Table of contents

FOREWORD

PREDGOVOR

FOREWORD

SAŽETAK

SUMMARY

INTRODUCTION

CONSTRUCTIVIST TEACHING

History of constructivism

Ontology and epistemology of constructivism

Dimensions of constructivism

Characteristics and types of constructivism

Constructivist learning

Constructivist teaching

Criticism of constructivist learning and teaching

Elements of constructivism in reform pedagogy movements

Art education movement

Working school movement

New school

Progressive pedagogy in the US

John Dewey and progressive pedagogy

Maria Montessori

Rudolf Steiner and the Waldorf pedagogy

Celestín Freinet

Peter Petersen and the Jena plan

Other representatives of reform pedagogy

DIGITAL MEDIA IN EDUCATION

Characteristics of media use in education

Constructivist education with digital media

Computer self-efficacy

Motivation for using digital media in education

EMPIRICAL RESEARCH METHODOLOGY

Research aim

Variables

Students – independent variables

Students – dependent variables

Teachers – independent variables

Teachers – dependent variables
Sample .............................................................................................................. 132
Methods ........................................................................................................ 134
Computer self-efficacy scale .......................................................................... 136
Constructivist learning scale .......................................................................... 142
Digital technology implementation questionnaire ........................................ 153

RESULTS AND DISCUSSION ........................................................................ 167
Students ........................................................................................................... 167
Teachers .......................................................................................................... 186
Student – teacher comparison (frequency of media use; school equipment; media ownership at home) ................................................................. 194
Teachers: assessing computer self-efficacy, constructivist learning, and motivation for using different media – differences based on independent variables ........................................................................................................ 196
Computer self-efficacy .................................................................................. 197
Constructivist learning assessment .............................................................. 199
Motivation for using digital media ............................................................... 201
Teacher correlations .................................................................................... 204
Students: assessing computer self-efficacy, constructivist learning, and motivation for using digital media – differences based on independent variables ........................................................................................................ 206
Computer self-efficacy .................................................................................. 207
Constructivist learning assessment .............................................................. 209
Motivation for using digital media ............................................................... 211
Student correlations .................................................................................... 214
Differences between students and teachers (computer self-efficacy, constructivist learning, motivation for using digital media) ........................................ 215
Computer self-efficacy .................................................................................. 215
Constructivist learning ............................................................................... 216
Motivation for using digital media ............................................................... 217

CONCLUSION .................................................................................................. 219
BIBLIOGRAPHY ............................................................................................... 230
INDEX ................................................................................................................ 252
APPENDICES ..................................................................................................... x
Appendix 1. Questionnaire for students .......................................................... x
Appendix 2. Questionnaire for teachers .......................................................... x

PODATCI O AUTORIMA .................................................................................... x
ABOUT THE AUTHORS .................................................................................... x
Foreword

Funded by the Croatian Science Foundation, the scientific project entitled School for the Net-generation: Internal Reform of Primary and Secondary School Education was carried out in the period from 1 September 2014 to 31 August 2017, within the framework of research activities of the Faculty of Teacher Education (University of Zagreb). This monograph is the result of long-term research on the role of digital media in informal learning environments created by schools for members of the so-called Net generation; however, only the results of more recent empirical research conducted by three members of the School for the Net-generation research team among Croatian primary and secondary school students and teachers are presented herein. Empirical results are contextualised within theories of education and learning presented in recent scholarly writings on didactics and psychology. The authors of the present monograph would like to take this opportunity to thank the Croatian Science Foundation and the Faculty of Teacher Education (University of Zagreb) for providing financial assistance necessary to conduct the empirical research, and to prepare and publish the results.

We are also grateful to the primary and secondary schools where data presented in this monograph and our other publications (Matijević et al., 2016) were collected. We owe special thanks to the students, teachers, principals and other experts employed in the following primary schools: “Đulovac” Primary School; “Ljubo Babić” Primary School, Jastrebarsko; “Lipik” Primary School; “Braća Radić” Primary School, Pakrac; “Vjenceslav Novak” Primary School, Zagreb; “Antun Gustav Matoš” Primary School, Zagreb; “Lijepa naša” Primary School, Tuhelj; First Primary School, Varaždin; “Ostrog” Primary School, Kaštel Lukšić; and the Second Primary School, Bjelovar. We would also like to acknowledge the assistance and cooperation of the principals, teachers and experts employed in secondary schools we visited in order to collect data and exchange opinions on teaching and learning for the Net generation. They include the following: Economics Secondary School, Čakovec; “Matija Antun Reljković” Secondary School, Slavonski Brod; Secondary Trade School, Vinkovci; and the Veterinary Secondary School, Zagreb.
The authors would also like to thank the reviewers of this book for their useful advice and critical remarks.

A list of selected publications produced by members of the research team in the course of this project has been included in a different monograph, prepared by the research team members (cf. Matijević, 2017, pp. 344–347).

*The Authors*
Constructivist teaching: Theory and empirical research

Constructivism cannot be defined or explained in a single, unique way: it is, at the same time, a theory of learning and a theory of knowledge. Constructivism and constructivist learning theories are based in ontology and epistemology. Theses and hypotheses inscribed in the constructivist view on the genesis of reality, knowledge and learning are neither new nor original. What is new, however, is the way they perceive and interpret that same reality, knowledge, and learning. When it comes to the history of constructivist thought, some authors claim it was first formed in the 20th century (Watzlawick, 1984; 2003; Ernst 1998; 2005; Piaget, 2002; 2005; Vygotsky, 1977). In contrast, some authors (Palekčić, Vollstädt, Terhart i Katzenbach, 1999; Pritchard & Woollard, 2010; Von Glasersfeld 2003) describe the long history of the development of constructivism, a history they trace back to the B.C.E period, while others believe constructivist thought has been around for a little over one hundred years (Schweizer, 2007).

Depending on their approach to constructivism, Null (2004) has divided constructivists into three groups, based on the specific level they focus on. The first of Null’s groups encompasses epistemological constructivists, i.e. theoreticians who study knowledge on the epistemological level, examining how, why, when, and where knowledge is created (constructed) within society. These theoreticians often deal with the social, political, and economic context. The second group consists of instructional constructivists, whose main focus of interest is research on local and individual constructions of knowledge which take place within individual classrooms, and are performed by individual students. These theoreticians and researchers therefore examine the processes of learning and instruction. They frequently point out that learning is not linear, and that it is rooted in students’ abilities to attribute meaning. Simply put, the third of Null’s groups includes researchers – prescriptive constructivists – who study constructivism by prescribing certain actions. They distil the entirety of theoretical and scientific discussions into a certain number of techniques and advice teachers should implement in their classrooms. There are some indications of attempting to prescribe what the teacher
“must” do in order to organise classes in accordance with the theoretical findings of constructivism (Null, 2004, pp. 181–182).

However, there are different types of theoretical approaches and different types of constructivism, which can be viewed through three theoretical lenses: philosophy (ontology and epistemology); the psychological theory of learning; and didactics (the theory of education) (Kanselaar, de Jong, Andriessen & Goodyear, 2002).

The philosophical approach focuses on ontology and epistemology, with the former examining the issue and nature of reality, and the means of its comprehension. This raises the question about whether all people perceive reality and the world around them in the same way and in terms of the same content. Developed in the 20th century, the second theoretical approach views constructivism as a psychological theory of learning. The basic premise of this learning theory is the notion that the learning process is facilitated by human activity, handling objects, and interaction with one's physical and social environment. The psychological constructivist theory has undergone significant development in the last three decades, primarily thanks to the implications its findings have had in the context of education. Older than the psychological approach, the third approach to constructivism is rooted in didactics and focuses on the characteristics and means of organising education, i.e. instruction and learning. In contrast to some other didactic approaches, the constructivist approach to education places emphasis on student activity. The constructivist approach in didactics stands in direct contrast to the dominant paradigm of the class-subject-lesson system and instruction from the front, which requires students to be silent, remain seated, listen, and observe.

There are several constructivist learning theories. Phillips (1995) lists three aspects of thinking about constructivist learning: individually or socially constructed knowledge; creation or discovery; and intellectual or physical knowledge construction. It should therefore come as no surprise that there are many classifications of constructivism, and that the concept is often understood as a synthesis of existing approaches: cognitive constructivism, personal constructivism, social constructivism, critical constructivism, and radical constructivism. Approaches that have had the most influence on the organisation of student-oriented education include the cognitive constructivist theory of learning and the social theo-
ry of learning (social constructivism). Constructivist learning is defined as a self-regulatory, interpretative, and non-linear process of knowledge building, supported by active interaction with one’s surroundings – both physical and social (Fosnot & Perry, 2005, p. 34). Within the constructivist paradigm, learning is seen as a constructive and situational process, with classroom education functioning as a source of support, stimulation and advice for students participating in the learning process (Palekčić, 2002; Babić, 2007). The role of the teacher is to organise learning activities, experiences and an environment in which learning will take place. Constructivist didactics ensures the conditions and circumstances which support independent learning (knowledge construction). Terhart (2003) explains that the principles of constructivist didactics have already been recognised and were founded at the beginning of the 20th century, within the framework of reform pedagogy.

To be sure, these theories of learning have not been immune to criticism. Kirchner, Sweller and Clark (2006) point to several weak points of constructivist education: namely, they consider constructivist education – especially research and problem-solving learning – to be based on the processes of scientific knowledge and scientific methodologies of a given discipline (mostly in the field of natural sciences). Kirchner (1992) explains that the way in which a (scientific) expert reaches scientific conclusions is not the same as classroom education and the didactic formation of the processes of instruction and learning. Mayer (2004), Kirchner, Sweller and Clark (2006), Rosenshine (2009) and others believe there is not enough empirical data to support the notion of the superiority of constructivist learning over learning through direct instruction.

However, it is important to recognise that constructivist learning is future-oriented. It is an anticipatory type of learning which lays the groundwork for competences necessary for studying. Regardless of the different approaches to what we call learning theories, the constructivist approach can be recognised in all previously mentioned ideas formed within reform pedagogy and didactics. The idea of the so-called new school was formed under the influence of art education and the working school movement. It is believed that constructivism first appeared within the field of arts at the beginning of the 20th century: first in Russia, from where it gradually spread through the rest of Europe. As an artistic style
and approach, constructivism first affected painting, and later developed into an approach to architectural design. All this could not have been excluded from the art classroom, where it was manifested as freedom of expression, encouragement of aesthetic perception and experience, and stimulation of creativity and divergent ways of thinking. Creative artistic expression, students’ individuality and creativity in artistic fields earned their place on the lists of content and activities in the curricula of general and trade schools, which presented a significant and necessary departure from highly didactic 19th-century intellectualism (Croatian Encyclopaedia, http://www.encyclopedija.hr/).

In didactics and pedagogy, constructivism implies the activity of all the participants involved, primarily the students. Representatives of one of the original pedagogical reform movements (the working school movement) which appeared at the turn of the 20th century, support active and independent student work. Proponents of the working school movement call for more active learning, with special focus on students’ manual labour. The working school movement developed during the Second Industrial Revolution, in the period of intensive search for new didactic strategies that would satisfy the needs and expectations connected to school results; this was a time when Maria Montessori, Dewey, Freinet, Feriere, Petersen, Parkhurst, Claparede, Decroly, Cousinet and others intensively examined didactic scenarios and strategies that highlight the different (individual, group) student activities connected to independent research, discovery, and problem-solving.

They provide changes in ways of thinking about the curriculum, as well as the processes of learning, instruction, and evaluation. Their approach to curriculum development presents a departure from the standardised curriculum and is based on students’ previous experiences. Learning and instruction are organised as processes of meaningful activities during which students gain new knowledge based on their previous experiences and abilities, which they increase and improve with the help of others and in cooperation with them. Education strategies promote questioning, research, reflection, and practical activities, while avoiding memorising facts. Naturally, this approach also affects evaluation methods and principles, which become part of the learning process. Standardised student evaluation and marking become pointless. Another
common feature of the previously presented projects and pedagogues is the search for balance between independent individual activities on the one hand, and students’ independent group and collaborative work on the other. All forms described here require teachers who are not lecturers, but organisers, moderators, and collaborators. However, despite these long-standing observations and solutions that have been tested in practice, many institutions of teacher education still insists on training future teacher-lecturers, who will rely primarily on lecture-demonstrations, ignoring constructivist principles.

A new wave of changes in education was prompted by computer technologies and new media. Initial research on the role and effect of computer technology was dominated by euphoria and the notion that in and of themselves, media would raise the quality of education and learning (Tamim et al., 2011; Timmermann & Kruepke, 2006). These results suggest that media-based instruction is at least as efficient as or even more efficient than instruction that does not rely on the use of media (Schmidt et al. 2009; Tørgerson & Elbourne, 2002; Zhao, 2003). The development and intensification of research which took place during the 1980s and lasted until around the middle of the 1990s resulted in a lowering of this estimate; in other words, research began to indicate that (digital) media-based instruction was as efficient as instruction that did not rely on media. Research conducted in the 1990s pointed out, and that from the 2000s confirmed that (digital) media are simply one of many factors whose interconnectedness (interaction, multivariance) can improve the quality and raise the level of reaching certain learning goals (e.g. Tamim, 2009; Tamim et al., 2011).

The importance of (socio)constructivist learning, self-regulated, contextualised, and cooperative learning supported by digital technologies (primarily the internet and Web 2.0 technologies) and contextualised within the relativisation of formal and emphasis on informal learning (anywhere, anytime) triggered the emergence of special discourse on what has been termed “worlds of digital learning” (Ger. Digitale Lernwelten) (Hugger & Walberg, 2010). Generally speaking, worlds of digital learning signify the possibility of self-regulatory, independent, but also collaborative learning supported by digital technologies.

It is not possible to fully examine the characteristics of contemporary education based on constructivist theories of learning and multimedia
education without studying the computer self-efficacy of teachers and students, and the motivation for implementing digital media. Research has confirmed that attitudes toward digital technology and the perception of one’s ability to use it play an important role in determining one’s success in performing tasks by employing that same technology. Computer self-efficacy is defined as the self-perception of one’s abilities to perform certain tasks and activities with the help of digital (computer) technology. Computer self-efficacy has developed from the theoretical concept of self-efficacy, proposed by Albert Bandura (1977, 1982, 1993, 1997). It is important to note that self-efficacy – be it a general or specific type of self-efficacy (Pintrich, 2004; Pintrich & De Groot, 1990; Schunk, 2005; Torrano Montali & Tores, 2004; Usher & Pajares, 2008) – is an important factor in motivation and self-regulated study.

When discussing the possibility of implementing digital technology into a specific phenomenon and process, i.e. education, learning, instruction, and schooling, the theory of values and expectations has proved highly useful (e.g. Eccles, 2005; Eccles & Harold, 1991; Wigfield & Eccles, 2000). In other words, this theory has proved to be the optimal theoretical and practical framework which can be used to explain a series of implementations of innovations in the educational context (e.g. Marušić, Jugović & Pavin Ivanec, 2011; Pavlin-Bernardić, Rovan & Marušić, 2017; Wozney, Venkatesh, & Abrami, 2006).

The aim of the present research was to examine the characteristics of digital media use and constructivist education, from the point of view of students and teachers in primary and secondary schools in the Republic of Croatia. Specifically, our goal was to examine the degree to which teachers and students possess individual digital media; the degree to which schools are equipped with digital media and encourage their use; the frequency of using individual digital media in the classroom; the level of computer self-efficacy; reasons for using digital media in the classroom (motivation for their use); and students’ and teachers’ views of constructivist learning. To collect data on computer self-efficacy, the Computer Self-Efficacy Scale developed by Teo and Ling Koh (2010) was used. To examine the elements of constructivist education, Taylor, Fraser and Fischer’s (1997) Constructivist Learning Environment Scale was used. To determine the motivation for using digital media in the class-
room, Wozney, Venkatesh and Abrami’s (2006) Technology Implementation Questionnaire was employed to examine the reasons, i.e. motivation, for using both digital technology and digital media in the classroom. The instruments were constructed based on the theory of values and expectations, and on the theory of motivation (e.g. Eccles, 2005; Eccles & Harold, 1991; Wigfield & Eccles, 2000). Further, our aim was to examine the characteristics of each previously listed variable with regards to the individual demographic characteristics of students and teachers. Finally, we wanted to determine whether or not differences in the examined variables exist between students and teachers.

Data were collected among participants \(N = 880\) from the whole of the Republic of Croatia. The aim was to encompass schools from all regions in Croatia in order to obtain the most representative sample possible. The sample included primary and secondary school students \(n = 512\) and teachers \(n = 368\). Data were gathered in January and February 2016 using the paper-and-pencil method. The research was conducted in accordance with the Code of Ethical Research Involving Children and Young Adults, and was entirely anonymous and voluntary. The research itself was quite extensive, and the following paragraphs present only some of the results of the detailed analyses, with regards to the independent variables.

A descriptive analysis shows that almost every student owns a computer and has internet access, a mobile phone, smart phone, and a social media profile. To a lesser, but still large, extent, students own multimedia software; an even smaller number of students owns tablets. These results correspond to those obtained by OECD (2015), which suggest that the digital divide with regards to socio-demographic factors no longer poses a real problem in education. A significant difference when it comes to ownership of digital media was determined with regards to student gender: compared to their male colleagues, more female students own mobile phones \(\chi^2 = -0.141; \text{df} = 1; \text{p} = 0.001\) and have social media profiles \(\chi^2 = -0.103; \text{df} = 1; \text{p} = 0.019\). A significant difference in digital media ownership with regards to the level of education was determined only for tablets: primary school students own tablets more often than secondary school students \(\chi^2 = 0.181; \text{df} = 1; \text{p} = 0.000\). When it comes to their results at school, students who finished the previous class with a passing grade are
less likely to have a computer ($\chi^2 = 0.526; \text{df} = 3; p = 0.022$) and internet access ($\chi^2 = 1.930; \text{df} = 3; p = 0.039$) than other students. Analyses of differences based on individual school programmes indicate that gimnazija (grammar) school students are slightly more likely to own some kind of multimedia software ($\chi^2 = 0.143; \text{df} = 1; p = 0.019$) than vocational school students. When it comes to the schools’ level of digital media equipment, it was determined that, on average, schools are somewhat equipped with computers, internet access, special computer programs, and projectors; they are equipped with SMART Boards to a lesser degree, and completely unequipped with tablets. Student assessments indicate that secondary schools are somewhat better equipped when it comes to internet access ($U = 27607.0; z = -3.346; p = 0.001$) and SMART Boards ($U = 29279.0; z = -2.276; p = 0.023$), while primary schools are better equipped with tablets ($U = 29649.5; z = -2.292; p = 0.022$). According to student assessments, classes very often include activities that require them to use the internet (63.7%), look up information online (56.6%), and use social media (60%). On the other hand, a large number of students believe classroom activities are organised so that they never get a chance to show video (54.3%) or audio recordings (73.8%), use online learning platforms (66.8%), or do any programming (63.5%). Based on the analysis of pedagogical practices in 174 case studies, Kozma (2003) established that in the majority of cases, students use various design tools in the classroom, such as presentations (78%), web resources (71%), and multimedia software (52%). When it comes to the degree in which the use of digital media in education and learning is encouraged, students assess that teachers usually do not encourage them to use digital media in the classroom or for studying purposes ($M = 2.33; SD = 0.89$); rather, it is their parents who mostly encourage the use of digital media ($M = 2.85; SD = 0.92$).

It was established that almost all the teachers included in the research own personal computers (99.7%), have internet access, and own mobile phones. To a lesser degree, they also have smart phones, multimedia software (64%) and social media profiles (65%); the smallest percentage of teachers own tablets (56%). Asked to comment on how well their schools are equipped with digital media, teachers on average consider the schools in which they work to be somewhat equipped with computers, appropriate computer programmes, projectors, SMART Boards, and tablets. 50% of the 605 teachers consider their schools to be fully equipped with
projectors, internet access, and computers. A little over 50% find their schools to be somewhat equipped with SMART Boards, although more than 40% claim their schools are completely unequipped with SMART Boards. More than 60% of teachers consider their schools completely unequipped with tablets.

It was established that 30–60% of teachers claim their principals encourage them to use digital media, while 30–45% claim they receive this type of encouragement from experts. On the other hand, around 30% of teachers state they were trained to use digital media in education during their professional development, while 1/5 of teachers point out they have not participated in this type of training.

With regards to assessments of media ownership among students and teachers, the Mann-Whitney U test established considerable differences in the ownership of computers (U = 91704,0; z = -2,909; p = 0,004), internet access (U = 91264,0; z = -3,420; p = 0,001), multimedia software (CD, DVD) (U = 69688,0; z = -9,436,432; p = 0,000), smart phones (U = 78728,0; z = -7,572; p = 0,000), and social media profiles (U = 65632,0; z = -11,925; p = 0,000); however, no significant differences were determined with regards to mobile phones (U = 93504,0; z = -0,984; p = 0,325) or tablets (U = 90456,0; z = -1,181; p = 0,238). A significantly higher number of teachers claimed to have computers and internet access at home, while more students claimed to have multimedia software, smart phones, and social media profiles.

Evaluating the constructivist learning environment at their school on a 4-grade scale (with 1 meaning “does not describe to me at all”, and 4 meaning “fully describes me”), students assessed that classroom education provides them with learning activities that, for the most part, enable them to maintain interest in learning and recognise its importance (M = 2,99), and promote critical thinking (M = 3,07) and collaborative learning (student negotiation) (M = 2,73). However, students also believe they are not given control of their own learning process (individualisation and self-regulated learning) (M = 2,43). Teachers also generally believe the learning environment they create for their students has constructivist elements. Specifically, they believe the learning environment enables students to develop a personal sense of the importance of learning (connecting the contents of learning with real-life situations) (M = 3,36), critical
thinking (M = 3.44), learning control (M = 2.96), and student negotiation (collaborative learning) (M = 3.8).

An analysis of the results determined no significant difference in evaluating constructivist learning with regards to teachers’ gender. Teachers who obtained their degree from faculties other than the Faculty of Teacher Education (University of Zagreb) have a significantly more negative perception of students’ learning control and negotiation abilities. Furthermore, significant differences were noted in evaluations of students’ abilities to recognise the personal importance of learning, students’ critical thinking, and students’ ability to negotiate when it comes to the learning process. Primary school teachers gave higher assessments of these elements than their secondary school colleagues. Considering the type of secondary school, significant differences were also established when it comes to the control factor. Grammar school teachers gave much lower assessments of students’ abilities to control learning than primary school and secondary vocational school teachers. Years of working experience did not prove to be a source of statistically significant differences in evaluating constructivist learning.

When analysing differences with the help of the Mann-Whitney U test in student and teacher assessments of opportunities for creating a constructivist learning environment, significant differences were determined with regards to each factor. Student assessment of the levels of the personal importance of learning (U = 56914.0; z = –10.026; p = 0.000), critical thinking (U = 56060.0; z = –10.293; p = 0.000), the ability to control learning (U = 49094.5; z = –12.155; p = 0.000), and their negotiation abilities with regards to the learning process (U = 59788.0; z = –9.292; p = 0.000) are much lower than the teachers’ assessment.

The research findings indicate that students gave a positive assessment of the value of using digital media in the classroom (M = 2.89), have similar expectations when it comes to achieving learning goals with the help of digital media (M = 2.83), and believe the use of digital media in learning activities does not require additional effort on their part (M = 2.83). It was found that teachers have a relatively high degree of motivation for using digital media in the classroom. In other words, teachers ascribe more value to digital media (M = 3.03) and their ability to successfully organise classes by using it (among other tools) (M = 3). Furthermore, they believe
that organising classroom activities with the help of digital media does not require additional effort on their part (M = 2.97). No significant differences were determined in teacher assessment with regards to gender. Assessments of the implementation of digital media and the investment of effort required to use them differ significantly depending on the teachers’ initial education: teachers who were trained at faculties other than the Faculty of Teacher Education gave a more negative assessment. There are no significant differences when it comes to teachers’ assessments of the implementation of digital media in terms of the education level of the school in which the teachers are employed, the education programme, or years of working experience.

The Mann-Whitney U test was used to examine the differences in student and teacher assessments of the motivation for implementing digital technology. Significant differences were found: students’ assessment of the values and benefits of classroom use of digital media (U = 86060,0; z = –2,193; p = 0,028), their expectations regarding the success of digital media use (U = 79907,0; z = –3,855; p = 0,000), and assessment of the effort required to use digital media (U = 84942,0; z = –2,497; p = 0,013) are considerably more negative.

The research findings confirm that students believe that they have an above-average level of computer self-efficacy in all aspects, i.e. in terms of basic computer skills (M = 3.63), the use of individual computer programs (M = 2.74), and internet skills (M = 3). Teachers assess their own levels of computer self-efficacy as being partially high. Namely, they consider their basic computer (M = 3.69) and internet skills (M = 3.03) to be above average, but find their ability to use computer programs to be below average (M = 2.01). Male teachers provided considerably more positive assessments of their computer self-efficacy than their female colleagues. It is interesting to note that teachers who graduated from the Faculty of Teacher Education consider their basic computer skills to be considerably lower than teachers who received pedagogical training from a different faculty, or who graduated from a different faculty and received pedagogical training only subsequently. Significant differences in evaluating computer self-efficacy were established among primary school and secondary school teachers. In both cases, secondary school teachers provided much higher evaluations of their computer self-efficacy. When it comes
to evaluating computer self-efficacy with regards to years of teaching experience, significant differences were found in the self-assessment of basic computer skills and computer program skills. Teachers with the most years of teaching experience gave the most negative assessment of these factors. There are no significant differences in assessing internet skills.

When analysing data with the Mann-Whitney U-test, partially significant differences were established in student self-assessment of computer self-efficacy, and teacher assessment of their computer program skills ($U = 55863.5; z = -19.364; p = 0.000$), as well the self-assessment of their internet skills ($U = 53416.0; z = -11.045; p = 0.000$). Students provided considerably more positive assessments of their computer program and internet skills. These findings indicate that students, and younger generations in general, consider the level of their own computer-efficacy to be much higher than that of their teachers, and older generations in general, which further supports previous findings on this issue (European Commission, 2013; Topolovčan & Matijević, 2014; Topolovčan, Matijević & Dumančić, 2016; Whitley, 1997).

The previously presented conclusions and results of some other research point to a need for more radical changes in pedagogical scenarios which contemporary schools offer members of the Net generation (Matijević, 2015; Topolovčan, Matijević & Dumančić, 2016; Matijević, 2017). Rooted in movements and orientations of reform pedagogy launched some hundred years ago, constructivist education provides positive options and stimuli for change in the pedagogical outlook which is meant to dominate the present-day classroom. This new outlook provides ample room for the implementation of digital media in both curricular and extra-curricular activities. While acknowledging the findings of multimedia pedagogy and curriculum theory, multiple intelligence theories, and the findings of educational neuroscience, pedagogical scenarios in education and in the classroom will continue to undergo significant changes in the coming years. The research findings presented in this monograph may be of use to experts faced with selecting criteria for choosing and pedagogically designing educational scenarios for new generations of students.


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Naslovnica
Sanja Zlatar

Grafička priprema
Dalibor Ferenčina

Tisak
ITG d.o.o.

ISBN 978-953-8115-26-4

CIP zapis dostupan u računalnom katalogu
Nacionalne i sveučilišne knjižnice u Zagrebu pod brojem 0000

Tiskano u kolovozu 2017.