# EXPERIENCE TOWARDS USING INFORMATION TECHNOLOGY IN TEACHING AND LEARNING

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## ABSTRACT

Digital competences are becoming a relevant element in the process of globalisation and economic development. Accessibility to E-learning materials in primary, secondary and tertiary education is an important part of education. This article aims to explore the accessibility of digital technology connection, with an emphasis on the development of students' social and professional competences. The research explores the student ICT levels (information and communication technology) knowledge, accessibility to technology and an opinion about their social and professional competences. The statistical data of using ICT tools in Croatian schools is explored in order to find out the elements of teaching scenarios used to create teachers training curriculum that incorporates digital technology. According to results from pilot studies, elements of possible-learning scenarios for the STEM (Science, Technology, Engineering and Mathematics; in Croatian Mathematics, Physics, Chemistry and Biology) area of teaching were analysed. Good knowledge and skills in this area enabled primary and secondary schools students to develop competences for future tertiary education and a competitive labour market. These results could be used to design student/teacher ICT training.

Keywords: Digital competences, Information and communication technology, STEM subjects.

## 1. INTRODUCTION

The usage of Information and Communication Technology (ICT) is becoming an important part of the current teaching and learning process. Teachers and students are developing their digital skills and competences in relation to modern technology. Digital competences include confident, critical and creative use of ICT, which enables goals related to work to be achieved, employability, learning, leisure and inclusion and/or participation in society (cited by Ferrari, 2013, pp 37). The mainstream of education in European countries is focused to the area of mathematics, sciences and technology. The reason is to adopt the education to the needs of modern society, particularly education and economy development. According to EACEA (2012), 20% of Croatia graduates in 2010 came in the MST (Mathematics, Science and Technology) area of sciences that includes Mathematics, Science, Computing and Engineering. The research was conducted among 34 European Countries. According to the data, 17 countries have more than 20% of graduates that come for the MST area.

The Croatian National Curriculum Framework for preschool education and general compulsory and secondary education from 2007 (pp 22) emphasises that one of the expected educational achievements or outcomes is acquiring information, technical and technological competences. The ICT competences that students acquire after completing their secondary education will be used to search for, collect and organise data, to analyse and synthesise information, to research, model and simulate processes in natural sciences, to problem solve and create new ideas and emphasise efficiency in learning as well to collaborate with others. Digital competences include the

confident and critical use of ICT at work and at home (Ministry of Science, Education and Sport, National Curriculum Framework for 0-1 Preschool Education and General Compulsory and Secondary Education, 2010, pp 26). Competences in technology enables people to apply scientific knowledge to human needs and the impact of human activity. According to the website statistica.com (Schwandt & Kröger, 2015), 96% of people aged 16-24 use the Internet on a daily basis. The percentage of Internet users aged 25-34 is 90%, 35-44 years old use the Internet less (86%), 79% of those aged 45-54 use the Internet on a daily basis and 68% people aged 55 or older use the Internet on a daily basis.

### *1.1 Literature & Theory*

The mainstream and the impact of using information and communication technology in the European schools is explored by Brecko *et al.* (2014). The policy action is focused to the usage of the ICT ICT-ELI (Enabled Learning Environment) in European schools. The elements of this strategy are focused to the professional development of teachers and staff, infrastructure, organisational development, leadership and research. The teachers and staff from 22 European countries recommended improvements in curriculum, policy, school and the professional development of staff.

According to the European Commission/Education and Training Monitoring 2015 Croatia (2015), 15 year old Croatians have higher levels of underachievement in mathematics and science in comparison to their peers in other EU Countries. The data collected for 2014 showed that 29.9% of 15 year old Croatians underachieve in mathematics and 17.3% underachieve in science. The European averages for the same subjects are: 22.1% of young people (15 years old) underachieve in mathematics and 16.6% underachieve in science. The same document explored the vision of more digitally mature schools, which aim to include ICT equipment in each school, teacher training for ICT/digital competence, school staff training, encourage creative thinking and prepare students for a competitive labour market.

This research, conducted by Wilson *et al.* (2015), placed an emphasis on the importance of ICT learning progression and social networking. The authors explored variables, such as knowledge about computers in the process of transition to ICT literacy, as applied in teaching of traditional and non-traditional school subjects. These competences and knowledge are applied to curriculum assessments.

### *1.2 Related Works*

ICT can be successfully applied in different areas of learning. The aim of research conducted by Svensson & Baelo (2015) was to estimate the perception by students of teachers regarding their digital competences. The elements of their self-perception were used for future training and professional development. The improvement of the teacher ICT competences includes pedagogical aspects of teaching (Bulali *et al.*, 2013). ICT competences and the possibility for interactive teaching needing to be developed among teachers and educators at all levels of education (Soleša & Soleša-Grijak, 2011). A useful tool for collaboration between school teachers is school networking with virtual platforms for exchanging information and examples of good practice (Butter *et al.*, 2014). Generally, using ICT in education of science depends on the level of digital competences of primary and secondary school teachers, which in turn have consequences in STEM and all other areas of teaching.

ICT usage in teaching and learning could be applied to design teacher training to develop their digital competences for STEM areas of subjects. Gracenea *et al.* (2015) explore learning scenarios for the teachers through

the process of monitoring, critical analysis, training and personalised approaches. The learning scenario includes an institutional designed model for learners and teachers regarding to the tools and methods that will be used to achieve learning outcomes. Some of the basic elements of the learning scenario incorporated in the learning scenarios of STEM subjects are: creativity, motivation, research questions which are connected to experienced based learning and the possible implementation of digital technology usage. These elements are used as the theoretical framework for estimating the learning scenarios in STEM subjects. The self-efficacy of online teacher communication depends on gender: male respondents have higher level of self-efficacy in online communication when using ICT tools in comparison to female teachers. The grade level has no correlation with the online communication self-efficacy of prospective teachers (Demir & Yurdugül, 2015). For example, Cunska & Savicka (2012) found that secondary school mathematics teachers could use interactive educational methods and ICT tools for promoting mathematics among secondary school students. Physics ICT can be used for the experimental team work in exploring different topics such as electric circuits and the optical phenomena in the atmosphere (Gosak & Pavlin, 2012). Chemistry teachers' attitudes towards applying ICT tools in teaching are important for creating an E-learning environment and are related to computer attributes, teachers' digital competences, culture perception and gender (Zhou *et al.*, 2010). Biology teachers in the south of Croatia reported positive aspects of using ICT and the Moodle platform for the creation of the teaching sensation for biology. They also emphasise the need for further education and training linked to teaching scenarios supported by ICT. School infrastructure needs to be improved by ICT technology (Kostović-Vranješ, 2016) and the existing teaching curriculum can be improved with topics related to computer and information literacy (Kostović-Vranješ & Tomić, 2014).

The main goals of two pilot studies are the measurement of the current situation in E-learning among Croatian students. The goal of the first research is to estimate university student attitudes towards the possibility of professional and social skills development. These skills will be an important factor for further education and employment in a competitive labour market. Respondents estimate their own experience in using E-learning materials in the second part of the research study. They evaluate experiences with E-learning technologies, accessibility to the Internet, approximate duration of daily Internet use and the benefits of social networks. The pilot studies provides insight to the current implementation of E-learning.

## 2. METHODS

Two separate studies were conducted in order to collect the data for exploring the current knowledge and habits of using information and communication technology in learning. In the first study, respondents were asked to estimate their attitudes towards different objects with regards to professional and social communication competences. The second study, a survey on student ability to create a virtual learning environment, was conducted online. Both studies were conducted at the beginning of the academic year. The reason to collect the responses at the beginning of the first semester of the undergraduate study is to measure the incoming digital competences immediately after completing the secondary education. The respondents are asked to estimate their opinion towards the different objects at the SD PK scale.

### *2.1. Respondents*

Respondents in the first study are N= 158 students. The majority of students were female $N_F$ = 95 (60.13%) and the rest were male students $N_M$ = 63 (39.87%). The respondents in second study were N= 79 University students, $N_M$ = 17 (21.52%) and number of female respondents is $N_F$ = 62 (78.48%). All respondents were aged 18-19, they were university students at the first year of the undergraduate Information Systems, Economy and Entrepreneur Study Programme.

### *2.2 Measurement Instruments*

The Survey "Student Ability to Create Virtual Learning Environments" was created by Dijana Karuović of the University of Novi Sad and was designed to estimate the digital competences of students as the part of the second study. The whole measuring instrument contains 33 items, with demographic characteristics and mostly multiple-choice questions. The instrument has 5 areas of research. In this paper, the responses linked to the Internet usage, LMS and web applications were be interpreted.

In second study the respondents were asked to estimate their opinion towards the different objects at the SD PK scale from 1-5. The SD PK scale is a type of rating scale which measures the attitudes and connotative meaning of objects, events and concepts (Osgood, 1957 in Dalton *et al.*, 2008). The SD PK scale is designed by author of this research for the purposes of measuring attitudes towards the importance of different social and professional skills, which will be useful for students during education. The whole PK SD Scale contains demographic variables such as gender and age, plus 10 objects for evaluation. Each evaluation object is estimated through 10 pairs of objectives and some of them will be presented in this Article.

## 3. RESULTS

Students attitudes towards communication and the possible development of professional and social skills acquired through the learning process are presented below.

### *3.1. Students opinion towards skills acquired through schooling*

The Semantic differential tool was used and the results are presented in Figures 1 and 2.

**Figure 1**

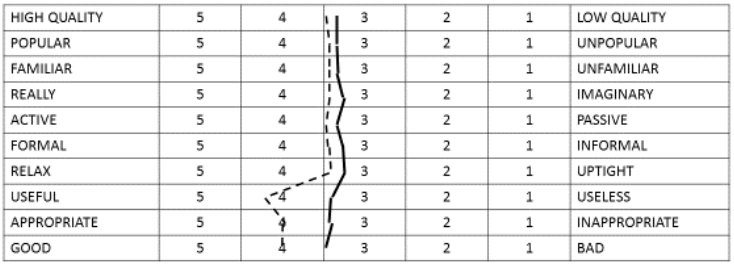
**Students Attitudes towards Communication (N=79)**

| | | | | | | |
|---|---|---|---|---|---|---|
| HIGH QUALITY | 5 | 4 | 3 | 2 | 1 | LOW QUALITY |
| POPULAR | 5 | 4 | 3 | 2 | 1 | UNPOPULAR |
| FAMILIAR | 5 | 4 | 3 | 2 | 1 | UNFAMILIAR |
| REALLY | 5 | 4 | 3 | 2 | 1 | IMAGINARY |
| ACTIVE | 5 | 4 | 3 | 2 | 1 | PASSIVE |
| FORMAL | 5 | 4 | 3 | 2 | 1 | INFORMAL |
| RELAX | 5 | 4 | 3 | 2 | 1 | UPTIGHT |
| USEFUL | 5 | 4 | 3 | 2 | 1 | USELESS |
| APPROPRIATE | 5 | 4 | 3 | 2 | 1 | INAPPROPRIATE |
| GOOD | 5 | 4 | 3 | 2 | 1 | BAD |

The students' estimates were mostly positive or neutral. Results (Figure 1) showed that student's attitudes towards communication were positive and the dominant value was 4 (on a 1-5 scale). Their opinion about the social and professional competences, which they acquire through education, were mostly positive or neutral (Figure 2). This result could be interpreted as the link between studying and further employment in the way that the study curriculum enabled good preparation for the future labour market. Teacher attitudes were related to the students' positive attitudes towards the usage of ICT in education (Sánchez *et al.*, 2012).

**Figure 2**

**Students Attitudes towards Social and Professional Competences (N=79)**



| | | | | | | |
|---|---|---|---|---|---|---|
| HIGH QUALITY | 5 | 4 | 3 | 2 | 1 | LOW QUALITY |
| POPULAR | 5 | 4 | 3 | 2 | 1 | UNPOPULAR |
| FAMILIAR | 5 | 4 | 3 | 2 | 1 | UNFAMILIAR |
| REALLY | 5 | 4 | 3 | 2 | 1 | IMAGINARY |
| ACTIVE | 5 | 4 | 3 | 2 | 1 | PASSIVE |
| FORMAL | 5 | 4 | 3 | 2 | 1 | INFORMAL |
| RELAX | 5 | 4 | 3 | 2 | 1 | UPTIGHT |
| USEFUL | 5 | 4 | 3 | 2 | 1 | USELESS |
| APPROPRIATE | 5 | 4 | 3 | 2 | 1 | INAPPROPRIATE |
| GOOD | 5 | 4 | 3 | 2 | 1 | BAD |

Legend: ——— = Social Competences - - - = Professional Competences

### *3.2. The Usage of Information and Communication Technology for Learning and Communication*

In second study, the 158 freshman students in the undergraduate Information Systems, Economy and Entrepreneur Study Programme were asked about their habits linked to the using of the information and communication technology. They were asked to estimate how many hours do they usually spend online. Their answers are presented at the Figure 3. More than half of the students (91 respondent or 57.58%) reported that they usually spend several hours each day being online. Several hours means 3-8 hours each day. The rest of the students reported that they spend more than 8 hours per day online (19.62%) or that they spend only few hours per day online (22.15%). Only one student spent less than one hour per day online. The results could be interpreted in order to emphasise the importance of quality of ICT tools and digital E-learning materials for students.

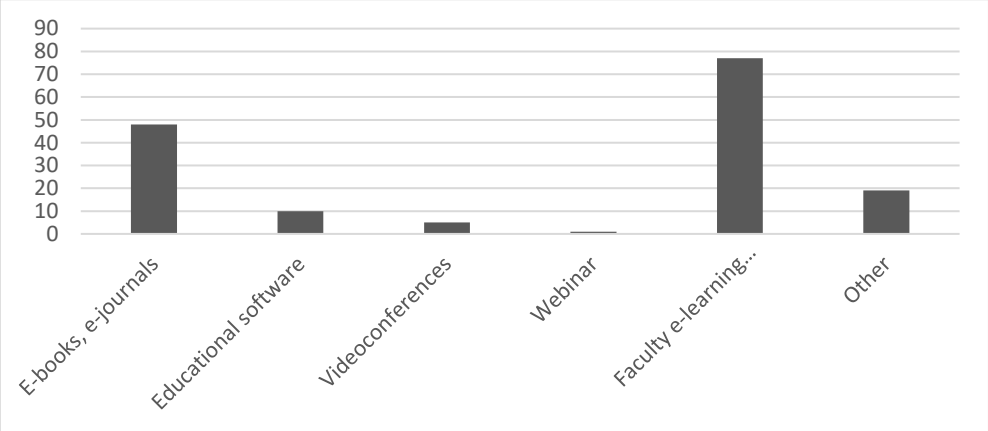
Students were asked which type of digital devices they used. Approximately 1/3 students used computers, 1/3 mobile phones or tablets and 1/3 students use both devices for the purpose of learning, networking and leisure time. The majority of students reported that they have access to the Internet on a daily basis (93.67%) and have experience in using E-learning materials (87.34%). This high level using E-learning materials results from implementing E-learning platforms at all teaching subjects at the all levels of study. The platforms like Moodle and Merlin are implemented in secondary school education. In spite of these relatively high results, the majority of university students reported that they have no experience in creating web applications. Only 14 respondents

(8.86%) at the first year of undergraduate study created web pages by themselves. These results could lead to implementation in the secondary school curriculum for the development of digital competences.

The majority of students use the following technology in their learning: Faculty E-learning platforms, e books or e journals and different education software's. At the moment, video conferences and webinars are not so popular for teaching and learning. Results are presented at the Figure 3. According to student opinion, video conferences or different types of educational software are not used so frequently. This area of teaching that could be improved by the implementation of different ICT tools in education and by supporting teacher training.

**Figure 3**

**Types of E-learning Technologies Used by Students (N=158)**




### *3.3. The Possibility for Implementation of Students ICT Experiences in STEM Subjects*

According to initial results, elements of training programmes to increase the development of digital competences for STEM areas of teaching could be included in learning scenarios. The learning scenarios could be designed for basic, medium and advanced levels of teachers' digital competences. The complexity of each level has been designed according to the following elements of this DIGCOMP (Ferrari, 2015): information, communications, content creation, safety and problem solving. In order to estimate how students and teachers are satisfied with learning scenarios in STEM areas of teaching, parallel forms of self-measuring instruments have been designed. The research is part of follow up activities. The results show the initial motivation for researching and self-oriented learning approach. School infrastructure, Internet access and enough computer tablets in each classroom are also predictors of successfully ensuring the learning outcomes in STEM areas of teaching.

## 4. CONCLUSION AND FUTURE WORK

The levels of digital competences for secondary school students after finishing secondary school are at different levels. Most of students use E-learning materials presented on different E-learning platforms. The majority of students have access to the Internet and use computers or self-phones for communication, learning and networking in leisure time. After finishing secondary education, students have neutral or positive attitudes towards professional and social competences that they acquired during education.

The results could be explore and interpreted for the purposes of designing the training for the primary schools and secondary schools teachers for supporting their secondary school student's digital competences. The school infrastructure and Internet access and availability of ICT support staff could be implemented in order to achieve learning outcomes in the STEM (Science, Technology, Engineering and Mathematics) areas. According to DIGICOMP (Ferrari, 2013), teachers could develop the following digital competences: information, communications, content creation, safety and problem solving, divided at basic, medium and advanced levels. The different levels of digital competences enables creating the national training syllabus for individual needs of each group of teachers. Improvements will be focused to the teaching material, developing teachers' digital competences and ensuring information and communication equipment for schools. Digital resources can be used by teachers for training design (Ciolan *et al.,* 2014). The further motivation for learning, the competences and knowledge that pupils and students will gather through the subjects like Mathematics, Science and Technology, could be successfully implemented at the area of the future competitive tertiary education and labour market.

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