

# FUTURE TEACHERS' OPINIONS ON THE DIGITAL COMPETENCIES OBTAINED DURING THEIR STUDIES

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## Abstract

*Different information and communication technologies have become part of the necessary competencies, as teachers are educators of the web generation, which is characterised by its members using the computer in each aspect of their lives. The use of the computer is specific for each individual field of teaching and as such cannot be directly compared. This article presents the results of a survey into how the field of study influences the use of ICT and the computer in future teachers. The participants in this study were 252 forth-year students from three faculties from University of Maribor, which educate future teachers: Faculty of Natural Sciences and Mathematics, Faculty of Arts and Faculty of Education. Our research has shown that students of natural, technical and computer science provided the most positive feedback about the availability of computers at the faculty, their performance, software, internet access at the faculty and internet access in their town of study. Future teachers expressed a more positive opinion on statements relating to the necessity of using the computer in class than on statements relating to their competencies for using the computer in class.*

**Key words:** *future teachers, teacher competencies, use of ICT in the study process, different fields of study.*

## Introduction

The education and schooling of children require a whole person along with a lot of knowledge and skills. This raises the question about the qualities and knowledge that today's teachers should possess. Numerous authors have written about teacher competencies (Marentič Požarnik, 2006; Rychen & Salganik, 2003; Svetlik, 2006; Špernjak & Šorgo, 2009) and most of them have been united in the fact that the existing list is not static. It needs to be changed and adopted to the society development.

The Official Gazette of the European Union (URL EU, št. 394/10, 2006) defines competencies as a combination of knowledge, skills and attitudes appropriate to the context, which include the ability to interpret concepts, knowledge, skills, social relations, attitudes, code of conduct and the relation to oneself.

Slovenian education is predominantly facing the division of competencies into (Razdevšek Pučko & Rugelj, 2006):

1. generic skills;
2. key competencies;
3. special (specific) competencies and
4. subject-specific competencies.

Among the numerous studies, the most comprehensive overview of key competencies in education is provided by the Eurydice study (Eurydice, 2002). According to Eurydice, generic skills are the group of competencies that an individual develops with his way of work and not with subject-specific learning. Special (specific) competencies include the group of competencies which an individual develops in a broader yet specific field (e.g.: natural science, which includes biology, physics and chemistry). Subject-specific competencies are those, which are developed through the teaching of individual disciplines (biology: knowledge of biological principles and concepts, etc.). Slightly less clear is the definition of the concept of key competencies, which enable the fulfilment of determined goals. Primarily, these are competencies which are relevant to the whole of the population, irrespective of gender, class, race, culture, family background or mother tongue. They must comply with the ethical, economic and cultural values and conventions of the society concerned.

The competencies, which are needed for an individual to be a good teacher, develop and change in accordance with social changes. There are a growing number of endeavours for a higher quality of education, while the quantity of information is increasing, information technology is developing, internationalisation is growing together with the need for lifelong learning, etc. There has been a debate on how ICT skills should be acquired by children, and whether these skills should be itemised in a hierarchy in guidelines for teachers. Regarding the fast technology development in recent years, the definition of digital competencies and keep restoring them in education is necessary.

Koniček & Mechlova defined digital competencies that involve the confident and critical use of Information Society Technology for work, leisure and communication. The definition is underpinned by basic skills in ICT: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet (Šimonová, Poullová, Šabatová, Koniček, Mechlova, 2009).

To define the model of future teacher's development in using ICT, it is necessary to carefully examine the state of computer equipment in educational institutions, future teachers' expectations in terms of ICT and also about the competencies already gained in this field.

In the last years, the influence and efficiency of ICT in education have been researched by different authors. The researches have been conducted on all levels of education. Sime & Priestley researched future teachers' views of the use of ICT in schools (Sime & Priestley, 2005). They established that while they welcomed the introduction of ICT as a tool for modernising teaching, students identified a variety of factors that hinder this process. The paper identifies some of the implications for those working with future teachers in encouraging their development of reflective practice with ICT and enhancing their positive attitudes in relation to the use of ICT in schools. Drent & Meelissen discusses the factors which stimulate or limit the innovative use of ICT by teacher educators in the Netherlands (Drent & Meelissen, 2008). Results show that several factors on teacher level influence the implementation of innovative ICT use in education. Hermans, Tondeur, Vanbraak, & Valcke researched the influence of the use of the computer in teaching in primary schools (Hermans, Tondeur, Vanbraak & Valcke, 2008). They claimed that among the factors influencing the use of ICT in class, the most important is the impact of computer experience, general computer attitudes and gender and only second is a positive effect of constructivist beliefs. Their research has also shown that traditional beliefs have a negative impact on classroom use of computers.

### *Problem of Research*

A factor strongly related to the use of ICT in education is the field of teaching. Due to specific differences of individual subject areas, the use of ICT strongly differs among teachers of different subjects. Each field has its own specifics and requirements.

Teaching natural sciences include modern computer equipment in laboratories, where they provide excellent support for experiments. Yerrick & Johnson presented different methods of the use of the computer in teaching natural sciences (Yerrick & Johnson, 2009). In their articles, Šorgo et. al. presented a computer-supported laboratory in secondary school biology classes (Šorgo & Kocijancic, 2006; Šorgo, Hajdinjak & Briski, 2008). Araujo, Veit & Moreira presented a study which investigated undergraduate students' performance while exposed to complementary computational modelling activities to improve physics learning (Araujo, Veit & Moreira, 2008). Monahan, Mcardle & Bertolotto included a web-based system, which uses Virtual Reality (VR) and multimedia and provides communication tools to support collaboration among students, into the study of natural sciences (Monahan, Mcardle & Bertolotto, 2008).

Teaching social sciences and humanities on the other side include ICT in different translation tools and computer as a device for presentations in the class.

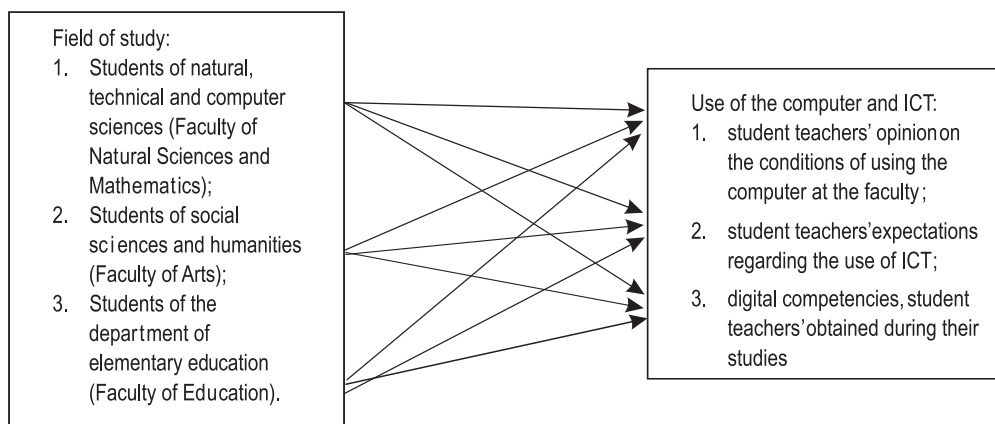
As today ICT undoubtedly represents an important aspect of teacher competencies, ICT and the use of computers among future teachers with respect to differences which can be found in relation to the field of study have been researched. On the basis of the provided theoretical starting points, it had been anticipated that future teachers of natural, technical and computer sciences would show substantially different patterns than future teachers of social sciences and humanities and future teachers of the department of elementary education.

### *Research Focus*

The research focused on certain questions relating to the frequency of using the computer and educational portals among future teachers and the students' opinions about the conditions of using computers at the faculty. Within this framework the following research questions were developed:

1. future teachers' opinion on the conditions of using the computer at the faculty;
2. future teachers' expectations regarding the use of ICT; and
3. digital competencies, future teachers' obtained during their studies.

These research questions were answered by future teachers of different fields of study: future teachers of natural, technical and computer sciences, future teachers of social sciences and humanities and future teachers of the department of elementary education, whereby the focus was on differences in their answers. Figure 1 shows the concrete relations addressed by our research.



**Figure 1. Correlation of the variables.**

The study reported in this article was conducted as a part of a post doctoral project “*Analysis of the Higher Education Technical Didactics and Creating the Application Framework for Transferring Technical Knowledge*“, which seeks to evaluate the ICT implementation in teacher education. The research was conducted among teachers in primary schools, future teachers of natural science, technical and computer science, future teachers of social studies and humanities; and future teachers of the department of elementary education. The article presents the future teacher part of the research, which explores the conditions of using the computer at the faculty, the future teachers’ opinion on the necessity of using the computer in class and the obtained digital competencies.

### **Methodology of Research**

The research was based upon descriptive and casual non-experimental methods of empirical pedagogical research (Sagadin, 1993).

#### *Participants and Sample Selection*

The participants in this study were 252 fourth-year students from three faculties from University of Maribor, which educate future teachers: Faculty of Natural Sciences and Mathematics, Faculty of Arts and Faculty of Education. At each faculty groups of students of different subjects of study were randomly selected. All volunteer future teachers in these groups were included in the survey.

The sample included:

- 87 (34.5%) future teachers of natural science, technical and computer science. This group included also 14 students with mixed subject connections; e.g. mathematics and English);
- 98 (38.9%) future teachers of social studies and humanities; and
- 67 (26.6%) future teachers of the department of elementary education.

### Measures

Data were gathered via an anonymous questionnaire. Research questions in the questionnaire were divided into three parts, with the focus being on the opinions of future teachers of science and technology:

- on the conditions of using the computer at the faculty;
- in their expectations regarding the use of ICT; and
- in the digital competencies obtained during their studies.

The scales of measurement was 5 and 6 point Likert-type response scales ranging from 1 (strongly disagree) to 5 (strongly disagree).

### Data Analysis

The data were first weighted: descriptively expressed Likert scales were weighted with the numeral values from 1 – “I completely disagree” to 5 – “I completely agree”. The data were processed with the statistical programme package SPSS. The Kruskal-Wallis test and Chi square test were used to verify whether there are any statistically significant differences among students of different fields of study.

## Results of Research

### Future Teachers' Opinions on the Conditions of Using the Computer at the Faculty

The first part of the research focused on how future teachers evaluate the conditions of using the computer at the faculty, i.e. if they see the conditions as supporting or hindering the use of the computer. The research was aimed at obtaining their opinion on the following conditions: availability of computers at the faculty, performance of computers at the faculty, software of computers at the faculty, internet access at the faculty and internet access in the town of study.

**Table 1. Mean of Rating Scores<sup>a</sup>, Standard Deviations and Rank Orders<sup>b</sup> of students reporting on the circumstances regarding the use of the computer for study purposes.**

Circumstances regarding the use of the computer for study purposes	Mean	SD	Rank order
Internet-access in the town of study is well arranged.	3.35	1.22	1
Internet-access at the faculty is well arranged.	1.99	1.08	2
Software of computers at the faculty meets the study requirements.	1.79	0.10	3
At the faculty, there are enough computers available for study purposes.	1.58	0.86	4
At the faculty, the performance of computers is sufficient for study purposes.	1.45	0.74	5

<sup>a</sup>A higher score indicates that students see an individual circumstance as more favourable for the use of the computer (1 = is not favourable for the use, 5 = is very favourable for the use)

<sup>b</sup>A lower rank indicates that students see an individual circumstance as more favourable for the use of the computer (1 = most favourable, 5 = least favourable).

These conditions are probably the important factors influencing the use of the computer among students. The students used a five-stage scale to express their opinion on whether the

conditions for the use of the computer are favourable or not. Statements relating to individual conditions were appointed numeric values from 1 – “I completely disagree” to 5 – “I completely agree”. The more the students agreed with individual statements, the more they believe the conditions to be favourable for the use of the computer. The results are presented in Table 1.

Regardless of their field of study, the students on average expressed a negative attitude to four (or the majority) of the statements, indicating their conviction that the circumstances of using the computer for study purposes at the faculty are unfavourable. The table 1 shows that students were least inclined to statements that the performance of the computers at the faculty is sufficient for use for study purposes and that there are enough computers at the faculty, which can be used for study purposes. The students expressed a positive attitude only to one of the statements – that Internet-access in their town of study is well arranged. It has become evident that it would be sensible to expand this question to research where the students access the internet in their town of study in addition to the faculty, which might be the subject of a later research.

The research further investigated whether the opinions regarding the conditions of using the computer at the faculty are the same among students of all three fields of study or if their opinions differ. Their answers are presented in Table 2.

Table 2 shows that statistically significant differences among future teachers of different fields of study are evident by all statements. Future teachers of natural, technical and computer science provided the most positive feedback for all statements, which means that among all students they provided the most positive answers about the availability of computers at the faculty, their performance, software, internet access at the faculty and internet access in the town of study. The availability of computers for study purposes and their performance was more positively evaluated by future teachers of the department of elementary education than by future teachers of social studies and humanities, while future teachers of social studies and humanities were more positive towards the statements regarding software, Internet access at the faculty and internet access in the town of study than future teachers of the department of elementary education.

**Table 2. Results of the Kruskal-Wallis test of differences in individual statements with regard to the field of study.**

	Field of study	$\bar{R}$	$\chi^2$	p
At the faculty, there are enough computers available for study purposes.	Natural <sup>a</sup>	144.98	11.225	0.004
	Social	115.65		
	Elementary	118.37		
At the faculty, the performance of computers is sufficient for study purposes.	Natural	142.81	9.563	0.008
	Social	117.23		
	Elementary	118.87		
Software of computers at the faculty meets the study requirements.	Natural	148.98	17.393	0.000
	Social	121.18		
	Elementary	105.09		
Internet-access at the faculty is well arranged.	Natural	152.86	22.669	0.000
	Social	117.94		
	Elementary	102.55		
Internet-access in the town of study is well arranged.	Natural	145.23	16.204	0.000
	Social	128.16		
	Elementary	99.75		

<sup>a</sup>Key:

- Natural – future teachers of natural science, technical and computer science;
- Social – future teachers of social studies and humanities;
- Elementary – future teachers of the department of elementary education.

*Future Teachers' Opinions on the Necessity of Using the Computer in Class and on the Digital Competencies Obtained During their Studies*

**Table 3. Mean of Rating Scores<sup>a</sup>, Standard Deviations and Rank Orders<sup>b</sup> of students reporting on the necessity of using the computer and competencies.**

Competencies	Mean	SD	Rank order
As a future teacher, it is essential that I am qualified to use the computer in class.	4.5714	0.71332	1
Today, use of the computer in class is necessary.	3.9841	1.06359	2
As a future teacher, I have sufficient knowledge to use the computer in class.	3.7738	0.96576	3
I have clear ideas on how to include the computer in class.	3.7341	0.81614	4
Use of the computer is essential in subject(s) that I will be teaching.	3.3016	1.21262	5
As a future teacher, I have sufficient knowledge to use educational portals in class.	3.1468	1.01692	6

<sup>a</sup>A higher score indicates that students expressed a higher level of agreement with an individual statement (1 = I completely disagree, 5 = I completely agree)

<sup>b</sup>A lower rank indicates that students expressed a higher level of agreement with an individual statement (1 = I completely disagree, 5 = I completely agree)

Six statements were provided and future teachers were asked to mark their agreement with each statement using a five-stage scale. Their answers are presented in Table 3.

It is evident from the table 3 that future teachers expressed a more positive opinion on statements relating to the necessity of using the computer in class than on statements relating to their competencies for using the computer in class. They expressed the highest level of agreement with the statement that as future teachers it was essential that they were qualified to use the computer in class and that today, the use of the computer in class was necessary. They agreed less with the statement that use of the computer was essential in subject(s) that they would be teaching. This statement was ranked only fifth. Even though the future teachers expressed a lower level of agreement with statements relating to their competencies for using the computer in class than with statement relating to the necessity of using the computer in class, their answers are still encouraging.

The research further focused on whether the opinions regarding the necessity of using the computer in class and on the digital competencies obtained during their studies are the same among students of all three fields of study or if their opinions differ. Their answers are presented in Table 4.



**Table 4. Results of the Kruskal-Wallis test of differences in individual statements with regard to the field of study.**

	Field of study	$\bar{R}$	$\chi^2$	p
As a future teacher, it is essential that I am qualified to use the computer in class.	Natural <sup>a</sup>	126.18	4.463	0.107
	Social	118.39		
	Elementary	138.77		
Today, use of the computer in class is necessary.	Natural	127.91	0.181	0.914
	Social	124.20		
	Elementary	128.04		
As a future teacher, I have sufficient knowledge to use the computer in class.	Natural	131.26	1.168	0.558
	Social	127.23		
	Elementary	119.25		
I have clear ideas on how to include the computer in class.	Natural	129.22	1.848	0.397
	Social	130.59		
	Elementary	116.99		
Use of the computer is essential in subject(s) that I will be teaching.	Natural	143.29	13.479	0.001
	Social	106.55		
	Elementary	133.88		
As a future teacher, I have sufficient knowledge to use educational portals in class.	Natural	130.25	0.951	0.622
	Social	121.13		
	Elementary	129.49		

<sup>a</sup>Key:

- Natural - students of natural science, technical and computer science;
- Social - students of social studies and humanities;
- Elementary - students of the department of elementary education.

The Kruskal-Wallis test was used to verify whether there are any statistically significant differences among students of different fields of study. Table 4 shows that such difference is evident only in one case: “Use of the computer is essential in subject(s) that I will be teaching.” Table 4 clearly shows that future teachers of natural, technical and computer science are more aware that use of the computer is essential in subject(s) that they will be teaching as future teachers of the department of elementary education and future teachers of social studies and humanities. In all other cases future teachers of different fields of study gave similar answers. That means that they have similar opinion about the necessity of using the computer in class and on the digital competencies obtained during their studies.

## Discussion

Regardless of their field of study, the students do not agree that: internet-access at the faculty is well arranged, software of computers at the faculty meets the study requirements, there are enough computers available for study purposes at the faculty and the performance of computers is sufficient for study purposes at the faculty. The students expressed a positive attitude only to one of the statements – that Internet-access in their town of study is well arranged. These results indicate a pessimistic image of future teachers’ beliefs, regarding the conditions for the use of the computer.



Future teachers of natural, technical and computer science provided the most positive feedback for all statements with regard to the conditions of use of computers at the faculty, which means that among all students they provided the most positive answers about the availability of computers at the faculty, their performance, software, internet access at the faculty and internet access in the town of study. This result is explained by the fact that natural, technical and computer science students are more prone to using a computer, as expected.

Even though there is an approximately same number of computers available in all three faculties (Faculty of Natural Sciences and Mathematics, Faculty of Arts and Faculty of Education), as these three faculties are located in the same facility, students of the Faculty of Education and the Faculty of Arts most commonly stated that there are not enough computers and that the equipment is unsuitable. This might show that they are not interested or even educated enough for their use. A suitable solution to this question would be a more frequent and more prudent use of ICT among teacher educators, which would motivate the students and encourage them to use the available modern technologies more efficiently.

The research has shown that future teachers of all three faculties are optimistic about the knowledge to use the computer in class while at the same time have clear ideas how to include computers in class. They are however less optimistic about the knowledge to use educational portals.

The proposals for practical use of the knowledge obtained as presented in this article are as follows: it would be good if the state would help obtain sufficient and appropriate computer software for faculties. Students can be enthusiastic about using the computer but if the appropriate equipment is not available, they cannot fulfil their expectations and ideas.

## Conclusions

The education and schooling of children require a whole person along with a lot of knowledge and skills. The net-generation of pupils is calling the net-generation of teachers. And teacher educators are those, who need to prepare the list of competencies that future teachers need. As today ICT undoubtedly represents an important aspect of teacher competencies, ICT and the use of computers among future teachers with respect to differences which can be found in relation to the field of study have been researched.

The paper presents the results of a survey into how the field of study influences the evaluation of the conditions of using the computer at the faculty, on the opinions on the necessity of using the computer in class and on the digital competencies obtained during their studies. The results of the research show that future teachers are pessimistic about the availability of computers at the faculty, their performance, software and internet access at the faculty and that they are a little bit more optimistic about internet access in the town of study. Future teachers of natural, technical and computer science provided the most positive answers about the conditions of using the computer at the faculty. The research established that students are optimistic about the knowledge to use the computer in class while at the same time have clear ideas how to include computers in class. Research results confirmed that expectations of future teachers of natural, technical and computer sciences show substantially different patterns than those of future teachers of social sciences and humanities and future teachers of the department of elementary education. They are more interested in modern technologies for private purposes as well as for study purposes.

Furthermore, an extensive research (this article presents only a fraction of the obtained knowledge regarding the use of the computer among students of different fields of study) into the opinions of students about the efficient use of ICT among teacher educators has been conducted. These results will be covered by future articles.

Research needs to be conducted also among teacher educators so that they use the computer in the study process prudently and give a good example stimulating the use of the computer among students. It would also be sensible to consider giving students tasks, where the computer would provide substantial support or where the use of the computer for the fulfilment of such a task would even be mandatory.

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