interactions with humanoid robots therefore account for the possible success of robot teachers.

While robot teachers were initially used to teach science, technology, engineering and mathematics (STEM) in schools, they are now also programmed to teach languages or assist in language teaching (Belpaeme et al., 2018; Scassellati et al., 2018). Although it is impossible that humanoid robots will take over the work of human teachers in the next few years, human teachers and humanoid robots will work together to provide additional opportunities and personalised education to students.

The use of humanoid robots in education will consequently change the roles of teachers, who will be less focused on common repetitive tasks and will instead enhance their roles as leaders, overall organisers, explainers and final evaluators. This may prove to be an economically viable solution to the shortage of teachers, too. Moreover, humanoid robots can help teachers and students to solve several open-ended problems; for instance, humanoid robots can determine each

student's individual preferences, motivations and difficulties, and can thus match the student's speed of learning and adapt to his/her needs. In the classroom, working with humanoid robots engages children and can bring high technology down to the practical everyday level. As listed in Table 1, four main roles can be identified for the use of a humanoid robot in education. The benefits of working with humanoid robots for educational goals are listed below (Chang et al., 2010; Jamet et al., 2018; Majgaard, 2015). Please note that some of the benefits stated are not specific to humanoid robots and can be provided to some degree by computers, too.

A humanoid robot can:

- help strengthen the scientific and technological culture in schools;
- make abstract knowledge concrete in order to teach the real-world application of science, maths, programming and engineering;
- help students to increase their creativity, and build and strengthen their cognitive development;
- help students to become active problem solvers and engage them in their own learning;
- facilitate the transfer of knowledge through activity-based projects;
- be used to apply scientific thinking through enquiry-based activities;
- emphasise meaningful problem-based learning through the integration and application of knowledge;
- develop the ability of thinking through problems with a focus on logical reasoning, analytical reasoning and critical thinking;
- build the strategic problem-solving, computational thinking and higher-order thinking skills essential in science and engineering subjects.

Table 1

Roles of a humanoid robot in education

Role	Description
Educational subject	Humanoid robots can be used to help children learn basic algorithms by programming objects and actions.
Learning support tool	Some educational activities can be successfully supported by humanoid robots. Implementation of a humanoid robot-assisted teaching methodology serves as a bridge between the acquisition and application of skills, knowledge and attributes.
Telepresence tool	By acting as a telepresence tool, humanoid robots can enable sick or hospitalised children to virtually attend classroom sessions at school. In addition, this role enables the human teacher to connect to the classroom and become virtually present through the humanoid robot's display.
Assisting the education professional	Humanoid robots can take a collaborative, complementary robot-human approach to the daily tasks of a classroom setting, thus allowing the teacher to focus on his/her pedagogical objective.

Note. Adapted from Abildgaard & Scharfe, 2012; Kanda et al., 2004; Mubin et al., 2013; Pandey & Gelin, 2019; Tazhigaliyeva et al., 2016.

Humanoid robots can better serve the requirements of students with special needs. They can be programmed to suit each individual student's needs, thus offering special education in a much simpler and more accessible format; for instance, humanoid robots can help children with autism spectrum disorder (ASD) to learn communication and social skills, and can help children with attention disorders to learn how to focus (Huijnen et al., 2017; Scassellati et al., 2018).

Although the main benefits of humanoid robots in education are increased engagement and higher motivation, they should currently be understood as a learning tool rather than a teacher (Lee et al., 2008). One of the main drawbacks of the use of humanoid robots in teaching is that teachers are very hesitant about their integration in teaching-related activities. Interestingly, teachers are generally much more critical of humanoid robots in schools than students and parents are (ibid.). Therefore, teachers need to be reassured that the ultimate goal of integrating humanoid robots in teaching-related activities is not to replace them, but rather to equip them with a novel teaching tool that can enhance the learning experience and motivation of the students. Furthermore, most teachers are currently unaware of the technical capabilities of humanoid robots; they do not trust humanoid robots for teaching activities and are uncertain about how to use them efficiently. Most teachers therefore prefer to have full control in a classroom setting and only assign humanoid robots restricted roles.

The roles and functions of humanoid robots in teaching a foreign language

Teaching a foreign language is a difficult task. The goal is to inspire and motivate students for learning, reading, writing, speaking and comprehending the foreign language. Students face many difficulties while learning a foreign language, primarily due to the negative interference of their native language and cultural differences. It is known that students who learn a foreign language apply knowledge from their native language (Mora Pablo et al., 2011). Although this can make understanding and using the foreign language easier, it can also be an obstacle to the proper internalisation of the rules of the foreign language. Another barrier to foreign language learning is students' own culture. Cultural differences may cause cultural misunderstandings and confusion. Students may have difficulties in communicating and interacting with native speakers of the foreign language due to cultural differences, and are unable to obtain a level of proficiency if they cannot appropriately use the foreign language in the context

of the culture of that language. Therefore, foreign language teachers must take into consideration the four strategies that students use to learn a foreign language (Hismanoglu, 2000). First, students tend to use their linguistic knowledge of their native language. Second, students attempt to transfer their cultural knowledge to make assumptions when communicating in the foreign language. Third, teachers must determine and highlight common features that may facilitate foreign language learning. Finally, teachers must be attentive to error correction, as errors may be the consequence of incorrect assumptions held about the culture of the foreign language or negative language transfer.

Although adults typically need to dedicate almost their whole time to learning a foreign language to achieve the desired goal (Deng & Zou, 2016), children are capable of adapting to a particular situation much more easily, and learning a foreign language is often easier for them. Since children learn a foreign language faster, they should be provided with opportunities to attend foreign language courses. Nevertheless, most primary schools in developing countries such as Turkey do not currently offer foreign language courses (Çelik & Kasapoğlu, 2014), although, due to the common interest in multilingualism resulting from globalisation, some of them are currently considering offering such courses (Ec.europa.eu, 2019). On the other hand, one of the biggest problems regarding this issue in developing countries is that if a primary school is not dedicated to students from immigrant families it typically employs only one or two foreign language teachers (native speakers), as it cannot generally absorb the expenses associated with more teachers. Furthermore, the teachers employed can only provide partial coverage due to timetable clashes. In this case, especially in big classes, a foreign language teaching assistant might be useful. This is the perfect role for a humanoid robot with multilingual interaction ability. Another important point in this regard is that children who have difficulties communicating with other children do not get appropriate public education. This situation is worse for children who cannot speak the official language of the country in which they live. If humanoid robots with multilingual interaction ability are equipped with appropriate interfacing mechanisms, they can be used to address this problem. However, if humanoid robots are going to be used in schools, they must be able to monitor everything that is happening in the classroom setting, to understand and interpret human language the way it is spoken, and to detect the emotions of each student. Another situation in which humanoid robots can be used is the teaching of sign language to hearing-impaired students (Al-Khulaidi et al., 2019).

According to the traditional foreign language teaching strategy, teachers play the role of the commander and students are the actors (Chang et al.,

2010). With this strategy, students can give commands during a learning activity, but some teachers may not be willing to follow the students' commands. In such cases, humanoid robots can be more successful than human teachers and maintain a higher level of engagement among the students (Xie, Antle, & Motamedi, 2008). Despite being a traditional teaching strategy, task-based teaching is another foreign language teaching strategy in which humanoid robots can be used. According to this strategy, humanoid robots can play the role of manager/stimulator, thus contributing to reducing the problem of classroom management and dealing with the problem of English avoidance (Kanda & Ishiguro, 2005).

With the advancements in robotics in recent years, the use, benefits and challenges of humanoid robots have been thoroughly investigated. Alemi, Meghdari and Ghazisaedy (2014) examined the use of humanoid robots for high school students in vocabulary learning and retention of English, and studied the effects of this approach. The authors demonstrated that humanoid robots can be used to create an enjoyable and effective learning environment and reduce student anxiety regarding learning English. The authors also showed that the use of humanoid robots for foreign language teaching helps students to learn in a more effective manner and increases their motivation. However, there are very limited materials designed for Robot-Assisted Language Learning (RALL) sessions and RALL cannot be directly applied to adult learners. Initial experiments carried out over the last few years indicate that, although the use of humanoid robots for foreign language teaching provides better results compared to traditional human-based language teaching, human-robot cooperation is essential (Meghdari et al., 2013).

Due to the increasing interest in using humanoid robots for foreign language teaching, a great deal of research is being undertaken on this topic. For instance, Second Language Tutoring Using Social Robots (L2TOR) is a scientific research project funded by the Horizon 2020 programme. Its aim is to design a tutor robot that can be used to support teaching preschool children a foreign language by interacting with children in their social and referential world ("L2tor – Language robot."). It is assumed that a tutor robot designed using the hardware of a well-known humanoid robot called NAO (see Figure 1) will support teachers by spending time with children in one-to-one tutoring sessions ("L2tor – Language robot"). The tutor robot will incorporate language-based tutoring about numbers and pre-mathematical concepts and spatial language, as well as facilitating basic vocabulary learning through storytelling. In addition to the role played by the tutor robot, a humanoid robot can also be used as a peer and learning tool; for instance, the NAO humanoid robot can be

programmed to speak multiple languages, although its text-to-speech engines have limited prosodic capacities and generate synthetic voices (Belpaeme et al., 2018). Dominey and Dodane (2004) showed that children typically rely on prosodic cues to comprehend spoken language. In addition, humanoid robots do not have facial cues, which may hinder the auditory-visual perception processes of both normal-hearing and hearing-impaired children, making the role of humanoid robots in a classroom setting questionable (Erber, 1975).

Unlike humanoid robots, Androids/Geminoids are incredibly realistic, with their appearance closely resembling specific human models. Their bodies are constructed by precisely measuring human models with 3D scanners, and gypsum is typically used to capture facial contours accurately ("What is Geminoid?"; Ackerman, 2016). A perfect example of a Geminoid is Geminoid F, which was designed in 2010 and can make twelve different facial expressions using air pressure (Guizzo, 2010). It was modelled after a real woman and has life-like silicone skin, realistic black hair and pearly white teeth (Guizzo, 2010). Compared to ordinary humanoid robots, it is quite skilled. Its teleoperation feature uses a smart camera to track a real person's facial expressions, enabling it to reproduce facial tics and other unspoken gestures. It has recently been used to teach Japanese to a group of Vietnamese people ("Beautiful lifelike robot teaches Japanese in Vietnam"). Although a Geminoid might be a perfect foreign language teacher for adults, Robins, Dautenhahn and Dubowski (2006) have demonstrated that children, in their initial response, prefer interaction with a relatively simple, featureless robot rather than a realistic, human-like robot. Since the response of children towards the plain robot was more social and proactive, Geminoids may not be suitable for teaching a foreign language to children.

Most humanoid robots designed for foreign language teaching take the role of a teaching assistant (Yorita & Kubota, 2012). Examples of such robots are IROBI (Han et al., 2008), the Telepresense robot (Kwon et al., 2010), Mero and Engkey (Lee et al., 2010), and the Humanoid robot (Chang et al., 2010). On the other hand, some humanoid robots, such as Robovie (Kanda et al., 2007), take the role of a learning companion or peer. Table 2 summarises the basic functions of a humanoid robot for various roles in foreign language teaching. Considering their typical skills, humanoid robots can be used in five different modes for foreign language teaching, as listed in Table 3.

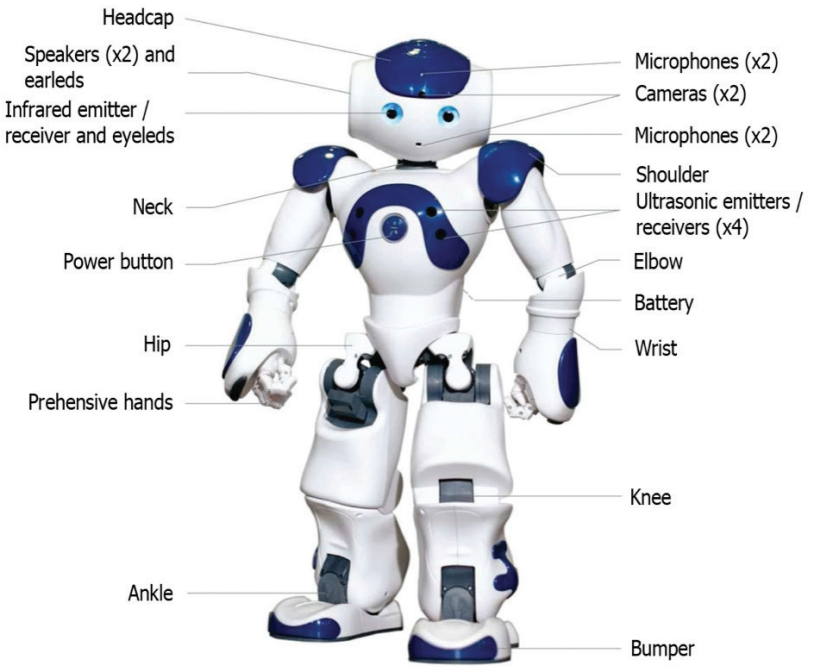

Figure 1. Humanoid robot NAO (Courtesy of SoftBank Robotics).

Table 2

Basic functions of a humanoid robot in teaching a foreign language

Role	Functions
Tutor	In this role, the humanoid robot acts as a tutor and performs various teaching-related functions, such as helping students to memorise vocabulary (Saerbeck et al., 2010).
Peer	In this role, the humanoid robot acts as a peer (friend) and performs functions related to learning goals such as acknowledging that the students pronounce words correctly (Han & Kim, 2009).
Learning tool	In this role, the humanoid robot itself acts as a learning tool; for instance, it can play with the students to help them learn certain phrases (Mubin et al., 2013).

Note. Adapted from Chang et al., 2010.

Table 3
Modes of a humanoid robot for foreign language teaching

Mode	Functions
Oral reading	In this role, the humanoid robot leads the students in repeating vocabulary and sentences aloud. Using male/female voice transitions, it enables the students to practise speaking in the roles of different characters.
Storytelling	In this role, the humanoid robot plays stories. While it is playing the stories, it can also provide some sound effects or perform comic actions to increase student engagement.
Question-and-answer	In this role, the humanoid robot instructs the students to develop their communicative competence so that they will be able to use the foreign language properly to communicate and comment.
Action-command	In this role, the humanoid robot asks the students to perform a number of selected tasks. The students can also ask the humanoid robot to do the same, and the robot obeys their instructions. This role is very useful in encouraging students to improve their speaking skills.
Cheerleader	In this role, the humanoid robot helps the teacher to lead certain games in which the students play individually or in groups. In addition, it can play the role of a fair judge and a coach in competitive games.

Note. Adapted from Chang et al., 2010.

Due to the increasing interest in humanoid robots, their benefits in foreign language teaching were investigated in the Repeat Robot project carried out by Hemminki and Erkinheimo-Kyllönen (2017). The NAO humanoid robot shown in Figure 1 was used to assist in teaching Finnish as a second language. It was shown that humanoid robots can reduce the fear of making mistakes and thus promote speaking. Moreover, compared to a human teacher, it was easier for students to ask for help from the humanoid robot in the learning situation. The humanoid robot was able to support self-paced and self-guided learning. Finally, the humanoid robot was able to deal with the students' feelings. However, some obstacles were encountered during the interactions, mostly due to the speech recognition function of the humanoid robot, as speech recognition is typically challenging when the speaker is not native.

Due to their great interest in technological tools, the use of humanoid robots for foreign language teaching of students with ASD is highly promising. Alemi, Meghdari, Basiri and Taheri (2015) demonstrated that humanoid robot teachers can successfully teach a foreign language to students with high-functioning ASD. On the other hand, it was shown that, if students with high-functioning ASD are to be engaged in a language class, strategies such as a specific seating order and routine greetings can be used to increase the success of teaching (Wire, 2005).

In summary, although the use of humanoid robots in foreign language teaching is promising and shows better learning outcomes (Alemi, Meghdari, & Ghazisaedy, 2014; Kanda et al., 2004; Tanaka & Matsuzoe, 2012), the impacts of robot embodiment in this context have not yet been investigated in detail (Belpaeme et al., 2018); for instance, an important question in this context is whether or not humanoid robots have advantages over virtual characters. Furthermore, the impacts of social behaviour have not yet been fully explored (Herberg et al., 2015), although some studies have presented positive results (Saerbeck et al., 2010) and it is clear that humanoid robots enable new possibilities and roles in teaching, such as the role of a peer. It has already been shown that the peer role reduces anxiety when learning a foreign language (Alemi, Meghdari, & Ghazisaedy, 2015).

Research challenges

Teaching a foreign language requires teachers to learn to constantly adapt to their students' needs. Teachers must therefore be able to recognise and deal with a variety of problems in the classroom setting and find solutions to these problems. Not only do they have to be able to stay awake and interested in the class, they have to be able to keep their students awake and interested, as well. However, small tweaks in their teaching methods can help teachers to create a more productive and casual environment for both themselves and their students. Although humanoid robots can successfully address the second issue, the first one requires significant research in robotics so that sophisticated speech and recognition modules can be developed. Otherwise, it will not be possible for a humanoid robot to successfully manage the classroom setting alone.

Children are very interested in their social interaction, so humanoid robots must be able to create human-like interaction and communicate socially if they are going to be positioned in classrooms and function as an inspiring and engaging learning tool. For such interaction, humanoid robots must be able to recognise children's faces, detect basic emotions from children's facial expressions, adapt their behaviour to children's feelings, and finally display a broad range of common expressions and emotions themselves. These kinds of behaviours necessitate significant research efforts in robotics; for example, the voice of a humanoid robot is generally not natural, and even current sophisticated humanoid robots cannot adapt to situations by changing the tone or pitch of their voice. Owing to their limitations in speech and emotion recognition capabilities, humanoid robots are typically not situated in classrooms autonomously at the present time.

Regarding teaching a foreign language to primary schools students, the most important issue to consider is that the students are already learning several subjects, so adding a foreign language may make effective learning difficult. Moreover, if the students' attention is further divided, other skills could be sacrificed. As the related literature shows, humanoid robots are successful at increasing student engagement, particularly at primary schools, thus creating a suitable environment for foreign language learning. However, another important issue is continuity, as only some high schools and universities offer foreign language courses, and the opportunity for necessary enhancement to the basic language skills obtained at a young age might not be available.

Humanoid robots designed for language teaching should collect data on their students' language skills and monitor the feelings and personal state of the students to identify things like confusion, boredom, sadness and joy. Human teachers make sense of all of the nonverbal cues they get from their students; therefore, if humanoid robots are going to be used as foreign language teachers they need to have a high level of social intelligence and state-of-the-art image processing skills that can analyse different facial muscle movements with a high degree of accuracy, so that they can dynamically adjust to how each student feels (Belpaeme et al., 2015; Belpaeme et al., 2018). Besides interpreting students' emotions, another important challenge is how to react to the information obtained from the student: What will the humanoid robot do if, for instance, the student gets bored?

One of the key shortcomings in the use of humanoid robots for foreign language teaching is the lack of well-defined curricula and learning material for teachers. Significant research efforts must therefore be devoted to the design of appropriate curricula and the development of learning material, as well as to the role of the teacher in addition to the development of robotic hardware and software (Mubin et al., 2013). Moreover, training teaching staff on humanoid robotics and how to execute curricula is essential. It is very clear that, if full integration of humanoid robots into our schools is desired and support from the teachers is expected, significant work must be done beforehand.

To sum up, the use of humanoid robots in education is fascinating and has huge potential, but it is also associated with enormous problems in terms of getting it right. Therefore, the lack of concrete evidence demonstrating the unique benefits of humanoid robots for foreign language teaching should be viewed as an opportunity to encourage interdisciplinary collaboration among experts (Kanero et al., 2018). Finally, although humanoid robots might be a promising solution for typical repetitive learning tasks of foreign language teaching, it is preferable to assign them a complementary learning tool role in the classroom setting, as they cannot hold students' attention by themselves.

Future research directions

Since children can learn a foreign language faster than adults, they should take foreign language courses from a young age. In this way, they can attain a mastery of the foreign language as they grow older. As the literature shows, children from non-native-speaking countries of a foreign language can learn their own native language and the foreign language at the same time (Kaushanskaya, Yoo, & Marian, 2011). The literature also shows that children become smarter if they are exposed to foreign languages at a young age.

The use of humanoid robots in education can help to close the gap between the best and worst schools, or between government-funded schools and private schools. For a number of reasons, including budget restrictions, government-funded schools find it hard to get the best teachers. However, the use of humanoid robots will address this issue, enabling the education received even in the most deprived region to be satisfactory. The prices of humanoid robots are currently high, but they may come down quickly if significant demand arises.

For a humanoid robot to act as a foreign language teacher for children, two of the major challenges are how to successfully interpret the students' emotions and how to react to that information. The humanoid robot should be designed and programmed in such a sophisticated way that it knows what to do when a child is frustrated or bored, or experiences some other emotion. In this way, the humanoid robot can be as friendly as possible to the child. On the other hand, the humanoid robot should also react to bad behaviour exhibited by the child. Significant time should be spent in observing teachers in kindergartens and primary schools so that humanoid robots can be programmed to successfully act like human foreign teachers.

It is known that, in most aspects, collaborative learning provides better outcomes than individual learning (Dillenbourg, 1999). In this regard, one of the questions that still needs to be addressed is whether the trend is the same while evaluating and comparing the learning processes of a student learning alone versus learning with a robot and versus learning with another student. This will show whether or not collaborative learning with a robot is as effective and time saving as learning with a human peer (Mubin et al., 2013).

In the last few years, various projects have been carried out to reveal how humanoid robot teachers can contribute to foreign language learning. The focus of these projects has mainly been to determine whether robots can successfully promote learning, as well as to examine the role of embodiment in robot teaching and the role of social interactions in teaching. Belpaeme et al. (2018) showed that, although humanoid robots are highly promising as teaching aids,

we encounter a complex picture because children do not just learn by being exposed to a teaching robot. Therefore, employing humanoid robots in language learning requires thoughtful design decisions and practices in three respects: what the role of the humanoid robot is, how the child's learning is positively supported, and how the humanoid robot's interaction can support this.

Although the benefits of humanoid robots in teaching are clear, there are still several open issues regarding how humanoid robot teachers can be used effectively in an educational setting. Teaching a foreign language to young children necessitates a clear understanding of how foreign language learning occurs in young children and interpretation of how children can sufficiently benefit from teaching. Transferring teaching to humanoid robots rises many other questions (Belpaeme et al., 2018), such as: Should humanoid robots simulate what human teachers do? Should humanoid robots act as a teacher or a peer? How should humanoid robots blend the native language and the foreign language? How should feedback be given?

Appropriate feedback is commonly used to support foreign language learning (Ateş-Şen & Küntay, 2015). Whereas positive feedback is explicitly provided, negative feedback is implicitly provided by recasting the correct information. Regarding the use of humanoid robots as a peer, evidence suggests that peers explicitly provide negative feedback without any correction, and that they do not generally provide positive feedback. The question therefore arises as to whether a humanoid robot should provide feedback when it takes the role of a peer (Belpaeme et al., 2018).

Last but not least, the possible effects of the use of humanoid robots on the human connection existing between teacher and students should not be neglected. The shift to humanoid robots in education may harm the connection if the possible effects are not investigated thoroughly. The teacher has something to gain or lose depending on the success or failure of the students, so s/he is motivated to push them academically. In this regard, humanoid robots designed to be used in schools must be able to show empathy in a convincing way, even if they are never be able to possess real emotional empathy.

Conclusion

The present paper has reviewed the functions of humanoid robots in foreign language teaching and examined novel approaches in the roles of humanoid robots. Research challenges and future research directions in this domain have also been presented. Although the literature does not provide support for the thesis that the physical presence of a humanoid robot alone has an

advantage for foreign language learning, there is sufficient evidence that it has positive impacts on learning and various other interaction outcomes. Due to the scarcity of experimental data, the effect of a humanoid robot on foreign language learning is not yet clear; however, the social behaviour that the humanoid robot can manifest and its motivational benefits are totally clear.

As suggested in this paper, although humanoid robots with multilingual interaction skills can be used in foreign language teaching, their lack of emotional intelligence, intuition and spontaneity, all of which are naturally found in human teachers, makes it difficult for them to observe and understand students' reactions in order to ensure a smooth communication flow. Moreover, if humanoid robots are going to be used as an inspiring and engaging tool, they need to be capable of recognising faces, detecting basic emotions from facial expressions, displaying a broad range of expressions and emotions, and adapting their behaviour to their feelings. However, these skills require significant research in robotics. Therefore, instead of replacing a human teacher, humanoid robots are particularly useful for selected repetitive functions in foreign language teaching. Finally, humanoid robots might create the risk of chaos in the classroom setting, and setting up and turning on humanoid robots at the beginning of lessons is time consuming. Although humanoid robots are more effective than other digital devices, no study indicates that they are more effective than human teachers, so they will not make human teachers redundant. It is expected that, within a few years, the teacher will no longer be the person standing at the front of the classroom. Since some routine tasks, such as marking, assessment and lesson preparation, will be done using computer-based systems, the main role of human teachers will be as organisers and discipliners.

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Digitalisation in Education, Allusions and References

Marianna Vivitsou[1]

The metaphor of digitalisation in education emerged during a period when phenomena such as budget cuts and privatisation, layoffs and outsourcing of labour marked the ethos of the twenty-first century. During this time, digitalisation was constructed as an ultimate purpose and an all-encompassing matter in education. As a result, these narratives add new configurations to the metaphor of digitalisation on an ongoing basis. Such configurations attribute a mythical fullness to the concept, in the sense that digitalisation goes beyond the limits of a property that needs be developed so that society can successfully deal with contemporary challenges and advancements. In this way, digitalisation emerges as a new hegemony in education, with narratives that are more and less directly referential. Less direct references add the element of allusion to the metaphor of digitalisation, in the sense that references can be more implicit/covert or even concealed/hidden. Moreover, as they combine with abstract terms and concepts, they make the boundaries of the technological and educational domains blurry and render education discourse vague. In order to examine the narratives of digitalisation and how they influence education discourse, this study aims to discuss and analyse relevant policy documents in relation to research and studies on the integration of digital technologies in classroom settings and the hybrid (or blended) learning environments that open up. For this purpose, the study uses thematic analysis and discourse analysis in order to trace allusions and references and discuss how emergent meanings relate to current and future needs in education generated by digitalisation itself.

Keywords: narrative, digitalisation, education, UNESCO working papers, hybrid/blended learning environments, allusion, direct/indirect reference

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Digitalizacija v izobraževanju, namigi in reference

Marianna Vivitsou

Metafora digitalizacija v izobraževanju se je pojavila v obdobju, ko so pojavi, kot so: krčenje proračuna in privatizacija, odpuščanja in najemanje zunanje delovne sile (»outsourcing of labour«), zaznamovali etos enaindvajsetega stoletja. V tem obdobju je bila digitalizacija konstruirana kot ultimativni namen in vseobsegajoča zadeva v izobraževanju. Posledično te naracije neprestano dodajajo nove konfiguracije k metaforam digitalizacije. Takšne konfiguracije konceptu prispevajo mitološko polnost, in sicer v smislu, da digitalizacija presega omejitve lastnine, ki mora biti razvita, da se družba lahko uspešno spoprijema s sodobnimi izzivi in z napredkom. Tako se digitalizacija z naracijami, ki so bolj ali manj neposredno referenčne, pojavlja kot nova hegemonija v izobraževanju. Manj neposrednih referenc metafori digitalizacije dodaja element namigovanja, in sicer v smislu, da so reference lahko bolj implicitne/prikrite ali celo prikrite/skrite. Še več, ko se združujejo z abstraktnimi pojmi in s koncepti, zamegljujejo meje tehnoloških in izobraževalnih domen ter proizvajajo izobraževalni diskurz, ki je nejasen. Z namenom preučevanja naracije digitalizacije in njenega vpliva na izobraževalni diskurz skuša prispevek obravnavati in analizirati dokumente relevantnih politik, ki se navezujejo na raziskovanje in študije integracije digitalnih tehnologij v učilnicah ter na hibridna (oziroma mešana) učna okolja, ki se odpirajo. Da bi lahko sledili namigovanjem in referencam ter obravnavali povezovanje vznikajočih pomenov s sodobnimi in prihodnjimi potrebami v izobraževanju, ki jih proizvaja digitalizacija, v prispevku uporabljamo tematsko in diskurzivno analizo.

Ključne besede: naracija, digitalizacija, izobraževanje, delovni dokumenti UNESCO, hibridna/mešana okolja, namigi, neposredne/posredne reference

Introduction

The aim of this study is to examine what new rationalities are emerging in education and society in an era when the discourse of digitalisation in education is becoming increasingly prominent and prevalent in Finland. The metaphor of digitalisation emerged during a period when phenomena such as public education budget cuts and privatisation, higher education layoffs and outsourcing of labour marked the neoliberal ethos of the twenty-first century. During the period 2015–2018, digitalisation was constructed as an ultimate purpose and, as such, an all-inclusive matter. Narratives that convey the all-inclusive character of digitalisation include government documents and other policy documents, and constitute the first wave of digitalisation.

In early 2015, the newly elected government of Finland published a long-term strategic government programme that included a section dedicated to education (Finnish Government, 2015). The theme of digitalisation of education is explicit in the programme, and objectives are set to meet the need to modernise learning environments and new pedagogical approaches utilising digitalisation. Modernisation includes the government funding new learning environments to update school information and communication technology (ICT) infrastructure, teacher education and inservice training to encourage the innovative use of ICT and teaching (Haukijärvi, 2016; Saari & Säntti, 2018). As Saari and Säntti (2018) put it, education discourse in Finland adopts the rhetoric of the information society. This stresses the possibility of bringing the education system up to date with the rest of society through the use of ICT in order to combat economic depression and the low level of productivity.

This narrative is mainly grounded in economic factors. Another relevant narrative stresses the need to move away from outdated pedagogies and learning environments in Finnish schools. As Saari and Säntti (2018) argue, while the former is constructed around a widely recognised truth, the latter might be contested. The argumentative strategy, for instance, of building a claim for the benefits of digitalisation on scientific results is weak. In addition, pedagogy-related narratives seem to calibrate themselves on securing economic competitiveness and safeguarding consensus on the necessity to update school pedagogy. However, evidence of the actual need for technology-based pedagogies seems to be lacking (Saari & Säntti, 2018, p. 448). Saari and Säntti (2018) do not elaborate further on whether consensus has been achieved or not; however, this first wave of digitalisation narratives did indeed raise the issue of general agreement.

The first wave unfolded in the period from 2015 to 2018 and included OECD and government documents, as well as general education discourse that

extended to the end of the previous government's term. The beginning of the new/second digitalisation wave was marked by the fact that the April 2019 elections resulted in a new government, and that UNESCO published a new working paper in the same year. Other sources that are markers of the transition include institutional strategic plans[2] that aim to establish the principles for the future, and thus to play a part in the new governmental policy.

Following the strategy for digitalisation, higher education institutions (HEIs) change the ways that university-based websites and new social media distribute their virtual space. Furthermore, media practices change and become more explicit with regard to future plans for the transformation of education. This means that strategic planning including higher education and the school becomes public on the Internet. In this process, the second wave of digitalisation arises at the intersection of political and rhetorical changes. In addition to expressions directly linked with digitalisation (e.g., digital pedagogy, tools, skills, etc.), rhetorical changes include other related terms (e.g., artificial intelligence and intelligent tools).

In this way, the link between digitalisation and teacher education brought forward by Saari and Säntti's study (2018) and evident in the first wave of digitalisation remains, as does the main argument that, if the future should be digitalised, teachers should be able to make this possible. In an effort to clarify the complicated situation, European and worldwide organisations issue reports aimed at encouraging education policies that address the issue of digitalisation. Narratives of digitalisation, then, tie in with discussions concerning the present and future of teacher education. As a result, the latter intersect with European and international documents (e.g., the UNESCO working papers on education policy, (UNESCO, 2019)) and influence one another in terms of, for example, what needs are established and which terms and concepts relate to those needs.

On the other hand, we cannot ignore the fact that, as Saari and Säntti (2018) argue, official narratives (e.g., OECD, 2015a,b) neglect the historical, ideological and social structure of schools. In this way, the possibility for tension to emerge increases due to overwhelming, yet abstract, promises for education reform and the realities and challenges in schools. The fact that an all-encompassing configuration attributes a mythical fullness to digitalisation makes such tension highly possible.

To explain the mythical dimension, I draw from Laclau's (2005) analysis of hegemony and the work of Holma and Kontinen (2015) in which the

2 For example, see Mission for the Government, University of Helsinki, 2018, https://www.helsinki.fi/en/university/mission-for-the-government-2019-2023-transform-higher-education-and-science-into-a-winning-asset-for-finland.

Gramscian perspective is discussed. Laclau (2005) links the mythical dimension of a property with the property's own limits. The Laclaudian argument is that, at some point in history, a property is attributed more meaning than it really possesses. In this sense, the property goes beyond its own limits and, as a result, acquires a mythical dimension. In our case, a mythical dimension means that digitalisation, although only a partial object in the process of social change, is viewed as the property that needs be developed so that society can successfully deal with contemporary challenges and advancements. This results in radical investment in digitalisation and technology, leading to digitalisation becoming a new hegemonic force in education. Both Laclau (e.g., 2005) and Gramsci (Entwistle, 1979; Holma & Kontinen, 2015) posit that hegemonic forces produce new moral, cultural and symbolic orders. Consequently, new boundaries are constructed. Within this framework, the question of consensus remains open. Consensus etymologically originates from the Latin *con* (= together) *-sentire* (= agree) and signifies general agreement over an issue. If, for example, there is agreement among social actors, including teachers, parents and policymakers, that digital transformation is needed in education, then digital pedagogies are introduced in education institutions and pedagogical practice.

As consensus requires the agreement of the majority, it is not always possible to trace whether it exists or not. It is, however, possible to trace whether there is no significant objection to a decision, policy or practice. This means that if there is no significant objection there is consent, or that permission is granted for a decision to take effect. Consent can be implied, informed or unanimous. For democratic institutions to work, consent is required, coherence of different voices needs to be built, and shared solutions must be sought in order to, in the end, safeguard democracy itself (Holma & Kontinen, 2015).

In the case of digitalisation in education, as mentioned earlier, it is not possible to know whether there is overall agreement about the necessity for digital pedagogy. What we do know, and what our research experience is telling us, is that a number of teachers have consented to integrate technologies into their pedagogical and teaching methods. Nonetheless, the dissociative rhetoric of official documents, as analysed by Saari and Säntti (2018), has brought forward a possible boundary between those in favour and those who resist the "new order". This means that both consensus and consent are at risk, especially when techniques such as praise-blame are used. As the issue cannot be resolved at this point, it is possible that the second wave of digitalisation will deepen the rift if narratives work against social consent for digitally enhanced pedagogies. For consent to exist, building coherence of different voices is needed. In this process, building alliances is essential (Holma & Kontinen, 2015).

Alliances establish the ground for coherent voices to take shape (Entwistle, 1979; Holma & Kontinen, 2015), thus influencing the overall discourse. Leaders in education, teachers and educational researchers are examples of actors whose voices are critical in the process of decision making and policymaking. Although there are power relations influencing how these roles are played out in the political reality, it is not the purpose of the present study to discuss these hierarchies. Moreover, the study takes it for granted that these roles form categories of specialists who are not necessarily elites. In addition, their perspectives should be considered in educational policymaking. These specialists' voices intertwine and interrelate and are distinct from the articulations of policy documents. Coherence can arise when practitioner/specialists' voices and policies resonate each other and one another. In other words, the voices of the actors involved should echo one another and be internally coherent. To this end, they need to be part of the overall discourse.

Policies are normally based on research results and accounts of good practices, and, much like in the case of metaphors and allusion (Irwin, 2001), the relation is unidirectional. For instance, education policies issued in 2019 reflect practices applied prior to that time, while the opposite cannot occur. This means that policy documents allude to other policy documents as well as to other narratives that precede them in time. Our task here is to determine what kind of allusions these are.

The UNESCO papers target education policymakers and aim to anticipate the extent to which digitalisation and artificial intelligence (AI) affect the education sector. As a matter of fact, the 2019 paper shifts the discourse from "digital" to "artificial intelligence", which is a marker of the transition to the second wave of digitalisation. In the discussion, the working paper explores how governments and education institutions rethink and rework education programmes and the challenges and policy implications that should be the focus in global and local conversations. In order to trace how policies and practices resonate one another, and the degree to which their relation is directly or indirectly referential, the study will examine metaphors and allusions of digitalisation.

Considering these, the study aims to examine second wave digitalisation narratives in EU policy documents in order to understand how these relate to practices in the domains of technology and education. To this end, the study will offer a critical discussion of the UNESCO working papers of 2017 and 2019 in relation to research studies on the integration of digital technologies into schools during the period 2012–2016.

The selection of documents was based on the fact that UNESCO papers influence education policy and practice at different levels, ranging from the

local to the international. Therefore, by discussing and analysing the agency's policy documents in relation to research findings, this paper aims to contribute to the overall discourse of digitalisation in education in Finland and Europe, as well as internationally.

Metaphors, digitalisation and digital pedagogy

According to metaphor theorists (e.g., Lakoff, 1993; Lakoff & Johnson, 1980; Ricoeur, 1978; Steen, 2011), a metaphor occurs when we talk about something by means of something else, and therefore a stretch or twist is required for sense making. This metaphorical twist involves a movement to a target domain from a source domain. In our case, digitalisation in education is a metaphorical phrase that requires a stretch of thinking from the technological to the educational domain in order to better understand what technology-enhanced practices involve. Considering first wave narratives, digitalisation is a twenty-first century metaphor that signals a strategic approach to the thorough transformation of the learning space environment, one that requires pedagogical adjustments with the collaboration of experts from various domains (Haukijärvi, 2016).

A metaphor does not necessarily only mark direct references to a target domain. In the case of digitalisation, for instance, the need to make changes in pedagogical methods is a direct reference within the totality of education discourse. As a result, the term digital pedagogy emerges. What constitutes digital pedagogy, however, remains obscure until it is defined in terms of what conditions the digital dimension generates and what new teaching/learning environments arise. In this sense, the reference to digital pedagogy is, rather than explicit, less direct and more covert. Therefore, this kind of reference to digital pedagogy is indirectly referential, and thus allusive in an implicit way (Irwin, 2001).

For further elaboration, I will use the FINNABLE2020 project as an example of direct reference drawing from the field of research and practice. The FINNABLE2020 project is an example of direct reference in the sense that its rationale explicitly states the purpose of digitalisation in education. It is an umbrella project that covers a range of areas, the Boundless Classroom being one of them. The Boundless Classroom encapsulates the intention to use multiple technologies systematically and create a unified and coordinated learning-for-engagement with fun experience for primary and secondary students by combining and dispersing elements of a story across multiple web-based, digital channels and connected classrooms. For this purpose, digital storytelling was developed as a pedagogical/teaching method based on a learner-centred approach aimed at enabling learning through the use of digital devices and

language for the production of stories in a video format. The overall aim was to give students a chance to tell their own stories about the topic under discussion, to highlight participatory practices, to increase engagement in the topic, to sustain collaborative efforts and to encourage shared learning and creativity. The conceptual basis of the implementation was grounded in the relevant literature (e.g., Hull et al., 2009, Lambert, 2013; McGee, 2015; Niemi et al., 2014; Woodhouse, 2008).

Based on the above, the material I draw on here includes research and studies performed by the research teams of CICERO Learning, the research unit at the University of Helsinki, and other relevant work. This paper, then, is to some degree an attempt to summarise our studies and projects (Niemi et al., 2014; Niemi & Multisilta, 2016; Vivitsou, 2016, 2018, 2019a,b) with a focus on the integration of digital technologies in schools.

Research studies themselves constitute narratives that synthesise the overall education discourse on digitalisation. As the narratives of the study will be discussed within a storytelling framework with a focus on integration, not only the main storyline dimensions of technology and pedagogical practice will be considered. Moreover, the settings where the events of the narrative unfold will be part of the discussion. In the case of technology-enhanced pedagogies, settings include the environments for teaching and learning that emerge through the integration of technology in pedagogical practice.

Technology integration in pedagogical practice

The Boundless Classroom/Digital Storytelling project attracted the attention and participation of teachers, students and schools across countries and continents. It involved parent/guardian permission and included introductory sessions at which researchers communicated the project aims to the school community. In this sense, it would be safe to claim that the integration of digital technologies in the school was realised on the grounds of the informed consent of the parties involved.

For research purposes, the digital storytelling-related research and studies involved surveys, field notes, observations and interview data arising while the international projects were organised and coordinated by the University of Helsinki during the period 2012–14. At that time, students from Finland, Greece and California, and later China (2015–16), were involved in making and sharing digital stories with peers across classrooms and countries using a web-based environment. From the start, therefore, there was an emphasis on hybrid/blended learning environments.

Hybrid or blended learning environments combine formal and informal settings and can include virtual classrooms, real-life classrooms, field trips and so on (e.g., Niemi et al., 2014; Vivitsou et al., 2017). As a result, in this kind of learning, not only context collapses in the hybrid situations, but time collapses, as well. In their study, Marwick and Boyd (2014) argue that context collapse occurs when real-life and virtual worlds are in ongoing interaction. Consequently, real-life, face-to-face communication purposes intertwine and become inseparable from the connected interactions. In this sense, the two contexts collapse within each other. In our research experience, evidence of this phenomenon is provided by the fact that schoolwork extends to after-school hours and involves multiple actors (i.e., students, parents, teachers, software developers, and so on). Consequently, both context and time collapse.

Such a complex situation requires a pluralist orientation and involves blending methods in order to cover, for example, the need for the adaptation of previous course design and existing tools (Dziuban et al., 2018) to accommodate digital-related objectives, to establish a participatory culture (Jenkins et al., 2016), to produce multimodal texts, and to address audiences by developing topic-based argumentation in storytelling. In connected classrooms, pluralism also involves consideration of using multiple languages for communication, awareness of peers' background contexts, histories and perspectives, and deep engagement (Niemi et al., 2014; Niemi & Multisilta, 2016) in order for student initiative to emerge (Vivitsou, 2016, 2018, 2019a,b).

Hybrid/blended learning environments for shared solutions

Considering the above, it is evident that hybrid learning situations very much depend on teachers' recursive practices taking action in both virtual and real-life classroom environments. This means that teachers construct professional knowledge in-action and at multiple levels, while observing students performing tasks and modifying decisions in situ. Recursive practices match the current need for flexible and hybridised teaching to guide and support students through the complexities of the digital era, as long as technological design satisfies such needs. In their studies, Niemi et al. (2014) and Niemi and Multisilta (2016) found that virtual spaces can encourage knowledge construction and information seeking, while the combination of formal and informal elements allows student initiative to develop with a focus on the subject matter (Vivitsou et al., 2016; Vivitsou et al., 2017). Overall, quantitative and qualitative analyses of the studies converge, in that multimodalities require literacies and competences that relate to the digital element (e.g., creating, shooting, remixing

stories), while collaboration toward shared solutions is a unifying principle and work in groups in both virtual and natural/real-life contexts is common ground. The ultimate purpose of hybrid/blended learning environments is, therefore, to become spaces where different voices speak in a coherent manner in order to work jointly for shared solutions. In the spirit of pluralism, an overall reconceptualisation of teaching is needed, one that considers fluidity over predefined scripts and in-action professional development.

Using web-based platforms for pedagogical purposes opens up a whole array of possibilities for activities and collaborative work to both structure and problematise the process and support student work (Vivitsou et al., 2017). This type of support is determined when teachers plan classroom work and design the course of action. In this sense, a new pedagogical genre (Vivitsou, 2016) emerges, one that encompasses the ways of acting and the purposes of those who act in order to generate cross-cutting text types, ranging from descriptive to expository to narrative to dialogic and reflective. Teachers' consent to use digital means attests to these insights.

The official rhetoric (e.g., Finnish National Board of Education, 2014; OECD, 2015a,b), however, separates the high level of teacher expertise and ICT use from each other without designating the particular areas in which teacher expertise fails digitalisation. Actually, it might be the other way around. This makes first-wave narratives allusive and implicit, very often hiding meanings.

Allusion is a reference that is indirect, in the sense that it requires more associations than mere substitution of a referent, it often draws on information that is not readily available, it is typically but not necessarily brief, and it may or may not be literary in nature (Irwin, 2001). Indirect reference is necessary but does not constitute a sufficient condition for allusion. For this reason, authorial intent and the possibility of detection in principle are required. Irwin (2001) contends that authorial intent, although difficult to prove, is an epistemological and hermeneutical issue, and, as such, needs thorough investigation. This can occur through the discussion and analysis of in-text associations with other texts and narratives.

Considering these, the present study, rather than seeking intentions, aims to trace allusions and references in policy documents through associations, in order to discuss how they influence the domains of technology and education. To do so, the study will seek to respond to the following research questions:

1. How do themes from the domains of technology and education relate in the first and second wave narratives of digitalisation found in policy documents?

2. What overt and covert references to hybrid/blended learning environments and collaboration emerge?

Methods

In order to discuss and analyse types of allusion and reference, the study will use qualitative methods and a critical discourse analytical framework. To achieve this, changes in the first and second waves of digitalisation will be examined, with a focus on how relevant terms are used. Following this, direct references (i.e., out in the open, overt) and indirect references (i.e., implied, covert) will be discussed in relation to research-based narratives with a focus on learning environments and collaboration. To this end, thematic analysis and discourse analysis will be used to discuss the UNESCO 2017 and 2019 policy documents in relation to earlier research and studies on the integration of digital technologies in the classroom.

For the initial analysis of the study, a keyword search was performed throughout the 2019 document to trace sections containing occurrences of phrases from the domain of technology and education. From the domain of technology, the lexical item "digital" and variations of "artificial intelligence" (i.e., in lower case, upper case and in the form of the initials AI) were used. From the domain of education, the items "teacher" and "teaching" were used. The results were compared with relevant searches in the 2017 UNESCO working paper. In this way, both first and second wave narratives of digitalisation were included in the database. A thematic analysis then followed, in order to identify key categories (Saldana, 2009) in the 2019 paper. Finally, a post-foundational discourse framework of analysis (Marttila, 2015) was applied to examine these types of text in relation to developments in both the technological and the educational domain.

Findings

As mentioned above, the 2019 paper shifts the discourse from "digital" to "artificial intelligence" and marks the transition to the second wave of digitalisation. In this transition process, keyword search findings indicate that the appearance of the "digital" element is still quite marked, while links are drawn to build the AI narrative in education. As discussed below, frequencies of the use of key terms play a role in this shift in discourse.

Terms and frequency of use

As shown in Table 1 below, there is more frequent use of the adjective-noun phrase "artificial intelligence" and less frequent appearance of "teacher" and "teaching" in the 2017 and 2019 working papers.

Table 1
Use of Terms in the Domains of Technology and Education.

	Technology			Education	
	2017	2019		2017	2019
Digital	638	96	Teacher	197	84
AI	5	441	Teaching	37	16

Note. Adapted from UNESCO reports, 2017, 2019.

More particularly, initial analysis shows an increased occurrence of various forms of artificial intelligence in the 2019 document. In contrast, occurrences of "digital" decrease compared to the 2017 document. For instance, "digital" appears in 638 adjective-noun phrases in 2017, but in only 96 in 2019. On the other hand, the term artificial intelligence appears in a total of 441 uses in 2019. In addition, the items teacher and teaching appear in 84 and 16 mentions, respectively, in 2019, but 197 and 37, respectively, in 2017.

Following this, a later stage of the analysis focuses on the 2019 paper and aims to identify which sections make use of the digital item. The findings show that, of the three sections of the document, Section II mainly uses phrases such as digital technologies, digital skills, digital competence/competencies and digital literacy. While these appear in subsections discussing preparing learners and the need for a new curriculum, the occurrences of digital are scarce in subsections about post-basic education and higher education. In contrast, the frequency of use of artificial intelligence and its variations increases throughout the 2019 working paper.

Main themes

Thematic analysis in the sections more relevant to the domain of education reveals two major themes in the 2019 paper: preparing learners and preparing teachers.

Preparing learners for future demands

The thematic analysis draws from Sections II and III of the 2019 document. More particularly, Section II, entitled "Preparing learners to thrive in the future with AI", presents examples from different contexts, while its subsection on the new curriculum for a digital and AI-powered world elaborates on the importance of advancing digital competency frameworks for teachers and students. This part points out the importance of developing new skills to create and decode digital technologies, and illustrates curricular reform efforts in many countries. The latter reveal the need for skills that would allow learners to identify and solve problems using computing techniques, methods and technologies. The word digital is used in adjective-noun phrases to modify words like technologies, skills and competencies. These combinations lead to the articulation of the main objective, which is to develop learner abilities to analyse, use and decode AI, as powerful technology whose scope, limitations, potential and challenges need to be understood.

The following subsection concerns digital competencies frameworks, presenting examples of frameworks and definitions of digital literacy and competencies. One of the example frameworks underlines the need for teachers to both manage digital technologies and teach them to students, in order to help students to be capable of collaborating, solving problems and being creative in the use of digital technologies.

Computational Thinking (CT) is the title of the last part of the section containing the frequent use of mainly digital +noun phrases. This subsection points out the interdisciplinary nature of CT, in the sense that it finds applications in disciplines other than computer science. According to the document, the presence of AI in the workplace is increasing, which makes CT a critical competency if learners are to cope with changing labour market demands. Examples of the level of CT integration in curricula follow. In these examples, countries are clustered based on the universal recognition across the EU of the importance of integrating CT. The main categories include countries that have commenced a curriculum review and redevelopment, those that are planning to introduce such a review, and those that have a longstanding tradition of computer science education, particularly in secondary school. The subsection that follows concerns higher education and contains no use of the word digital, while the appearance of AI variations become more frequent than in the preceding sections.

Challenges in preparing teachers

Section III concerns challenges and policy implications, explaining that these should be part of global and local conversations on the possibilities and

risks of introducing AI in education. One challenge is to prepare teachers for AI-powered education. This is a two-way path: on the one hand, teachers must learn new digital skills to use AI in a pedagogical and meaningful way, while, on the other, AI developers must learn how teachers work and create sustainable solutions in real-life environments

The section discussing how to prepare teachers for AI-powered education and preparing AI to understand education points out that the effectiveness of learning analytics systems lies in their usefulness and relevance to both learners and educators. The claim is made here that teachers should be given autonomy to manage classrooms and schools, as it is teachers who are most familiar with learners' needs. The report concludes that teachers will remain at the frontline of education, adding that it is misinformed to claim that AI can replace teachers. In this respect, teacher training is a critical aspect of teacher empowerment to use education data to improve pedagogy. Training programmes should account for new competencies and aim for a clear understanding and a critical perspective on technologies, development of research and data analytical skills to eventually enable teachers to take advantage of AI.

Overt and covert references

Following the thematic analysis, Sections II and III and their subsections were further analysed in order to trace overt and covert references in the policy document to the educational domains related to hybrid learning environments and collaboration. Table 2 below shows part of the results of this analysis.

Table 2
Overt and Covert References in Technology and Education/Pedagogy Domains

	Technology	Reference	Education/pedagogy	Reference
Hybrid learning environments	digital devices digital technologies	Overt	digital era digital content digital identity digital society	Covert
Collaboration	Academic institutions with private companies; between industry and the education sector AI developers Digital Maker movement Making curriculum Maker framework	Overt	Communication and collaboration (technologies, identity) (Basic) Digital literacy Digital skills, Digital competence and gaps Digital Solutions Digital Communications Digital Learning	Covert

Note. Adapted from UNESCO report, 2019.

As shown in Table 2 above, in the domain of technology, there are overt references to digital devices and technologies, and thus an explicit link is established with tools used in blended environments. However, the link is rather abstract and generic and, as such, very loose. The link is more explicit in the area of collaboration, although an elaboration of the conditions that should underlie the collaboration of academic institutions with the private sector would make the picture a lot clearer. Links with the domain of education are less overt in relation to both learning environments and collaboration. Again, references are rather superficial, without properly elaborating, for example, what relations exist in "digital era", "identity" and "society", and how they interact with reality.

Discussion

This is a first attempt to discuss and analyse narratives of digitalisation and draw conclusions about how these relate to developments in the domain of technology and education. More studies are therefore needed to further investigate the phenomenon and confirm or falsify the findings. For this purpose, more documents should be included in the database for analysis, drawing from the work of other social partners and actors, such as NGOs, with experience in the training and application of digital methods and literacies. The findings could then be discussed in relation to the domains of technology and education.

The present study offers insights into three main categories of examination. In terms of narrative shifts, the findings of keyword searches show that there is a movement from the digital element to the notion of artificial intelligence. More studies are therefore needed on the definitions, significations and applications of artificial intelligence, since the discussion is heading in that direction.

Although there is no direct reference (e.g., quotation) to it, the 2019 paper echoes the earlier report on "Digital skills for life and work" (UNESCO, 2017). Thus, the narrative arguing for the need to digitalise education and provide online learning opportunities continues. This provides evidence of allusion in the more recent report and, along with stylistic similarity and lexical properties, echoes the earlier one. This manifestation of allusion occurs in more and less explicit ways, and is mainly indirect and articulated through the use of phrases containing the word digital.

Consequently, the references to what online learning opportunities will be like are more covert than overt, and the meanings become, to some degree, concealed, especially in relation to hybrid/blended environments and collaboration. There are therefore gaps in the report from a methodological,

conceptual/theoretical and practical point of view. For example, problems arising from recursive practices in hybrid situations, and solutions to tackle these problems, are not mentioned. Eventually, even if we consider the aphorism included in the report as evidence of critical discussion, the lack of associations with other parts of the text makes the allusion lose its meaning. The aphorism refers to innovations in education as full of lost promises, through failing to understand how teachers work and the culture of schools. As a result, the report suggests, AI developers need to participate in new dialogues with educators, content designers and cross-disciplinary specialists. Although the section opens up space to draw parallels with computational thinking and ground CT within the overall education discourse, this opportunity is not used.

Conclusions

The present study discusses and analyses first and second wave narratives of digitalisation in policy documents and examines how shifts in thematic choices and terminology relate to developments in the domains of technology and education. This is an important task, as government and European documents establish the ground for a consensus favourable to digitalisation in education. The importance of the task lies in the fact that the praise-blame rhetorical technique employed in first wave policy documents makes discourses of consensus and boundaries of consent blurry and divides interpretations of the teachers' role in education. On the one hand, the expertise of Finnish teachers is recognised as being high quality; on the other, their use of technology is supposed to be meagre.

Our research experience (e.g., Vivitsou 2016, 2018, 2019a,b) in the area of integrating digital technologies into classroom practices, however, has shown that teachers consent to technological integration on the basis that it expands the learning environment from conceptual, methodological and practical points of view that take into consideration the nature of digitalisation, artificial intelligence, virtual reality and other configurations of technology. Claiming that there is no need for digital pedagogy is therefore an oversimplification. However, pedagogical adjustment would require a marked reference of both parts of the adjective-noun phrase (i.e., DIGITAL PEDAGOGY, instead of DIGITAL pedagogy) to balance out the metaphor (Vivitsou, 2019b).

While the argument for pedagogical adjustments is valid, a more sophisticated approach to pedagogy is needed. Practically, this means that if teachers and the wider community are to keep renewing their consent to technology-enhanced practices, teacher education and related narratives should incorporate

more critical and socially embedded paradigms and approaches to technology. As Holma and Kontinen (2015) point out, social consent requires building alliances to articulate coherent voices able to balance out the hegemonic force of technology and safeguard democracy. Teachers are certainly one part of this constantly evolving equation.

It becomes more and more evident nowadays, for instance, that the model of deregulation that Finland has adopted opens the door to privatisation and marketisation in education. As Hovemark et al. (2018) explain, deregulation means that state rules on the internal work of schools are delegated to lower administrative levels such as municipalities. Thus, instead of being the main provider, the state becomes the regulator of a system that becomes more and more market-oriented. The second wave of deregulation in the 2000s presents an example of the complexity of the situation. During that time, the attempt to create a school market by profiling schools, using privatisation and intensified school choice, gave rise to questions of segregation and differentiation (Hovemark et al., 2018). This put at risk the profile and the essence of Finnish education as a system that combines top quality with equality, equity and equal opportunities.

Consequently, the integration of technology in schools creates scepticism in the wider society as to who is going to be authoring the narrative of education in the years to come. Technology actors such as AI developers and companies are part of the alliance-building process. However, the limits of their role still remain uninvestigated and underdefined at this point. The UNESCO policy documents, for instance, make direct reference to AI developers and partnerships between education, industry and the private sector, but they do so in a generic and abstract manner. As the stakes are high, such partnerships should be thoroughly described, because, in the end, we will be called upon to answer hard questions regarding, inter alia, who will be making decisions: Educators? Developers? Companies? All of these? And under what conditions?

Unfortunately, the working papers do not respond to these questions at the moment; in fact, they barely pose them. From the point of view of rhetoric, it seems that the more direct references to technology-based narrative increase, the more references to pedagogy and teachers/teaching decrease and become more covert and, ultimately, concealed. However, this opens up the space for further dispute rather than consent.

According to Irwin's (2001) interpretation, we can construct allusions to purposefully elicit and include the reader's response. Moreover, Irwin adds, the goal is to please the reader/receiver of the intended message, albeit indirectly. As a matter of fact, etymology concurs with this view. Allusion has a Latin

origin and stems from *alludere* (= to mock, play with). This insight offers a specific purposefulness to allusion and adds to its metaphorical gamut. On this basis, we might need to consider the possibility that allusions are by nature incomplete and the process of completing them is a productive one, which results in the most important element of the text always being missing. In our case, what is missing at the moment is a more generalised effort to put together think tanks and research to establish shared spaces for shared intelligences to confer and negotiate toward shared solutions to common problems.

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Biographical note

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Instructional Leadership Effects on Teachers' Work Engagement: Roles of School Culture, Empowerment, and Job Characteristics

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In the article, the relations between the principal's instructional leadership, school culture, psychological empowerment, job characteristics, and teachers' work engagement was examined on a sample of 310 elementary school teachers. The results showed no direct effects of the principal's instructional leadership on work engagement; however, they proved the belief that the principal could have an indirect effect on teachers' work engagement through indirect variables: school culture, teacher empowerment, and job characteristics. The research method is structural equation modelling, for the purpose of which five research tools (the Principal Instructional Management Rating Scale, the School Culture Survey, the Job Diagnostic Survey, the Psychological Empowerment Questionnaire, and the Job Engagement Questionnaire) were used for data collection. The participants were selected through a stratified sampling method. The reliability was assessed by Cronbach's alpha. The results showed that the model fitted the data and that the relationship between instructional leadership and job engagement was established entirely through school culture, empowerment, and the job characteristics of teachers. The principals are recommended to apply the instructional leadership approach. By assisting teachers in collaboration, instilling collective leadership, and communicating a shared vision, the principals can contribute to developing a positive and participatory school culture.

Keywords: instructional leadership, work engagement, school culture, empowerment, job characteristics

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Učinek določitve učnega načrta in usmerjanja pouka, ki ga izvaja ravnatelj, na delo učiteljev: pomen šolske kulture, opolnomočenja in značilnosti poklica

Adel Zahed-Babelan, Ghodratollah Koulaei, Mahdi Moeinikia in Ali Rezaei Sharif

V članku smo na vzorcu 310 osnovnošolskih učiteljev preučili odnose med ravnateljem, ki določi učni načrt in usmerja pouk, šolsko kulturo, psihološkim opolnomočenjem, značilnostmi poklica in delovno angažiranostjo učiteljev. Izsledki niso pokazali neposrednih učinkov ravnateljevega usmerjanja na delovno vnemo, vendar so podprli prepričanje, da bi lahko ravnatelj posredno vplival na delo učiteljev prek posrednih spremenljivk: šolske kulture, opolnomočenja učiteljev in značilnosti poklica. Metoda raziskave je modeliranje strukturnih enačb, pri čemer smo uporabili pet raziskovalnih orodij za zbiranje podatkov: ocenjevalno lestvico usmerjanja pouka, ki ga je izvajal ravnatelj, anketo o šolski kulturi, anketo o poklicni diagnostiki, vprašalnik o psihološkem opolnomočenju, in vprašalnik o poklicnem udejstvovanju. Preiskovanci so bili izbrani z metodo stratificiranega vzorčenja. Zanesljivost je bila ocenjena s Cronbachovo alfo. Izsledki so pokazali, da model ustreza podatkom ter da je bilo razmerje med ravnateljevim usmerjanjem pouka in zaposlovanjem v celoti ugotovljeno s šolsko kulturo, z opolnomočenjem in s poklicnimi značilnostmi učiteljev. Ravnateljem se predlaga, da uporabijo pristop, v katerem določijo učni načrt in usmerjajo pouk. Ti lahko prispevajo k razvoju pozitivne in sodelovalne šolske kulture, in sicer tako, da pomagajo učiteljem pri njihovem medsebojnem sodelovanju, da vzbudijo kolektivno vodenje in sporočijo skupno vizijo.

Ključne besede: določitev učnega načrta in usmerjanje pouka, delovna vnema, šolska kultura, opolnomočenje, značilnosti poklica

Introduction

Leadership is one of the most studied topics in the organisation sciences, and employee engagement one of the more recent. However, the relationship between leadership and employee engagement has not been widely investigated. As many organisations invest significant resources in retaining, developing, and engaging employees, human resource development (HRD) professionals are tasked to develop and partner with leaders to deliver those strategies effectively. Thus, a comprehensive understanding of the relationship and mechanism between leadership and engagement is essential in order to inform leaders on how best to cultivate positive results in followers (Carasco-Saul, 2014; Kim & Kim, 2014).

Leadership has increasingly been perceived as a critical factor in organisational as well as school effectiveness. The increased interest in instructional leadership evidenced over recent decades is due to the trend of continuous reforms of education systems throughout the world. These changes have led to a dramatic growth in the importance of the role assigned to school leaders, both individually and collectively (Hallinger & Huber, 2012). According to Hallinger and Heck (1996), studies yielded frequent instances of positive findings concerning the role of the principal in school effectiveness.

Work engagement is a matter of concern for leaders and managers in organisations across the globe; they recognise it as a vital element affecting organisational effectiveness (Welch, 2011). Work engagement is defined as a positive, fulfilling, work-related state of mind that is characterised by vigour, dedication, and absorption (Schaufeli et al., 2002). Employee engagement concerns the degree to which individuals make full use of their cognitive, emotional, and physical resources to perform role-related work. Thus, employees who are engaged in their work have energetic, enjoyable, and effective connections with their work (Xu & Thomas, 2011). They state that leadership is a crucial antecedent to engagement. Leadership research shows that certain leadership behaviours have a clear association with engagement. Trust in the leader, support from the leader, and creating a blame-free environment are considered to be components of psychological safety, a condition proposed by Kahn, which leads to employee engagement. However, few studies have attempted to provide evidence of association between leadership and employee engagement (Bedarkar & Pandita, 2014), In other words, a gap remains in understanding what leadership behaviours could affect engagement-encouraging cultures as well as the processes around which leader behaviours bring about higher levels of engagement, which is in line with the more drastic argument that there is no research directly linking leaders' behaviours and follower engagement (Xu &

Thomas, 2011). By examining current literature that studied the relationship between leadership and employee engagement, we have attempted to fill the knowledge gap while offering a comprehensive understanding of that relationship to leaders in organisations.

The task of unravelling the effects of instructional leadership on teacher engagement has been complicated by the concurrent effects of three related but separately measured constructs: school culture, teacher empowerment, and their job characteristics.

In the 1980s, when instructional leadership emerged as a new construct, some scholars questioned both its relevance and viability as a guiding metaphor for school leadership. Thirty years later, 'instructional leadership' and 'leadership for learning' are widely accepted by policymakers and practitioners as essential elements of management practice in schools. Indeed, recent reviews of research largely confirm early assertions concerning the relationship between instructional leadership and student learning. Thus, contrary to early predictions, instructional leadership has demonstrated impressive staying power as a core concept guiding both practices in the field of educational leadership and management (Hallinger, 2010).

The dynamic processes of culture creation and management are the essence of leadership and lead one to understand that leadership and culture are two sides of the same coin (Schine, 2004). School culture is commonly used to describe the unique working conditions inside organisations and to distinguish one school from another. Organisational culture represents a broad umbrella, referring to the traditions, rituals, shared norms, and assumptions of a school. These site-specific beliefs are adopted over time and provide a distinct character to the school. Educational theorists have reported that the principals' impact on learning is mediated through the culture of the school and is not a direct effect (Hallinger & Heck, 1998). There is substantial evidence in the literature to suggest that a school principal must first understand the school's culture before implementing change. Bulach (2001) stated that a leader must identify a school's existing culture before attempting to change it. Leonard (1999) studied the dynamics and complexities of a school culture when teacher values were compatible or in conflict with school culture, with predictable results. Mortimore (2001) warned that we should concentrate on establishing more knowledge about the complex interactions between culture and schooling. Lakomski (2001) studied the claim that it is necessary to change an organisation's culture to bring about organisational change and concluded that there is a causal relationship between the role of the leader and organisational learning. Leaders use culture to shape employee engagement (Gordon, 2013). A collaborative culture

is the foundation upon which a professional learning community rests. Such a culture is an essential ingredient for long-term, continuous school improvement (Deal & Peterson, 1999). Collaborative school cultures have been presented as the best setting for learning for both teachers and students. School leaders that shape their cultures to become more collaborative should reap the benefits of greater teacher performance and satisfaction. Many authors have written about school culture. For this study, 'culture' is defined as the guiding beliefs, assumptions, and expectations that are evident in the way a school operates (Gruenert, 2005). Successful school principals comprehend the critical role that the organisational culture plays in developing a successful school (MacNeil et al., 2009). School cultures are categorised as either positive, toxic or anywhere in between. Core values within the school often play an essential role in determining the type of culture one will find in a school. A positive school culture is the result of many influences. Schools should be focused on creating a learning community for all involved. All individuals should have a sense of caring and respect for each other. Staff and students need to be positive about their ability to set and achieve ambitious goals. Positive attitudes go a long way in developing and maintaining a positive culture. As instructional leaders, principals can create a positive and collaborative school culture. By helping teachers collaborate, instilling collective leadership, and communicating a shared vision, principals can contribute to developing a positive and collaborative school culture. Principals may consider providing teachers with frequent common planning and team time, and an atmosphere of lifelong learning and trusting relationships in order to establish a positive and collaborative school culture. People in toxic cultures tend to concentrate on negative values. Classrooms often become isolated with no deeper bond to bring them together. People become fragmented in other ways. The result is that the school lacks a shared vision. People then feel lost and become negative about their situation. The whole culture becomes dysfunctional (DuPont, 2009). Healthy school cultures can '[…] lead to enhanced commitment and performance that are beyond expectations. As a result, the school is better able to achieve its goals (Sergiovanni, 2006).

There are many different ways to assess school culture with none being perfect. Steven Gruenert (1998) developed The School Culture Survey. Gruenert argues that researchers need to use both quantitative and qualitative assessments to measure organisational culture. The researchers use The School Culture Survey combined with qualitative methods the researcher will gain the necessary insights to describe a culture.

Employee empowerment has been recognised as an essential contributor to organisational success. Empowering employees is essential for organisations

to react quickly to changes in the environment. Psychologically empowered employees positively influence individual and organisational outcomes. Psychological empowerment is positively associated with engagement and commitment. Jose and Mampilly (2014) showed that 71.7 per cent of the variation in employee engagement is explained by the four dimensions of psychological empowerment together. Psychological empowerment is defined as a motivational concept composed of four dimensions: meaning, choice, competence, and impact. Meaning corresponds to the value employees assign to their job according to their beliefs and standards. It is the fit between the requirements of a task or work goal and personal values or ideas. Meaning in work is seen as a method of fostering employees' motivation and attachment to work, thus resulting in engagement. Choice refers to the degree to which an individual perceives that he can initiate and regulate his actions. The core element of this concept is the feeling of self-determination. Workers feel responsible for their outcomes if they experience autonomy to make decisions regarding their tasks. According to the Job Demands Resources model of work engagement, job resources such as autonomy start a motivational process that leads to work engagement. Competence is defined as the employees' beliefs in their capability to perform their tasks skilfully. It refers to the perception that one has the required abilities to cope with different work situations (Spreitzer, 2007). Competence derives from the concept of self-efficacy, which promotes initiative, persistence, and greater effort to deal with difficult situations (Bandura, 1969). Finally, impact corresponds to the perception that employees' behaviours may influence results at work. It is the degree to which employees feel that they can make a difference through their behaviours in order to accomplish their task goals that contributes to employee engagement (Quiñones, Van den Broeck, & De Witte, 2013). Rinehart, Short, Short, and Eckly (1998) found that empowerment can be traced to the relationship between principals and teachers. If the thrust of reform is to shift decision making to those closest to the core, then teacher empowerment is an essential issue; and the association between principals and teachers becomes paramount. Therefore, principals should develop persuasive attributes of pursuing similar goals. School leaders may enable the empowerment of teachers and teams by frequently expressing their genuine belief that teachers care about the goals of the school, are competent to make good decisions in areas of major concern and are presumptively honest in their intentions (Dee, Henkin, & Duemer, 2003).

Teacher empowerment is increasingly gaining attention among scholars and practitioners across educational contexts due to its positive associations with a number of teachers' work-related outcomes. A basic assumption of

teacher empowerment is that teachers are autonomous professionals who are willing to perform their best at work when they feel intrinsically motivated and satisfied. Accordingly, advocates see an imperative need for school leaders to adopt a more empowering management approach to facilitate teacher empowerment effectively. However, the relationship between psychological processes of empowerment, particularly in terms of school leaders' empowering behaviours and teachers' psychological empowerment remains largely underexplored according to Lee and Nie (2014). They found that principals' perceived empowering behaviours were not directly associated with teachers' job satisfaction but teachers' work motivation (i.e., meaningfulness, competence, choice and impact) was positively associated with teachers' job satisfaction. They speculated that the principals' perceived empowering behaviours might be indirectly associated with teachers' job satisfaction through teachers' work motivation.

Despite limited empirical research on teachers' psychological empowerment as a mediating variable, many recent studies in the non-educational work contexts have reported that employees' psychological empowerment mediated the relationship between leaders' empowering behaviours and employees' work outcomes such as job satisfaction.

Research suggests that followers are paying more attention to concepts such as meaningful work, authenticity, and social responsibility. Thus, the leaders need to be prepared with new perspectives, visions, and models that equip them to meet the challenges of an evolving organisational landscape (Shuck & Herd, 2012). Management and leadership play a significant role in employee engagement, but it is equally important for employees to have enthusiasm for the work that they do. Beyond mastering the job's tasks, employees need to feel pride in what is being accomplished and share in the excitement when goals are achieved. The more employees feel they are building their own skill sets and feel competent and in control of their work product, the more likely they are to demonstrate high levels of engagement (Wiley, 2010). According to the job characteristic theory, having new tasks incorporated into an employee's daily work changes the 'core job characteristics' of that work. This model provides employees with more experienced meaningfulness, more experienced responsibility, and greater knowledge of the fruits of their labours—three psychological states that motivate employees and increase their job satisfaction. When administrators trust faculty with decisions dealing with issues of teaching and learning, time, teachers' voices will eventually be heard in the spheres of administrative decisions. Eventually, the principal's influence will expand too, into the spheres of teaching and learning. This form of work redesign will flatten the organisational hierarchy as both groups share their traditional spheres of work.

Thus, it is suggested that administrators experiment with redesign reforms that redefine the nature of teachers' work (Mayrowetz & Smylie, 2004). Therefore, one of the fundamental ways in which leaders influence followers is by creating meaningful work. Testing this notion, we linked leadership behaviours to employees' perceptions of their jobs (e.g., the significance, meaningfulness, and importance of the work). Salancik and Pfeffer (1978) argued that characteristics of a job or a task are 'not given but constructed'. In other words, employees use information from their social context (such as social norms and expectations) to make judgments and develop perceptions of the 'meaningfulness, importance, and variety of the job'. Salancik and Pfeffer further specified that supervisors are a potent source of social information and that they can affect employees' attitudes about their jobs and tasks to a considerable extent.

Based on the review of the literature, the hypothesised conceptual model that guided this study is displayed in Figure 1. In this model, leadership is viewed solely as an independent variable. Therefore, principals are hypothesised as shaping a variety of processes that indirectly influence teachers. Understanding the routes by which principals can improve school outcomes is a worthy goal for this research.

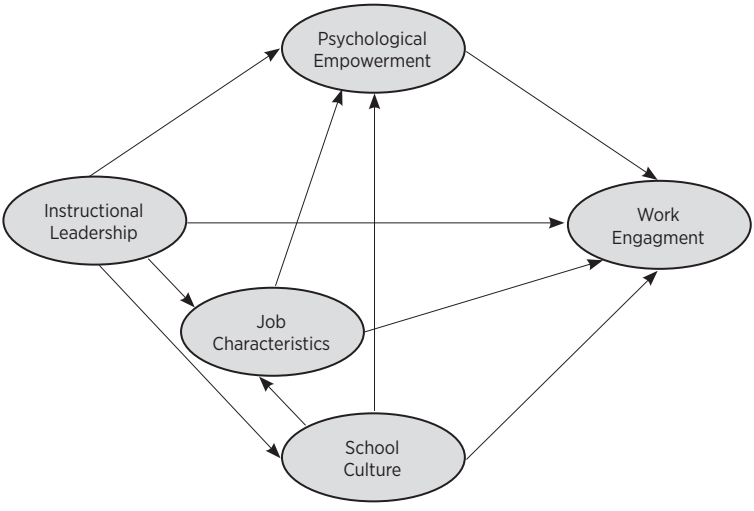

Figure 1. Theoretical framework.

Based on the model the following hypotheses have been formulated:

- H1: Instructional leadership is positively related to work engagement.
- H2: Instructional leadership is positively related to school culture.
- H3: Instructional leadership is positively related to job characteristics.

- H4: Instructional leadership is positively related to psychological empowerment.
- H5: Instructional leadership affects psychological empowerment indirectly via school culture and job characteristics.
- H6: Instructional leadership affects job characteristics indirectly via school culture.
- H7: Instructional leadership affects work engagement indirectly via school culture, psychological empowerment and job characteristics.
- H8: School culture affects psychological empowerment indirectly via job characteristics.
- H9: School culture affects work engagement indirectly via psychological empowerment and job characteristics.
- H10: Job characteristics affect work engagement indirectly via psychological empowerment.

Method

Data collection

To achieve the objectives of the study, we used structural modelling to test the fit of the conceptualisations that model principals' instructional leadership effects on teachers' engagement.

The study utilised a five-part questionnaire, which contained a series of questions to which participants responded by indicating their level of agreement/disagreement on a five-point scale ranging from strongly agree (score = 5) to strongly disagree (score = 1). Data were collected on the following measures.

Principal instructional leadership was measured using a 22-item scale derived from a short version of the PIMRS[3] Teacher Form Scale measuring the three dimensions (i.e., Defines the School Mission, Manages the Instructional Programme, Develops a Positive School Learning Climate) (Hallinger & Wang, 2015).

School Culture Survey (SCS), a six-factor, 35-item survey was completed by teachers about their school's culture. The factors are (1) Collaborative Leadership, (2) Teacher Collaboration, (3) Professional Development, (4) Collegial Support, (5) Unity of Purpose, and (6) Learning Partnership.

The Empowerment Scale. Spreitzer's (1992) multidimensional measure of empowerment is a self-report scale that includes four types of feelings: (a) autonomy, defined as a sense of freedom in making choices about how to

3 Principal instructional management rating scale.

do one's work, and the resulting feelings of personal responsibility for these choices; (b) competence, defined as the belief in one's ability to perform a job successfully; (c) meaningfulness, defined as the perceived value of one's job in relation to one's personal beliefs, attitudes, and values; and (d) impact, defined as the belief that one is producing intended effects and has control over desired outcomes through one's task behaviour (Spreitzer, 1992).

The Job Diagnostic Survey. Employees' perceptions of their jobs were assessed using a 23-item version of the Job Diagnostic Survey (Hackman & Oldham, 1980). Employees responded to statements about their job on a scale ranging from 1 (very inaccurate) to 5 (very accurate).

Employee Engagement. To measure employee engagement, the short form of the Utrecht Work Engagement Scale (UWES) was used (Schaufeli et al., 2006). The UWES includes three dimensions of engagement (vigour (3 items), dedication (3 items), and absorption (3 items)) to comprise a nine-item measure. The items are presented as descriptive statements, and respondents indicate the frequency with which each statement applies on a five-point scale.

Participants and data analysis

The statistical population of the study consisted of 1,606 teachers, working in 168 elementary schools. The sample size was determined based on Krejcie and Morgan's formula (1970), which consisted of 310 participants selected via a proportional stratified random sampling approach. Participants of the current study were a random sample of male and female elementary teachers in the northwest of Iran (West Azerbaijan Province), working in an urban teaching district. Of the subjects, there were 289 females and 21 males. The mean ages of the subjects were 36.11 (women), and 34.55 (men) years; 6% of respondents did not mention their age. They were of two educational levels: Bachelor (N=266) and Master (n=29); 5% did not state their educational level. According to Noora (2008), the culture of teaching in Iran is primarily teacher-centred, and the curriculum in schools is a top-down curriculum; the Ministry of Education dictates all the decisions regarding textbook selection and the exams. However, not much control is exerted on teaching methodology. The results of the exams are not determined by numerical scores but use the terms 'excellent', 'good', 'satisfactory' and 'needs further improvement'. Most teachers are strict about setting lots of supplementary books for students to work on preparation for exams, in addition to the books they study at school.

We tested the model using structural modelling software, LISREL 8.8. Structural modelling, a form of path analysis, allows the testing of assumptions

of causality in relationships among multiple variables within a model. It fits the need in this study to understand relationships among multiple interrelated variables.

Results

Even though all measurement scales were validated in previous studies, it was necessary to ensure the reliability and validity of the measurement scales in this study. To do this, this study assessed the internal consistency of each construct measurement scale by Cronbach's alpha coefficient estimates and examined interconstructs' convergent reliability by interconstruct correlation coefficient estimates. The resulting findings are shown in Table 1.

Table 1
Reliability Estimates

α for whole items of each instrument			α for sub-dimensions of each instrument	
Instructional Leadership	22 items	.96	Defining the School Mission	.88
			Managing the Instructional Programme	.92
			Developing a Positive School Learning Climate	.91
School Culture	35 items	.97	Collaborative Leadership	.92
			Collegial Support	.78
			Learning Partnership	.79
			Professional Development	.83
			Teacher Collaboration	.82
			Unity of Purpose	.84
Empowerment	12 items	.94	Competence	.81
			Autonomy	.87
			Impact	,86
			Meaningfulness	.74
Job Characteristics	23 items	.91	Skill Variety	.68
			Task Identity	.74
			Task Significance	.71
			Autonomy	.68
			Feedback	.65
Work Engagement	9 items	.95	Vigour	.82
			Dedication	.90
			Absorption	.93

As shown in Table 1, the internal consistency reliabilities for all of the constructs exceeded Nunally's (1978) required level of .70 (from α =.91 to α =.97). Thus, the measures tended to be reliable in the context. Additionally, this study also assessed the internal consistency for each sub-dimension of the measurements. (Coefficient alpha ranges from .65 to .93). Furthermore, correlation analysis indicated acceptable inter-correlations among the latent variables at the p = 0.01 level, as shown in Table 2

Table 2
Correlation Matrix of ETA and KSI

Variable	Mean	2	3	4	5	1
2) School Culture	137.56	1.00				
3) Psychological Empowerment	45.92	.93	1.00			
4) Job Characteristics	90.26	.77	.79	1.00		
5) Work Engagement	35.33	.95	.98	.79	1.00	
1) Instructional leadership	86.23	.90	.89	.74	.89	1.00

Testing the structural model

The structural relationships among five variables were tested by structural equation modelling (SEM) using the Lisrel 8.8 statistical package. SEM allows researchers to examine measurement errors and both direct and indirect structural relationships among variables. As shown in Table 3, the hypothesised model provided an overall adequate fit to the data.

Table 3
Model Fit Indices for Hypothesised Model

Model Fit Indices	χ^2	χ^2/df	RMSEA	SRMR	RMR	GFI	AGFI	CFI	NFI
Hypothesised Model	381.65	2.12	.067	.027	.42	.87	.84	.99	.99

As depicted in Figure 2 and with regard to the measurement part of the structural model, all factor loadings of the constructs for each latent variable are greater than .50 (Hair et al., 2006), indicating statistical significance (factor loadings ranged from .79 to .96). The effect size of the paths was determined by standardised path coefficient (SPC), which represents standardised regression coefficients that measure the effect of one variable on other variables. The significance of SPC is determined by a t-value, and when that value is higher than 1.96 (Kline, 2011), SPC estimates are statistically significant. They are depicted near the lines

in Figure 2. The results showed that most of the hypothesised structural relationships among the five latent variables were statistically supported.

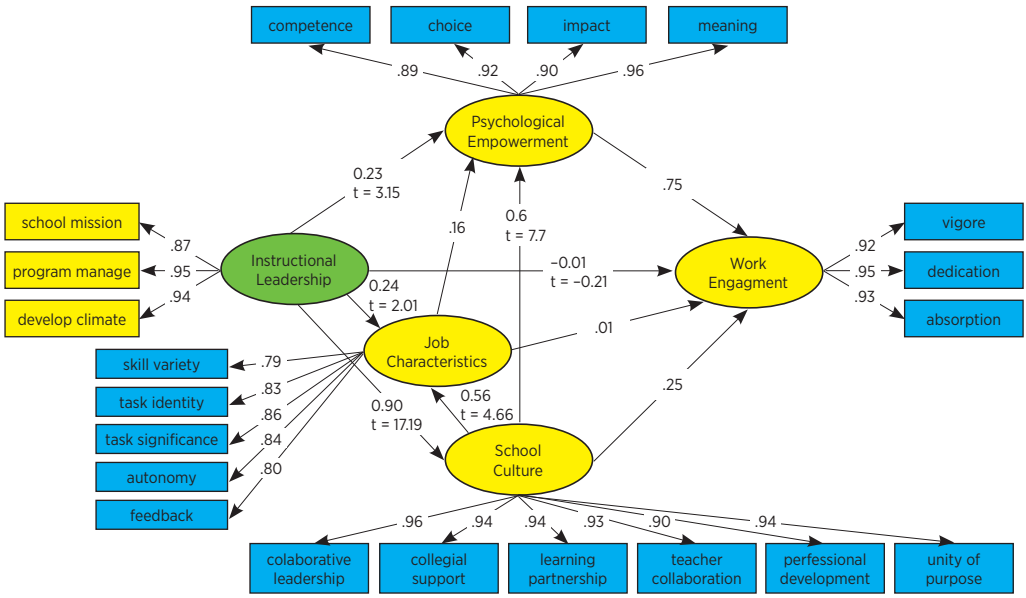

Figure 2. Standardised solution.

The results showed that instructional leadership had a positive, direct and statistically significant influence on school culture (H2), job characteristics (H3), and psychological empowerment (H4) but not on work engagement (H1).

The Correlation Matrix of latent variables is illustrated in Table 1.

This study developed six other hypotheses to examine the mediating role of school culture, job characteristics, and psychological empowerment. As shown in Figure 2 and Table 4, to further explain the influential relationships among latent variables, instructional leadership affected psychological empowerment indirectly via school culture and job characteristics (H5), on job characteristics indirectly via school culture (H6), and on work engagement indirectly via school culture, psychological empowerment and job characteristics (H7 as the main hypothesis of the study). In addition, school culture affects psychological empowerment indirectly via job characteristics (H8) and work engagement indirectly via psychological empowerment and job characteristics (H9). Finally, job characteristics affect work engagement indirectly via psychological empowerment (H10).

Additionally, this study examined SEM direct and indirect standardised path coefficients to further explain the influential relationships among latent

variables. According to the results of the hypothesised model in Table 4 and Figure 2, the study hypotheses were examined as follows:

Instructional leadership had the total effect of .90 on school culture; of .89 on psychological empowerment, of which .66 was transmitted via school culture and job characteristics; of .74 on job characteristics, of which .50 was transmitted via school culture and of .89 on work engagement, of which .90 was transmitted via school culture, job characteristics and psychological empowerment. School culture had the total effect of .69 on psychological empowerment, of which 0.09 was transmitted via job characteristics; of .69 on .56 on job characteristics and of .78 on work engagement, of which .52 was transmitted via job characteristics and psychological empowerment. Psychological empowerment had the total effect of .75 on work engagement. Job Characteristics had the total effect of .16 on psychological empowerment and of .13 on work engagement, of which .12 was transmitted via psychological empowerment.

Table 4
Standardised coefficients of direct, indirect and total effects

Path	Direct effect	Indirect effect	Total effect
Leadership → Culture	.9	0	.9
Leadership → Empowerment	.23	.66	.89
Leadership → Job Characteristics	.24	.50	.74
Leadership → Engagement	-.01	.90	.89
Culture → Empowerment	.60	.09	.69
Culture → Job Characteristics	.56	0	.56
Culture → Engagement	.26	.52	.78
Empowerment → Engagement	.75	0	.75
Job Characteristics → Empowerment	.16	0	.16
Job Characteristics → Engagement	.01	.12	.13

Conclusions

The analysis of results identified that instructional leadership had a positive association with work engagement although the direct relation between them was non-significant in the model and the first hypothesis was not supported, but the total effect is completely due to mediating variables indicating their full role between the two. This finding is analogous to the results of Pavlova (2013) who suggested this interesting result because of some probable gap between employees and leadership.

The next result is the positive association of instructional leadership and school culture. This result confirms previous studies (e.g., Le Clear, 2005; Peterson & Deal, 2009; Schine, 2004; Valentine, 2006) that found that leadership and culture are two sides of the same coin and that having a collaborative school culture is necessary for effective performance, and that the stronger the culture, the more effective the organisation. To develop a meaningful and productive school, leaders must shape a culture in which every teacher can make a difference, and every child can learn and in which there is a passion for, and commitment to promoting the best is possible. However, as Iran has a relatively high power-distance culture (Dastmalchian et al., 2001) and schools do not wish to change quickly, the principal's role is inherently conservative and emphasises managerial rather than leadership behaviour. Principals have always been agents of stability rather than agents of change. Nevertheless, the current era poses new challenges for school principals and creates a new cultural context for education and schools. Educational systems implementing reforms need to be moderated by the will and skill of school principals. This has resulted in a new interest in changing school principals from agents of stability into leaders of change. Therefore, principals need to work harder at articulating the basis of reform and at creating interest among teachers in engaging in education.

The association between instructional leadership and core job characteristics is consistent with other findings (Gagné et al., 1997; Piccolo et al., 2012; Piccolo & Colquitt, 2006; Purvanova et al., 2006). One of the more powerful influences a leader can have on followers is in the 'management of meaning' as leaders define and shape the 'reality' in which followers work. According to Piccolo and Colquitt (2006), leaders could influence perceived core characteristic levels by changing the language, imagery, and symbols used to communicate meaning on the job.

We also found a positive link between leadership and empowerment, which is consistent with previous findings (Maxfield & Flumerfelt, 2009; Rinehart et al., 1998). Since managers are mostly characterised as being the decision makers, empowerment strategies need to start where the power lies, at the top. Given the increasing complexity of the global environment, it is no longer conceivable for managers to be the source of all knowledge; therefore, managers need to consult and involve workers in the decision-making process as opposed to merely expecting worker compliance.

Thomas and Velthouse (1990) suggested changing the environment to enhance empowerment. The job characteristics studied here are one instance of this type of change. In this vein, Hackman and Oldham (1975) proposed concrete interventions intended to increase the levels of desirable job

characteristics. The present study demonstrated that the dimensions of empowerment can be affected by job characteristics.

The result shows the role of school culture in increasing teachers' psychological empowerment. School culture which is based on open communication and flexibility allows teachers to participate in decision making and express their opinions and support feedback.

Finally, increased leadership empowerment behaviour will result in higher levels of psychological empowerment, which, in turn, will increase work engagement. When leaders thus increase employees' degree of authority, decision-making and accountability, share information and support, develop and coach employees for innovative performance, employees will experience feelings of control. When individuals feel that their inputs are valued and that they make a meaningful contribution to the business strategy (impact), they will feel more engaged.

Practical Implications, Limitations and future directions of research

Our results have significant practical implications:

- Leadership training courses could be developed to teach leaders how to create meaning for jobs that may on the surface appear to be less important or significant. This can be done by linking jobs to the broader purpose, goals, and mission of the organisations.
- Developing programmes to give greater emphasis on increasing school leaders' awareness of what constitutes empowering leadership behaviours and how their empowering behaviours may affect teachers' psychological empowerment and teachers' work outcomes.
- Participative decision making should be encouraged, and the leader should create an open atmosphere so that everybody becomes involved in discussions, and a healthy atmosphere leads to the increased morale of fellow teachers to work hard for attaining the department goals. Therefore, they would be advised to adapt participative management techniques and programmes aimed at increasing teachers' participation. This can provide an alternative to a traditional bureaucratic structure with a top-down approach to decision-making.
- Teacher empowerment strategies should be highly contextualised. Policy makers and educational administrators can empower teachers through providing holistic support, focusing on establishing ongoing communication and collaboration in schools, aligning the goals of school restructuring with teacher empowerment.

- The effort to create and align schools' goals with teachers' personal goals should become the priority for school administrators.
- To achieve high work engagement, organisations first need to develop cultural contexts and practices for shaping a collaborative culture. Possible interventions could include structured leadership programmes that encompass behaviours, competencies, and attitudes needed to develop a good leader. The organisation could focus on other leadership development methods such as mentoring and coaching. It is vital for managers to fully understand what the indirect effects of instructional leadership on work engagement through psychological empowerment and school culture mean, in order for them to develop interventions to promote such behaviours. One possible intervention could be to create awareness and knowledge of the constructs as well as evidence-based interventions linked to the findings.

This study also has several limitations. First, because the data in this study were cross-sectional and not longitudinal in nature, some causal relationships could only be inferred, rather than empirically supported. Longitudinal and experimental studies need to be considered to give more definite conclusion about the causal effects between each variable. Second, the survey was given only to teachers in elementary schools, so the generalisation of high schools must be made carefully.

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Competence of Croatian Student-Teachers and Primary School Teachers in the Visual Arts

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In visual arts education, specific competences pertain to having knowledge from the theory and praxis of visual arts and the teaching methodology of visual arts. The goal of this research was to examine the opinions of 231 students of graduate teacher studies and 143 in-service primary school teachers about the importance of specific competences in the visual arts, as well as the level of achieving the stated competences during studies. The frequency of teachers attending various forms of professional training in the visual arts was also examined. Two questionnaires were designed for the research. The data obtained with the questionnaires were processed at the level of descriptive and inferential statistics. A Wilcoxon Signed Ranks Test was used to compare the differences in the arithmetic means between the perception of importance and the perception of possessing the competences between these two groups. The research has shown the existence of a statistically significant difference between the self-assessment about the importance of specific competences in the visual arts, and the self-assessment of having these competences, both with students of the Croatian faculties of teacher education and primary school teachers. The results also have shown the insufficient presence of teachers' further professional training in the visual arts area.

Keywords: competence, primary school teachers, professional training, student-teachers, subject-specific competences, visual arts education

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Kompetence hrvaških študentov pedagoških smeri in osnovnošolskih učiteljev likovne vzgoje

Zlata Tomljenović in Svetlana Novaković

V likovni vzgoji se specifične kompetence nanašajo na znanje iz teorije in prakse likovne umetnosti ter na metodologijo poučevanja likovne umetnosti. Cilj raziskave je bil preučiti mnenja 231 študentov pedagoške smeri in 143 osnovnošolskih učiteljev o pomembnosti specifičnih kompetenc v likovni umetnosti ter stopnjo doseganja navedenih kompetenc med študijem. Prav tako smo preučili, kako pogosto se učitelji udeležujejo različnih oblik strokovnega usposabljanja na področju likovne umetnosti. Za namene raziskave sta bila sestavljena dva vprašalnika. Pridobljeni podatki so bili obdelani na ravni deskriptivne in inferenčne statistike. Za primerjavo razlik v aritmetičnih sredinah med zaznavanjem pomembnosti in dojemanjem posedovanja kompetenc med tema skupinama je bil uporabljen Wilcoxonov test vsote rangov. Raziskava je pokazala obstoj statistično pomembne razlike med samooceno o pomembnosti specifičnih kompetenc v likovni umetnosti in samooceno posedovanja teh kompetenc pri študentih pedagoške smeri na Hrvaškem ter pri osnovnošolskih učiteljih.

Ključne besede: kompetence, osnovnošolski učitelji, strokovno usposabljanje, študentje pedagoške smeri, predmetno specifične kompetence, izobraževanje na področju likovne umetnosti

Introduction

Today, formal education and teachers' professional development are directed towards gaining competences, which pervades over the obsolete pedagogical paradigm of teaching as information transference. The teacher should possess competences that encompass not only routine knowledge transference, but also significantly more complex knowledge, abilities, and decision making. The aforementioned competences refer to the responsible designing of the teaching process, to seeking creative ways of its implementation, to quick and efficient adapting to dynamic and unforeseen teaching situations, to motivating the pupils' independent and creative art expression, using new technologies and stimulating integral (cognitive, affective, and psycho-motor) development of the pupils' personality (Bamford, 2006; Efland, 2002; Eisner, 2002). Teachers acquire qualifications for these competences during their professional education. However, this is not enough since rapid social and educational changes have created the need for constant improvement through the expanding and deepening of professional knowledge, i.e., through acquiring new competences which teachers gain through lifelong learning (Hudson & Hudson, 2007; Valenčič Zuljan, 2001). Development of professional competences should be stimulated in initial, as well as in further professional teachers' education (Craft, 2000).

Apart from the general pedagogic and psychological, as well as didactic and methodical competences, the teachers' professional development includes the acquisition of certain subject-specific competences related to particular disciplines, i.e., school subjects. In visual arts, as a school subject, these competences include the knowledge of theory and history of visual arts, knowledge of visual arts pedagogy, knowledge of the specifics of the teaching process, knowledge about the purpose, goals and tasks of visual arts as a school subject, the ability to recognise and understand the pupils' individual and art specifics and their ways of learning, the ability to adjust to one's own knowledge and capacities to new situations, and the ability to apply an open and reflexive way of teaching (Burnard & Hennessy, 2006; Marshall, 2005).

Development of competences in visual arts in teacher education studies

The reform of higher education started in Croatia with the signing of the Bologna Declaration in 2001, and in the 2005/2006 academic year, the first generation of 'Bologna students' enrolled at the Croatian faculties (Domović &

Vizek Vidović, 2010). The concepts of the Bologna Declaration have also been implemented in current educational concepts in the visual arts following acceptance of the European standards for teachers' competences and qualifications (Zgaga, 2007). These concepts are also reflected in the context of higher education in the Republic of Croatia based on the competence approach to higher education (*competence-based curriculum),* which provides a broader definition of learning results than restricting them to mere information acquisition: they are directed towards the competences that a student needs to develop throughout the course of his or her study (Lončarić & Pejić Papak, 2009; Muršak, 2001; Vizek Vidović, 2009). In accordance with the Bologna Declaration Guidelines, at the faculties of teacher education in Croatia today, integrated undergraduate and graduate studies for the education of teachers in primary education are carried out over five years. When discussing the subjects related to visual arts, i.e., the methodology of visual arts education at Croatian faculties, the programmes are somewhat different in terms of comprehensiveness, i.e., the number of subjects connected to the area. However, they correspond with the foreseen learning results, i.e., with the competences that a student should acquire in the course of his or her studies. It can be stated that, within the framework of these programmes, students are empowered to gain art and pedagogic knowledge, skills and standpoints, which are shaped on the basis of visual arts-theoretical and practical experiences, and which a student, in accordance with his or her abilities, integrates and uses in a certain teaching situation (Tacol, 2006).

The modern concept of visual arts education corresponds to Perrenoud's (2002) understanding of gaining competence in terms of a person's training for the usage and integration of the acquired knowledge in complex, different, and unforeseen situations. In making and implementing faculty programmes for visual arts education methodology, the process of acquiring general pedagogic and psychological, as well as didactic and methodological competences, should be harmonised with the acquisition of professional, i.e., subject-specific competences (Razdevšek Pučko & Rugelj, 2006). It is essential to observe the student-teachers' competences in visual arts classes in the context of achieving the purpose of visual arts education, which means that student-teachers should know the goals, results of learning and general standards of the subject (Barton, Baguley, & MacDonald, 2013). The importance of the acquisition of subject-specific competences in the context of teaching visual arts has been confirmed by a recent survey (Podobnik, 2011) in which it is stated that an adequate quality of teaching cannot be reached without their development.

Apart from the cognitive aspect, gaining competences also includes the

motivational and emotional aspects of doing (Saarni, 1999, 2003; Weiner 2005). In other words, the development of competences in the area of visual arts education comprises the cognitive aspect:obtaining theoretical, conceptual, abstract knowledge (obtaining knowledge of visual arts theory, visual arts history and visual arts teaching methodology); the functional aspect (development of agility, skills and procedural knowledge possibility to recognise, shape and solve visual arts problems; skills in using art techniques); and the emotional-motivational and educational-socialisation aspect (esthetic sensitivity development, professional responsibility, autonomy and ethics) (Peklaj & Puklek Lepušček, 2006; Pevec Grm & Škapin, 2006).

To stimulate the pupils' creativity, teachers should be creative in their classes (Shepherd, 2005). In doing so, they should be familiar with and use modern, interactive approaches to learning and teaching, various teaching means and aids, including ICT technology; they should include their pupils in independent and active work, and stimulate their desire for new and different ways of solving visual arts problems (Tomljenović, 2015). Teachers should know the level of their pupils' previous knowledge and visual arts characteristics/visual arts types of pupils in order to prepare the teaching topics more successfully, to determine visual arts tasks, and to assess the pupils' artwork (Duncum, 1999). What is needed is the openness towards using new visual arts technique and their combinations, i.e., stimulating students to experiment with art techniques and materials since good educational work has a great impact on the forming part of the artistic development of pupils (Duh, Herzog, & Gosak, 2011). The pupils' critical thinking, as well as the expression of their thoughts and associations, new and unusual ideas, unforeseen visual arts solutions and imagination, should be encouraged as a prerequisite for the development of creative thinking and expression. It is essential that teachers understand the teaching content and that they possess the ability to interpret it and connect it with other teaching contents and life situations (Atkinson, 2002; Bonwell, 2000; Hurwitz & Day, 2007; Taylor, 2007).

The contemporary understanding of competences as developmental categories implies the teacher's care for his or her further training, i.e., lifelong education. Thus, it is crucial that a teacher, among other things, possesses the ability to recognise information from his or her surroundings which are essential for professional improvement, and the desire, i.e., the intrinsic motivation for lifelong learning, i.e., personal growth (Niemi & Kohonen, 1995). L. Bognar and B. Bognar (2007) believe that the process of continuing education for teachers is as important as formal education if it is not reduced to authoritative over-teaching and giving instructions but represents a process in which

teachers critically rethink their professional activity. Traditional professional development workshops should be replaced with an alternative professional learning context, an innovative learning environment (work-based learning) in which modern approaches to teaching and the strategies for their mastering in practice, which offer concrete and applicable solutions, will be demonstrated (Desimone, Porter, Garet, Yoon, & Birman, 2002; Wilson & Berne, 1999).

Research problem and research questions

In the context of the Bologna changes in higher education in Croatia, the study programmes of teachers' education are also changing and developing in all areas, including in visual arts education. Contemporary visual arts education places numerous tasks before primary school teachers for which they are not fully prepared during their formal education, although the existing subjects that comprise the visual arts area at the faculties of teacher education in Croatia are attempting to optimally satisfy the students' qualifications with their programmes. Research also shows that visual arts, as a subject, are often neglected in relation to the 'important'/educational subjects, and it is mostly seen as a 'non-cognitive', practical activity whose purpose is relaxation of pupils (Garvis & Pendergast, 2012; Russel-Bowie, 2009, 2012; Tomljenović & Novaković, 2014). The objective of the applied empirical research was to establish the final year student-teachers' and the in-service primary school teachers' opinions about the importance of having specific subject-specific competences and their own qualifications in the area of visual arts.

Apart from the main objective, the following specific research questions were established:

1) Which subject-specific competences in the area of visual arts do the students and teachers consider essential, and which do they think they possess?
2) Are there any statistically significant differences in the perception of the importance of certain subject-specific competences and the perception of possessing these competences between both groups (students and teachers)?
3) Within the visual arts area, in which areas would the students and teachers like to improve their levels of mastering subject-specific competences?
4) How often do the teachers participate in various forms of professional training in the area of visual arts?

Method

Sample

A total of 231 students (12 male and 219 female) participated in the research. These respondents were student-teachers of the fourth and fifth year at the faculties of teacher education in Zagreb, Petrinja, Čakovec, and Rijeka (hereinafter: students). Furthermore, 143 in-service primary school teachers (2 male and 141 female) participated in the research (hereinafter: teachers). They were employed in the aforementioned cities and in Istria County. The participants were randomly selected. Teachers differ according to the degree of professional education: slightly over one half of the teachers (55.9%) hold a two-year college degree while 44.1% hold a university degree. This difference is a consequence of the educational policy in the Republic of Croatia. Before the Bologna process, primary school teachers' education lasted two, then four years, and now, after the introduction of Bologna changes, graduate studies at Croatian universities last five years. A total of 118 respondents have the status of teacher (82.5%) while 25 of them (17.5%) have the status of mentor or counsellor. Most of the teachers (more than two thirds of the respondents) are middle-aged (between 36 and 55 years of age), i.e., they have between 11 and 30 years of work experience. Slightly over one tenth of the respondents belong to the group whose age is less than 35 and another one tenth to the group whose age is over 55. The average age of the respondents is 45.

Data collection procedures and analysis

Two questionnaires were designed for this research: one for the students of the faculties of teacher education, and one for the primary school teachers. The questionnaires contained close-ended questions. Both questionnaires had the first two questions in common: they referred to the perception of importance, i.e., to the degree in which the participants believe they possess the 25 stated subject-specific competences whose acquisition is needed to optimally carry out visual arts classes. In designing the list of competences, we acted in accordance with the curricula for visual arts and visual arts subjects at the faculties of teacher education in Croatia, and with some existing systematisations in the region (Tacol, 2006). The respondents assessed their own competences and qualifications on the basis of a Likert-type scale with five items. Apart from these, the questionnaire for the teachers contained two additional questions, and the questionnaire for the students one additional question. The research is based on a quantitative research paradigm. The data obtained by the questionnaires were processed at the level of descriptive and inferential statistics.

Results and discussion

Teachers' and students' perception of the importance of subject-specific competences and the level of their possession

The results in Table 1 show the teachers' and students' perception of the importance of subject-specific competences, and the degree of their possession. Data are presented in terms of means (M) and standard deviations (SD). The perception of the importance of these competences was measured on a scale from 1 to 5 (1= not at all important, 2= slightly important; 3 = moderately important; 4 = important; 5= very important).

Table 1

Descriptive features of specific competences importance evaluation in the visual arts area, and the assessment of possessing them on behalf of the teachers and students

Competences	Participants	Importance		Possession	
		M	SD	M	SD
Knowledge of, understanding of and the use of the visual arts language (visual arts elements and compositional principals) in visual arts classes	students	4.52	.638	3.87	.664
	teachers	4.34	.742	3.69	.899
Knowing, understanding, and applying basic visual arts history/cultural heritage contents in visual arts classes	students	3.75	.779	3.36	.701
	teachers	4.58	.834	3.22	.791
Knowing, understanding, and applying basic visual communications and design contents in visual arts classes	students	4.05	.654	3.43	.782
	teachers	3.91	.638	3.33	.862
Possessing aesthetic sensitivity for the works of visual arts and the ability to choose them for the methodological realisation of the visual arts programme	students	4.21	.687	3.68	.740
	teachers	4.15	.715	3.52	.803
Knowledge of visual arts techniques in the drawing area	students	4.62	.553	3.97	.733
	teachers	4.64	.481	4.12	.707
Knowledge of visual arts techniques in the painting area	students	4.63	.559	3.97	.739
	teachers	4.62	.488	4.13	.711
Knowledge of visual arts techniques in three-dimensional shaping area	students	4.54	.595	3.66	.791
	teachers	4.43	.677	3.78	.723
Knowledge of visual arts techniques in the graphics area	students	4.49	.632	3.55	.858
	teachers	4.38	.614	3.47	.758
Knowing the process of visual perception and the visual arts procedure, and the development of one's own creative thinking and expression	students	4.49	.652	3.88	2.126
	teachers	4.29	.579	3.63	.775

Competences	Participants	Importance		Possession	
		M	SD	M	SD
Knowledge and understanding of the visual arts curriculum, and developing and executing the visual arts curriculum in the class teaching	students	4.41	.666	3.73	.863
	teachers	4.25	.622	3.78	.764
Knowing the importance, purpose, goals, and results of learning visual arts as a school subject	students	4.46	.630	3.93	.777
	teachers	4.45	.590	4.09	.759
The ability to independently programme, plan, organise and manage the teaching process, appreciating the particularities of visual arts as a subject	students	4.40	.683	3.80	.857
	teachers	4.31	.674	3.94	.820
The ability to connect (correlate) the visual arts contents with other areas/other school subjects on the structural level	students	4.34	.679	4.02	.704
	teachers	4.39	.531	4.29	.680
Knowledge of and the ability to use various teaching means and tools, and independently apply ICT technology in visual arts classes	students	4.24	.698	3.97	.804
	teachers	4.01	.569	3.70	.823
Knowledge of contemporary strategies of independent, active, and research learning and its application within visual arts classes	students	4.13	.657	3.57	.856
	teachers	3.83	.682	3.41	.816
The ability to motivate students for visual arts activities and stimulate their creative thinking and expression	students	4.69	.550	4.15	.739
	teachers	3.83	.682	3.41	.816
Recognising and respecting children's visual arts development, and adjusting the curriculum to students' individual visual arts features	students	4.63	.582	3.88	.851
	teachers	4.53	.528	3.86	.737
Development of students' visual perception and visual arts aesthetic sensibility	students	4.48	.603	3.71	.827
	teachers	4.31	.536	3.88	.736
Development of motor agility and students' sensitivity through the use of different visual arts techniques	students	4.50	.625	3.79	.818
	teachers	4.43	.511	4.05	.715
Developing students' recognition, understanding, and using visual language on their own artworks, works of visual arts, and in their own surroundings	students	4.27	.645	3.75	.756
	teachers	4.06	.579	3.71	.777
Developing cooperative relationships, empathy and self-respect in joint activities and students' creative work	students	4.58	.576	4.19	.713
	teachers	4.51	.515	4.21	.701
The ability to analyse children's artworks and to objectively and critically evaluate students' achievements in visual arts classes	students	4.46	.573	3.99	2.143
	teachers	4.47	.501	3.94	.714
The ability to reflect, i.e., knowing methodological and professional criteria for rating one's own work within visual arts classes	students	4.24	.582	3.56	.837
	teachers	4.15	.585	3.73	.619
Understanding and using appropriate procedures of scientific-research work in the visual arts area	students	3.72	.770	3.04	.922
	teachers	3.63	.689	2.98	.884
Awareness about the importance of professional training and lifelong education in the visual arts area	students	4.08	.715	3.76	.876
	teachers	4.17	.605	4.10	.695

According to the respondents' assessment, almost all stated competences are important or very important, which suggests that the awareness of the

respondents about the importance of the competence approach to the realisation of learning outcomes is high, as is the perception of the importance of visual arts education within the curriculum, regardless of its current status (reflected in the predetermined elementary school schedule of only one hour per week). The arithmetic mean of the stated items ranges from 3.72 (students)/3.59 (teachers) to 4.69 (students)/4.64 (teachers). The students assessed the following competences as being the most important: the ability to motivate the pupils for visual arts activities and to stimulate their creative thinking and expression; recognising and respecting the children's visual arts development, and adjusting the curriculum to the pupils' individual visual arts features (visual arts types); knowledge of visual arts techniques (in the drawing and painting areas, and in three-dimensional shaping area; knowledge of, understanding of and the use of the visual arts language (visual arts elements and compositional principals) in visual arts classes; development of cooperative relationships, empathy, and self-respect in joint activities and the pupils' creative work. The students assessed the following competences as of least importance: knowledge, understanding and application of basic visual arts history/cultural heritage contents in visual arts classes; knowledge of, understanding and application of basic visual communications and design contents in visual arts classes; also, understanding of and using appropriate procedures of scientific research in visual arts. Teachers assessed as the most important competences similar variables as the students did: knowledge of visual arts techniques in the drawing and painting area; recognising and respecting the children's visual arts development, and adjusting the curriculum to the pupils' individual visual arts features; also, development of cooperative relationships, empathy and self-respect in joint activities and the pupils' creative work. In contrast, they assessed the same three variables as being of the least importance as the students did.

The results show that assessment of the importance of individual competences in both groups is relatively similar. Both groups of respondents consider most of the stated competences to be important. The following competences are perceived as the most important: knowledge of the visual arts language and visual arts techniques, knowledge of the children's visual arts development and visual arts types of pupils, and the development of cooperative relationships, empathy, and self-respect at work. The results are expected, as these competences form the foundation of the teaching process and the majority of teaching hours is devoted to their acquirement both at faculties and in professional training. Furthermore, classroom teaching (in Croatia, this term refers to the first four years of elementary education) is less demanding than teaching in higher classes, as older students are capable of understanding more abstract and complex contents, such

as stylistic periods, contemporary art concepts, etc. However, such an approach can be criticised as an obsolete teaching approach, as these contents to a certain degree and with a customised approach can also be offered at a classroom level.

Competences that are perceived as the least important are related to the knowledge of visual arts history and visual communications, and those related to the knowledge of contemporary working strategies (independent, research learning, and implementing research activities on behalf of the teacher). We can note that these competences are 'the youngest', i.e., they have become a part of the Croatian faculty curricula in the last 10 to 20 years. For their effective understanding and implementation, students have to possess not only theoretical knowledge but much more practice organised outside the faculty classroom, i.e., in schools, which is, due to organisational and financial problems, a 'weak point' of all study programmes in Croatia. It is also not uncommon for some teachers and mentors in schools to teach visual arts in an established traditional way for students' practice exercises. For similar reasons, understanding of the role of teachers as researchers and active factors in changing traditional forms of education remains very poor for most existing but also future teachers. The greatest difference in assessing the importance between the two groups is noticeable in the ability to motivate the pupils to participate in visual arts activities and in the ability to stimulate their creative thinking and expression, which the students assessed as one of the most critical variables while the teachers assessed it as one of the least significant variables. The reasons for this can be found in the fact that these activities are a part of the usual process that teachers accomplish through their teaching activities, hence the abilities that they acquire and develop through their daily professional experience. However, it can be said that some teachers in the long term lose their freshness and creativity in the teaching process because of different factors (mostly because of the lack of time for a quality realization of visual arts classes). Students are, however, aware of the importance of these competences, as study programmes are based on modern approaches to learning and teaching.

The perception of the level of possession of subject-specific competences was measured on a scale from 1 to 5 (1 = I do not possess any; 2 = I possess them in a small amount; 3 = I partly possess them; 4 = I possess them to a greater degree; 5 = I fully possess them). Regarding the possession of specific competences, the arithmetic mean of the stated items ranges from 3.04 (students)/2.98 (teachers) to 4.19 (students)/4.29 (teachers). Students consider themselves most qualified in the area of developing cooperative relationships and empathy among pupils, in the correlation between visual arts contents and other subjects' contents, in the area of ICT technology usage and the use of other

teaching means, and in the knowledge of the visual arts techniques of drawing and painting. Teachers consider themselves the most competent in the area of cross-curricular teaching (connecting visual arts contents with the contents of other school subjects), and in developing cooperative relations and empathy among pupils, as well as in the area of knowledge of the visual arts techniques of drawing and painting, in the area of motivating the pupils to engage in visual arts activities; also, in the area of knowledge of the importance, purpose, and goals of visual arts as a subject. It is interesting that, at the same time, the respondents consider the majority of the stated competences as being the most important. The assessment results of the least developed competences overlap in both groups: both the students and the teachers consider themselves the least competent in understanding and using appropriate procedures and scientific research, in the knowledge of visual arts history and visual communications (these competences are also considered as the least important), and in the use of graphic art techniques. This fact can be interpreted as follows: these contents are less represented in curricula (both in faculties and in primary and secondary schools); consequently, the students consider them to be less important; for the same reason, they are considered to be the least competent in the mentioned areas. Due to the limited number of hours foreseen for the content of visual arts education in the entire educational system, these contents should be given more attention when planning and implementing a lifelong learning programme for teachers. As far as the latter competence is concerned, the graphic art techniques are unfairly ignored in visual arts education, mostly because it takes more time for their use than for working with other common art techniques. However, today there are many new graphic art techniques adapted to school conditions but also a lack of professional literature that would bring them closer to a broader circle of employed teachers.

Furthermore, it is noticeable that the students give a somewhat greater importance than the teachers to all the stated competences; on the other hand, the teachers assess their possession of the stated competences to a somewhat greater degree, but not significantly greater (although, considering their years spent in service and experience, it is expected that this difference is even greater).

The teachers assess the level of competence possession equally as the students, or even somewhat higher, and assess the level of mastering these competences somewhat lower than the students in as many as ten variables. The reason for this could lie in the modernisation of the curricula at the faculties of teacher education, and the rise in the quality of their implementation in the didactic sense (the accent is on appreciating methodical particularities of visual arts teaching, basing classes on active, cooperative, and research-oriented

learning, and stimulating intrinsic motivation, the application of contemporary work strategies, ICT technology, etc.), but also in inadequately following modern trends in the educational work of teachers who possess much more experience in the application of demanding theoretical concepts in practice.

The analysis of the results has established a difference in the perceptions of the importance and the level of possession of specific competences between students and teachers, which builds on the results of some other studies in this area (Oreck, 2004; Welch, 1995). A Wilcoxon Signed Ranks Test was used to compare the differences in the arithmetic means between the perception of importance and the perception of possessing the competences between these two groups since the variables are continuous and normally distributed. For the purpose of this research, summation variables were designed so that the arithmetic mean of the importance assessment of all 25 competences is summarised in the group result, i.e., in one variable. This was also done with the assessment of the level of the possession of specific competences.

Table 2

Results of the Wilcoxon Signed Ranks Test of the comparison of the subject-specific competences importance assessment and the perception of possessing the same competences for students and teachers

	Importance			Possession		Wilcoxon Signed Ranks Test	
	N	M	SD	M	SD	Z	p
Students	231	4.356	.346	3.768	.517	-11.550	.001
Teachers	143	4.259	.309	3.783	.555	-8.312	.001

Note. Correlation is significant at the .01 level (2-tailed).

The analysis of the results has shown a statistically significant difference between the perception of the importance and the perception of the level of possessing subject-specific competences, both in students (Z=-11.550, p=.001) and in teachers (Z=-8.312, p=.001) (Table 2). It was found that the perception of the importance of certain competences both in students and in teachers is significantly higher than the perception of their possession level. From this, we can infer that the students' possession of the stated competences in the area of visual arts education after graduation is not satisfactory, as well as the fact that the teachers make little progress during their professional development in this area. The reasons for this may be different: a small number of hours at the faculties foreseen for visual arts education, the outdated approach to learning and teaching (the emphasis is

on the acquisition of theoretical knowledge, instead of the acquisition of practical knowledge and skills), financial and organisational problems in schools (too many pupils in classes, too little time (only one hour per week for visual arts) for the quality implementation of teaching contents provided by the curriculum, lack of appropriate teaching and technical resources, lack of support from colleagues, etc.). These factors can cause a loss of enthusiasm, motivation and self-confidence in teachers' professional work. They also indicate the constant need to modernise teachers' professional development programmes, which should be planned based on the relevant research and teachers' actual needs and interests.

Perception of visual arts areas in which students and teachers would like to acquire additional knowledge and skills

Apart from the stated questions, the teachers' and students' questionnaires also included a question about specifying those areas within visual arts education that should be given more attention at the faculty, i.e., in planning professional teacher training.

Table 3
Perception of the areas of visual arts within which teachers and students would like to improve their level of mastering subject-specific competencies

	students		teachers	
	f	%	f	%
Use of visual arts techniques and visual arts-creative expression	118	51.1	108	75.5
Development of aesthetic sensibility and the ability to analyse works of art	117	50.6	76	53.1
Specificities of didactic and methodological procedures of organising and executing classes	114	49.4	62	43.4
Connecting visual arts content with contents of other subjects	69	29.9	20	14.0
Subject content (visual arts theory, visual arts history, cultural heritage)	50	21.6	18	12.6
Nothing needs changing	7	3.0	3	2.1
Total	**231**	**100**	**143**	**100**

The results show that students and teachers have similar priorities in gaining subject-specific competences. Both would like to improve their abilities in using visual arts techniques, and especially their visual arts creative expression (up to 75% of teachers and 51.1% of students) (Table 3). This finding is interesting since this area (drawing and painting art techniques) is given the highest rate when assessing the importance and possession in both groups and can

be interpreted as a consequence of priority interest that students and teachers show precisely for using visual arts techniques, i.e., practical work with pupils. This result can be a consequence of the popular, but also the obsolete and prevailing concept of visual arts education as a primarily practical activity whose main goal is to relax the pupils through art expression. The results may also indicate a desire for the better mastering of the use of three-dimensional art techniques and graphic art techniques, as those areas for which the respondents feel less competent. The second area in importance, to which, according to the students, not enough attention is given during the studies, is the development of aesthetic sensibility and the ability to analyse artworks (50.6%). This is followed by the area connected with the specificities of didactic and methodical procedures of organising and executing the teaching process (49.4%). Similar results are found with teachers: 53.1% would like to gain additional competences related to didactic and methodical procedures and organisation and execution of teaching while 43.4% assess they need additional knowledge and abilities connected with aesthetic sensibility growth and artworks analysis. The area in which the teachers and the students feel the least desire to receive additional training is visual arts theory and visual arts history and the area of connecting visual arts content with other areas. The placement of competences connected with the area of visual arts theory, visual arts history and cultural heritage at the end of the table could be linked to poor rating of these variables in terms of importance, but also possession, which can be interpreted by the fact that the respondents consider these components in visual arts teaching to be less important, so they want the least additional training in this area. The assumption is that students and teachers also have the least desire to be additionally educated in connecting visual arts with other areas, because the possession of this competence is assessed with the highest rates by both students and teachers, i.e., the respondents consider that they possess it to a higher degree.

Teachers' professional training in the visual arts

The aim of this research was also to determine how often the teachers participate in some form of professional training in visual arts throughout their career. The greatest number of respondents, almost half of them, have participated in some form of professional training in the context of visual arts teaching between three and five times; about one fourth of the teachers have participated once or twice, around one sixth of the participants between five and ten times, while an equal percentage of the respondents have participated in professional training more than ten times and have never participated (6.3%). Considering that the average age of the respondents is 45, it can be concluded that teachers

do not participate often enough in any of the forms of professional training which are connected to visual arts teaching. One of the reasons for this most probably lies in the rare occurrence of professional training in this area. On the other hand, as stated earlier, visual arts education is considered peripheral to other 'important' subjects (mathematics, mother tongue, foreign language), which can weaken the teachers' perceptions about the importance of art education in general (Welch, 1995), as well as their motivation for gaining further professional training in this area. Furthermore, the opinion that continues to prevail in Croatian education is that the subject of visual arts is mostly practical in nature and, especially in the realm of class teaching, considers its main role to be pupils' relaxation with the lowest degree of teacher's influence or his/her interaction with the pupils. This perception could also be associated with the very poor presence of the visual arts in the Croatian curriculum, which is only one lesson per week, or 35 lessons per year, in all grades of primary school. The results can also indicate the teachers' insufficient awareness of the importance of further professional education after graduation from their faculties.

Table 4
Frequency of teachers' professional training in the context of visual arts education

	f	%
never	9	6.3
once to twice	35	24.5
3 to 5 times	69	48.3
5 to 10 times	21	14.7
more than 10 times	9	6.3
Total	**143**	**100**

Conclusions

The possession of subject-specific competences in the visual arts is a prerequisite for the quality implementation of visual arts classes (Prentice, 2002; Tacol, 2007). The conducted research examined the assessment of these competences among students in their final years of study at faculties of teacher education, as well as among in-service primary school teachers. The assessment of their own qualification in the context of the stated competences was also examined. The analysis of the results has shown that both the students and the teachers consider subject-specific competences in the visual arts area to be important or very

important. The results, however, also indicate the fact that the respondents possess the given competences only partly or to a lesser degree. On the one hand, this is understandable since the students of the faculties of teacher education are educated in several areas, i.e., they need to master contents and didactic and methodological knowledge in six basic areas/school subjects that they will be teaching in school (Croatian, maths, science, physical education, music, visual arts), and because of this they cannot engage in a detailed training in the sense of optimal acquisition of all stated competences. In contrast, this fact might also indicate insufficiently elaborated programmes that need to be changed in order to achieve better methodical and practical qualifications, i.e., programmes that should dedicate more time to practical exercise with appreciating contemporary approaches to learning and teaching. The findings of this study have confirmed some of the problems that teachers from other countries also encounter, and they relate to the question of whether the expectations of a primary school teachers' subject knowledge are too high, and in what way the balance between the demands of mastering particular methodologies and the abilities to understand and successfully realise their contents in school practice could be achieved (Alter, Hays, & O'Hara, 2009). According to some research (Russel-Bowie, 2009), it appears that, because of the study programme's demands, visual arts teaching is one of the areas which suffers the most from the lack of subject-specific knowledge and skills acquirement; i.e. during the studies, as well as in teaching, more time is dedicated to 'more important' subjects such as maths, mother tongue and foreign languages. This research suggests the need for continuous monitoring and modernisation of the existing curricula in order to ensure the conditions for optimal acquisition of necessary subject-specific competences for all students. In addition, the results also show an insufficient presence of professional training in the visual arts area. So, it would be interesting to examine the reasons for which teachers rarely participate in professional training programmes in the visual arts area. In order to improve the existing status, it is necessary to establish better cooperation between faculties of teacher education and educational institutions, which are directly or indirectly connected with teachers' professional training and professional development, with the goal of improving professional betterment and life-long learning, which will, among other things, be related to the research of specific professional and methodical areas of particular subjects, such as visual arts education.

Given the fact that the issue of subject-specific competences in visual arts education has not been explicitly studied yet in Croatia (and abroad), we have attempted to contribute with this paper to the research field while being aware of the fact that we have implicitly opened new questions that may be the subject of further studies.

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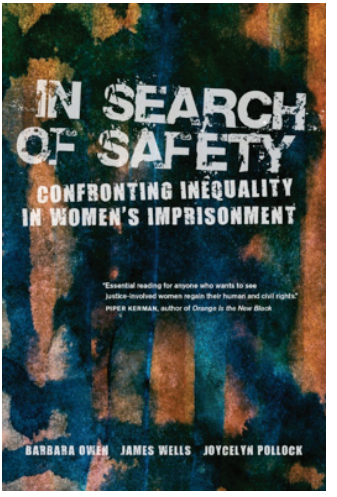
Barbara Owen, James Wells and Joycelyn Pollock, *In Search of Safety: Confronting Inequality in Women's Imprisonment*, University of California Press: Oakland, CA, 2017; 280 pp.: ISBN: 9780520288720

Reviewed by Darja Tadič[1]



In Search of Safety takes a close look at the sources of violence and conflicts in women's prisons. As the reader will probably note, the authors distance themselves from the individual pathology approach to explaining interpersonal conflicts and violence, focusing instead on unravelling the structural inequalities that shape conflict contexts in prisons. This approach reflects the authors' sociological perspective, as they tackle the topic by using gender, intersectionality, structural inequalities, life trajectories and capital as central conceptual investigative tools.

The book has several overlapping goals. In addition to witnessing and documenting women's experiences with imprisonment, it offers a new analysis of the contemporary prison by reframing the question of trouble and violence as a further expression of broader societal inequalities. The reader should notice the absence of the increasingly present (in criminology, social sciences and public debates, as well) "security" and "dangerous criminal others" discourse. Rather than searching for dangerous prisoners, the book reveals broader violent and unsafe social structures that create interpersonal violence.

The authors examine how intersectional inequalities and cumulative disadvantages are the root of prison conflict and violence. Women must negotiate these inequities by developing forms of prison capital (social, human, cultural, emotional and economic) to ensure their safety while inside. The authors also analyse how conflict and subsequent violence result from the gendered context of substandard prison conditions, inequalities of capital among those imprisoned, and relationships with correctional staff.

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Several past research findings are integrated in the book, with the authors drawing on data they had collected over the course of ten years in three studies of women's prisons and jails. In these overlapping studies, they interviewed over 150 imprisoned women and dozens of staff members using the mixed methods approach. Their research was undertaken through open-ended focus groups, asking participants to describe experiences and perceptions of violence and safety in prisons. Through these interviews, the authors also developed a survey instrument to measure women's perception of safety and violence, validating the questionnaire with over four thousand women around the country.

In the first chapter (Intersectional Inequality and Women's Imprisonment), the authors open the book by presenting the central concepts used in their research. They emphasise the fact that women's multiple and cumulative disadvantages and everyday lives in the community condition their pathways to prison. As well as focusing on gender-specific experiences, they also use an intersectional approach by taking into account the importance of the interconnected identities and statuses of individuals and groups in relation to crime and criminality. The reader is warned of the importance of understanding that women's prison experience is also shaped by their "prisoner" status.

The second chapter (Pathways and Intersecting Inequality) describes women's pathways to incarceration, focusing on the impact of intersectional inequalities in women's lives in the free world. Their lives prior to prison are often shaped by their gendered life circumstances and roles, such as the predominance of the caregiving role with regard to children and housing, experiences of victimisation and abuse, unequal employment opportunities, and so on. Before prison, most of the women lived unsafe lives. For many, threats to their physical, sexual, emotional and psychological safety can be found in their homes, neighbourhoods and, often, in their relationships. Intersectional inequality and oppression are significant contributors to women's criminal behaviour.

Chapter 3 (Prison Community, Prison Conditions) examines prison conditions and elements of the prison community that contribute to women's fears over safety while confined. Conditions of material scarcity, substandard living quarters, and few programme and treatment resources are exacerbated by the crowding that characterises contemporary correction institutions. Women's attempts to neutralise, escape or protect can take many forms: bullying another inmate, forming inmate families, withdrawing from certain activities, and other behaviours. In the absence of alternatives, and with the reality of living in a climate of fear, these behaviours offer a sense of control and provide psychological and physical relief.

In chapter 4 (Searching for Safety through Prison Capital), the authors explore how women's prison culture reflects and responds to gendered inequalities. Prison culture mediates these inequities by mapping cultural routes to survival and safety, while at the same time creating the potential for risk and danger. Inequality within prison is expressed in relations between all members of this community. This chapter also outlines the strategies and tactics that women deploy in their search for safety, which is embedded in prison capital. They face unsafe situations by using various forms of their capital. The authors define "doing safety" as a daily effort that shields women from situational and structural violence in the prison community.

Chapter 5 (Inequalities and Contextual Conflict) explores the impact of inequality on women's imprisonment as it creates and sustains conflict. This chapter provides a detailed description of the forms of gendered violence.

Chapter 6 (Intersections of Inequality with Correctional Staff) expands on the consequences of the obvious inequality between correctional worker and prisoner. In relation to staff, imprisoned women develop various strategies in their search for safety, such as cooperating with rules and regulations, treating staff politely and deferentially, and deflecting staff attention.

In the closing chapter (Gendered Human Rights and the Search of Safety), the authors suggest that women's prisons, because they are unsafe, have become the site of state-sponsored suffering in the reproduction and reinforcement of multiple forms of inequality through the gendered harm of imprisonment. They argue that women's prisons harm women and their life chances in unnecessary ways, concluding: "There is no doubt that all imprisoned people suffer by confinement. We have determined, however, that the overt gender discrimination in the wider society and within the prison adds another punishing layer to the gendered cumulative disadvantage faced by justice-involved women."

The reader interested in research methodologies will probably be inspired by some distinctive methodology steps and specifics that shaped the data collection process in the studies that represent the basis of the book, such as the unique focus group methodology that was developed. The focus groups' questions were developed through a multistage process. Initial questions were pretested in four preliminary prisoners' groups and revised and modified in team discussion with imprisoned women, thus giving them an active role in the process of developing research tools. The imprisoned women also alerted the researchers to the fact that it is not possible to investigate violence and conflict in focus group meetings lasting just an hour or two. They advised the researchers that the topic itself demands the creation of a safe conversation environment,

which takes time. The authors are aware that the core and the essential part of the findings came about precisely in these prolonged phases of focus group meetings, which were suggested and encouraged by the imprisoned women themselves.

This kind of research approach demonstrated the authors' perception of the imprisoned women as active co-creators in the research process. The research is based on the active participation of the research group (imprisoned women), acknowledging the group as the source of the knowledge and an important subject (rather than just an object) of investigation. Contemporary criminology often does exactly the opposite: it distances itself from the imprisoned (by collecting data from the staff instead) and in so doing neglects the central role that imprisoned people's voices have precisely in the development of prison criminology (e.g., Clemmer, Becker, Gresham and Sykes in the USA, Cohen in England, Mathiesen in Scandinavia, and Foucault in France). The importance of putting the imprisoned person in the role of informer is one of Wacquant's central methodology warnings, as well. Owen, Wells and Pollock's work is therefore an all the more significant contribution to contemporary criminology. It seems that they were fully aware of the difficulty and complexity of prison research.

At the same time, the inclusion of the voices of the imprisoned is all the more important when investigating *women's* prisons. Only by giving a voice to imprisoned women can the researcher avoid constructing typical (and harmful – a critical mind would say violent) narratives about women in prisons as being passive, conforming and obedient. The authors have enabled them to enforce their right to present and explain their own situation in a first-hand way, giving them the power, which will definitely be an advantage in their future search for safety.

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