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# THE INFLUENCE OF THE FIELD OF STUDY ON THE USE OF MODERN INFORMATION AND COMMUNICATION TECHNOLOGIES AMONG STUDENT AND TEACHERS

# UTJECAJ STUDIJSKOG USMJERENJA NA UPOTREBU MODERNIH INFORMACIJSKIH I KOMUNIKACIJSKIH TEHNOLOGIJA IZMEĐU STUDENATA I UČITELJA

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*Abstract*

Being a teacher is becoming a growingly demanding job, as the swift development of modern technologies is undoubtedly expanding the required competence framework. Different information and communication technologies have become part of the necessary competencies, as teachers are educators of the Y 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 instruction 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 student teachers. The sample covered fourth grade students of different fields of study (teacher training programmes): students of natural, technical and computer sciences, students of social sciences and humanities and students of the department of elementary education. Our research has shown that students of all three training programmes often use the computer in their everyday life but slightly less often for study purposes. Students of natural, technical and computer science reported about the use of educational portals more often than students of the other two fields of study did, while there were also differences in the use of individual portals among students of individual fields of study. Our research has further 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.

*Sažetak*

Kako se sa brzim razvojem modernih tehnologija širi okvir kompetencija koje su neophodno potrebne za rad učitelja, to zanimanje iz godine u godine postaje sve zahtjevnije. IKT su zauzele svoje mjesto među potrebnim kompetencijama pogotovo zato jer učitelji obrazuju generaciju Y, koja računalo koristi na svim životnim razinama. Upotreba računala je specifična za svako područje obrazovanja i kao takva nije direktno usporediva. Naš članak predstavlja rezultate istrage u kojoj nas je zanimalo u kolikoj mjeri smjer studija utječe na upotrebu IKT i kompjutora kod studenata - budućih učitelja. Uzorak je obuhvatio studente četvrte godine različitih pedagoških smjerova: prirodoslovno-matematičkih i tehničkih znanosti, sociooloških znanosti i studij razredne nastave. Naša istraga je pokazala, da studenti svih triju smjerova često koriste računalo u svakodnevnom životu, a manje često za potrebe studija. Studenti prirodoslovno-matematičkih i tehničkih znanosti su češće odgovorili da koriste obrazovne portale nego studenti drugih dviju smjerova. Isto tako su se među studentima različitih smjerova pokazale razlike u upotrebi vrste tih portala. Naše istraživanje također je pokazalo, da su studenti prirodoslovno-matematičkih i tehničkih znanosti ti koji su izrazili najviše pozitivno mišljenje o raspoloživosti računala na fakultetu, njihovom kapacitetu, programskoj opremi, pristupu internetu na fakultetu i pristupu internetu u gradu studija.

## Introduction

Being a teacher appears a very simple job and with regard to working hours also very appealing. The work of teachers is often unappreciated, as teachers "work only a couple of hours a day and even that only with children". The same people, who underestimate the work of teachers, on the other hand themselves complain how much time and energy their own children require. And this is exactly it: 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 posses. Razdevšek Pučko /**1**/ provides an extensive list of starting points and paths to draw up a list of qualities and requirements (competencies) that our teachers should meet. Numerous authors have written about teacher competencies (see Marentič Požarnik, 2006; Rychen & Salganik, 2003; Svetlik, 2006; Špernjak & Šorgo, 2009). The Official Gazette of the European Union /**2**/ 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. In Slovenian education, we are predominantly faced with the division of competencies into:

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

Among the numerous studies, the most comprehensive overview of competencies is provided by the Eurydice study /**4**/. 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. Svetlik /**5**/ prepared a synthesis of nine series of key competencies and joined them in the following sets:

1. social competencies within the meaning of establishing good interpersonal relations, cooperation or teamwork, cooperation in the community and similar;
2. mastery of the mother tongue, reading within the meaning of acquiring written information fast, writing and speaking, communicating ideas and information;
3. the ability of divergent thinking, critical judgement, creativity and problem solving;
4. mastery of new technologies, especially information and communication technologies;
5. intercultural competence within the meaning of knowing general and different cultures and mastery of at least one foreign language;
6. mastery of independent learning strategies and planning of their life or personal development;
7. mastery of numbers, mathematics, analytical thinking;
8. entrepreneurship within the meaning of the ability to organise, plan, manage, make decisions, etc.

The competencies, which are needed for an individual to be a good teacher, develop and change in accordance with social changes. There is 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.

## PCK and TPACK

When first computers appeared more than twenty years ago, these were not extensively used in education, so the definition of teacher competencies at the time was substantially different. In 1987, Lee Shulman /**6**/ defined teacher knowledge by introducing the idea of pedagogical content knowledge. He claimed that the emphases on teachers' subject knowledge and pedagogy were being treated as mutually exclusive domains in research concerned with these domains. He developed the construct of "pedagogical content knowledge" (PCK) in response to some of the problems of teaching and teacher education. There is a connection between content knowledge and pedagogical knowledge in science teaching, which is implicit in many of the statements of the NSTA Standards.

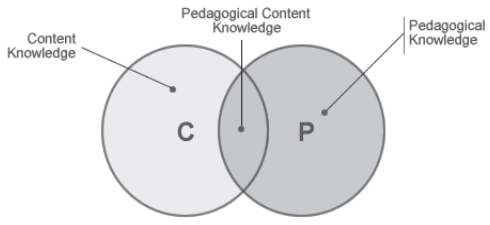


Figure 1: Shulman´s PCK model

Science teachers must have content preparation, which usually takes place outside of colleges of education. Enfield /**7**/ wrote that such learning of content presents problems for pre-service teachers and science teacher educators, which are:

- a poor match between learner needs and teaching methodology;
- in many traditionally taught courses the emphasis is on learning large amounts of information at a rapid pace;
- division of knowledge, for convenience into disciplines, fields and subfields that may contain the development of linkages among concepts across fields.

Most science teacher content knowledge comes from disciplinary fields, while understanding of teaching comes from the field of education. This separation, revealed in the problems outlined above, reinforces a model of scientific disciplines that is dissimilar from models of teaching and learning science. Research /**8**/ has shown science teachers approach scientific problems differently than scientists due to their understanding of the pedagogical implications of learning science. Such separation leads students of teaching to have bifurcated understandings of science education. The mentioned research examined the practical connections of PCK to science teaching and found, through empirical study, that there might be value to having prospective teachers study subject matter from a teaching perspective. This study has shown the importance of PCK in teaching, especially science teaching.

Enfield /**9**/ pointed out that educators must think carefully about the scientific ideas and concepts that they would like students to learn. Educators must begin to look for ways to reveal the assumptions and beliefs shared by the scientific community. For example much scientific knowledge is built on evidence. Students of science need to understand the implicit value scientists place on this kind of knowledge. Further, these students need to be able to understand the consequences of these ideas and beliefs. Teachers of science need to be prepared to help students uncover the embedded texts of scientific ideas. PCK provides a useful lens for teachers to begin to help students see the assumptions of science. However, this requires more than knowing content and how to teach. It requires an understanding of how to teach the content, namely PCK. On the basis of the PCK model, Enfield /**10**/ proposed a model, in which content and pedagogy are joined, forming a leading edge in a less linear model of standards and which represents the complexity and challenges of science teaching.

Shulman's PCK model was constructed at a time when information technologies had not yet been present, at least not in today's form, so he did not discuss technology and its relationship to pedagogy and content. Shulman's model can be interpreted as an overlap of two fields of competencies. With the major changes in the fields of global economy, information science, new production and management models, development of technologies and the hyperproduction of information, it became evident that teachers were not appropriately prepared or not competent enough for these new fields. One of such fields are information and communication technologies. Teachers, who are today educating the Y generation, have a very difficult task with respect to mastery of information technologies, as they did not obtain the necessary competencies during their education. This is why teacher educators gradually began including new knowledge in the educational process, thus enabling future teachers to obtain the required competencies. Technology knowledge (TK) is knowledge about standard technologies, such as books, chalk and blackboard, and more advanced technologies, such as the Internet, digital video, and virtual laboratories. This involves the skills required to operate particular technologies. In the case of digital technologies, this includes knowledge of operating systems and computer hardware, and the ability to use standard sets of software tools such as text editors, spreadsheets, browsers, e-mail and different online tools.

Numerous researchers have conducted extensive studies into the importance and influence of ICT on the quality of education and they developed new teaching models. In 2006, Mishra /**11**/ completed Schulman's PCK model upgrading it into Technological Pedagogical Content Knowledge (TPACK). He attempts to capture some of the essential qualities of knowledge required by teachers for technology integration in their teaching, while addressing the complex, multifaceted and situated nature of teacher knowledge. At the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge: Content (CK), Pedagogy (PK), and Technology (TK). See Figure 2.

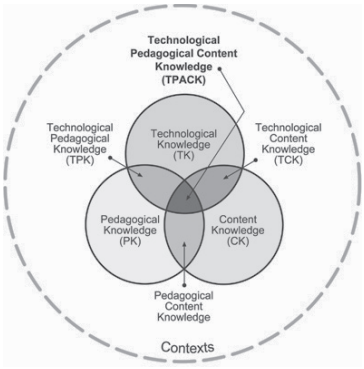


Figure 2: TPACK model - The Three Circles: Content knowledge (CK), Pedagogical knowledge (PK), and Technological knowledge (TK), overlap to lead to four more kinds of interrelated knowledge (TPK, TCK, PCK and TPACK).

TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones.

Effective technology integration for pedagogy around specific subject matter requires developing sensitivity to the dynamic, transactional relationship between all three components. A teacher capable of negotiating these relationships represents a form of expertise different from, and greater than, the knowledge of a disciplinary expert (say a mathematician or a historian), a technology expert (a computer scientist) and a pedagogical expert (an experienced educator).

In the last years, the influence and efficiency of ICT in education have been researched by different authors. This research has been conducted on all levels of education. Sime & Priestley /**12**/ researched student teachers´ views of the use of ICT in schools. 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 student 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 /**13**/ discusses the factors which stimulate or limit the innovative use of ICT by teacher educators in the Netherlands. Results show that several factors on teacher level influence the implementation of innovative ICT use in education. Hermans et. al. /**14**/ researched the influence of the use of the computer in teaching in primary schools. 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. The factor that we see as 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. We are not trying to say that the use of computers in social sciences is less appropriate than in natural sciences but merely wish to point out the obvious difference. Natural sciences include modern technologies in laboratories, where they provide excellent support for experiments. Yerrick and Johnson /13/ presented different methods of the use of the computer in teaching natural sciences. In their articles, Šorgo et. al. /15/, /16/ presented a computer-supported laboratory in secondary school biology classes. Araujo et. al. /17/ presented a study which investigated undergraduate students' performance while exposed to complementary computational modelling activities to improve physics learning. Monahan et.al. /18/ 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. As today ICT undoubtedly represents an important aspect of teacher competencies, we have decided to research how ICT and the computer are used among student teachers with respect to differences which can be found in relation to the field of study. On the basis of the provided theoretical starting points, we anticipate that students of natural, technical and computer sciences show substantially different patters than students of social sciences and humanities and students of the department of elementary education.

**Research**

In our research, we are interested in certain questions relating to the frequency of using the computer and educational portals among student teachers and the students' opinions about the conditions of using computers at the faculty. Within this framework, we developed the following research questions:

1. How often do students use the computer in their everyday life and how often do they use it for study purposes?
2. How often do the students use educational portals and which educational portals do they use?
3. How do the students evaluate the conditions of using the computer at the faculty?

We addressed these research questions to student teachers of different fields of study: students of natural, technical and computer sciences, students of social sciences and humanities and students of the department of elementary education, whereby we were interested in the differences in their answers. Diagram 1 shows the concrete relations addressed by our research.

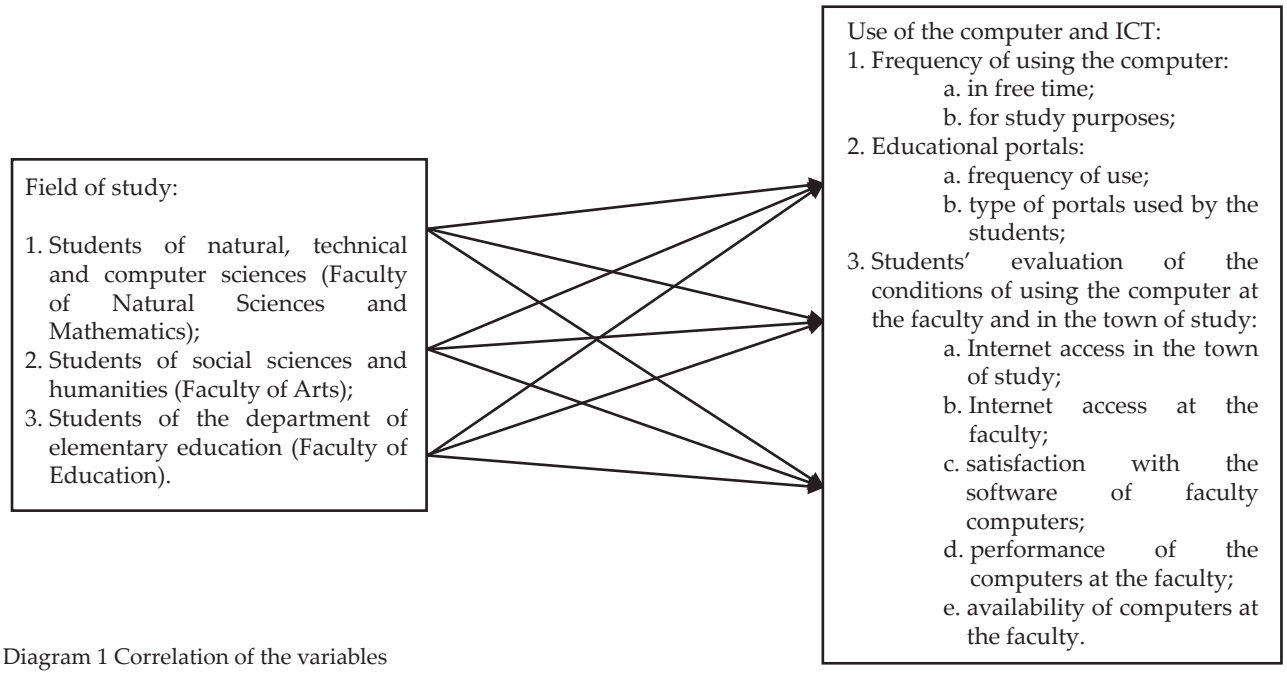


Diagram 1 Correlation of the variables

The research was based upon descriptive and casual methods, rather than an experimental method of empirical pedagogical research (Sagadin).

**Methodology**

***Participants***

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. The sample included:

- 87 (34.5%) students 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%) students of social studies and humanities; and
- 67 (26.6%) students of the department of elementary education.

The sample included 213 (85.3%) female students and 37 (14.7%) male students, according to the proportion of female and male students attending faculties which educated for future teachers.

***Data collection and processing***

Data were gathered via an anonymous questionnaire, which was developed specifically for this study by author and co-author. The questionnaire was piloted on a small group of students. The first part of the questionnaire asked students to provide general information (study program and sex). In the second part of the questionnaire, a number of questions about the use, expectations and competencies regarding the use of the computer among student teachers were posed. This article focuses on the use of the computer among student teachers and the conditions of using the computer among these students. We used the chi-square to examine the frequency of using the computer and educational portals as well as the type of educational portals among students of different fields of study. In the case of a theoretical frequency that was too low, we took into account the corrected chi-square values (Kullback test). We also used the Kruskal-Wallis test to examine the students' opinion about the conditions of the use of the computers among students of different fields of study.

**Results**

***How often do students use the computer in their everyday life and how often do they use it for study purposes?***

We were first interested whether student teachers use the computer in everyday life. On the basis of the previously stated theoretical starting points that one of the characteristics of generation Y is the frequent use of the computer, we assumed that the young generation often uses the computer in its everyday life. The answers as provided by the students are presented in Table 1. They have confirmed our expectations. Due to the low frequency, we joined the answers once a week and several times a week into the answer "once to several times a week".

Table 1: Frequency of using the computer with regard to the field of study

| | Students of natural, technical and computer sciences | Students of social studies and humanities | Students of the department of elementary education | Total |
|---|---|---|---|---|
| **Once to several times a week** | 2<br>2.3% | 7<br>7.1% | 4<br>6.0% | 13<br>5.2% |
| **Every day** | 24<br>27.6% | 23<br>23.5% | 17<br>25.4% | 64<br>25.4% |
| **Several times a day** | 61<br>70.1% | 68<br>69.4% | 46<br>68.7% | 175<br>69.4% |
| **Total** | 87<br>100% | 98<br>100% | 67<br>100% | 252<br>100% |

**$\chi^2$ = 2.810, df = 4, $p$ = 0.590**

The table shows that the majority of students use the computer several times a day (69.4%) regardless of their field of study. This group is followed by students, who use the computer every day (25.4%) while the answer of using the computer once to several times a week was provided by the smallest number of students (5.2%). There were also other available answers for the students to choose: never, once a month and up to three times a month but these answers were not chosen by any of the interviewed students.

If we evaluate the answers with regard to the field of study, it is evident that the provided answers about the frequency of using the computer do not differ substantially with regard to the field of study. There were also no statistically significant differences in calculating the frequency of using the computer among students of different fields of study ( = 2.810, df = 4, p = 0.590). Students of natural, technical and computer sciences (70.1%) as well as students of social studies and humanities (69.4%) and students of the department of elementary education (68.7%) most often stated that they use the computer several times a day.

The possibilities of using the computer are relatively diverse, while we were next interested in how often student teachers use the computer for study purposes. With regard to these questions, students again had similar answers to choose from. The results are presented in Table 2.

Table 2: The frequency of using the computer for study purposes with regard to the field of study

| | Students of natural, technical and computer sciences | Students of social studies and humanities | Students of the department of elementary education | Total |
|---|---|---|---|---|
| **Up to once a week** | 3<br>3.4% | 12<br>12.2% | 8<br>11.9% | 23<br>9.1% |
| **Several times a week** | 34<br>39.1% | 47<br>48.0% | 33<br>49.3% | 114<br>45.2% |
| **Every day** | 39<br>44.8% | 33<br>33.7% | 21<br>31.3% | 93<br>36.9% |
| **Several times a day** | 11<br>12.6% | 6<br>6.1% | 5<br>7.5% | 22<br>8.7% |
| **Total** | 87<br>100% | 98<br>100% | 67<br>100% | 252<br>100% |

**($\chi^2$ = 10.559, df = 6, $p$ = 0.103)**

In the theoretical part, we stressed that today's teachers must use ICT in the classroom. Several factors influence the use of ICT in the classroom, while we cannot neglect the frequency of using the computer already during the teacher training programme, as this provides the students with the experience and knowledge which they later need in their job. The obtained results are positive in this respect, as they show that students often use the computer for study purposes. The above table shows that the majority of students use the computer for study purposes several times a week

(45.2%), while more than one third of students (36.9%) use the computer for study purposes every day. An approximately same percentage of students use the computer for study purposes up to once a week (9.1%) and several times a day (8.7%).

We were interested if there are any differences in the frequency of using the computer for study purposes among students of different fields of study. The calculation of students of different fields of study did not show any statistically significant difference in the frequency of using the computer for study purposes ( = 10.559, df = 6, p = 0.103), while there is nevertheless a tendency of the computer being used for study purposes more often by students of natural, technical and computer sciences than by students of the other two fields of study. A more detailed look of the students' answers in Table 2 shows that the biggest number of students of natural, technical and computer sciences (44.8%) stated that they use the computer for study purposes every day. Students of social studies and humanities and students of the department of elementary education most often stated that they use the computer for study purposes several times a week (48% and 49.3% respectively). We believe that such answers can be related to the nature of the field of study, as the study of natural sciences requires a more frequent use of the computer and can make the student's work much easier or make it even possible at all. With regard to the nature of their study, students of social studies and humanities and students of the department of elementary education are not that bound to using the computer for study purposes.

***How often do the students use educational portals and which educational portals do they use?***

We were further interested how often student teachers use educational portals. We were again interested in the frequency of use in relation to the field of study. Due to the low frequency, we joined the answers several times a week and every day into the answer as evident from the table. The answers are presented in Table 3.

Table 3: Frequency of using educational portals with regard to the field of study

| | **Students of natural, technical and computer sciences** | **Students of social studies and humanities** | **Students of the department of elementary education** | **Total** |
|---|---|---|---|---|
| **I do not use educational portals** | 12<br>13.8% | 22<br>22.4% | 16<br>23.9% | 50<br>19.8% |
| **I use them less than once a month** | 21<br>24.1% | 43<br>43.9% | 18<br>26.9% | 82<br>32.5% |
| **I use them a few times a month** | 29<br>33.3% | 24<br>24.5% | 22<br>32.8% | 75<br>29.8% |
| **I use them several times a week to every day** | 25<br>28.7% | 9<br>9.2% | 11<br>16.4% | 45<br>17.9% |
| **Total** | 87<br>100% | 98<br>100% | 67<br>100% | 252<br>100% |

**($\chi^2$ = 20.385, df = 6, $p$ = 0.002)**

There were statistically significant differences in calculating the frequency of using educational portals among students of different fields of study ( = 20.385, df = 6, p = 0.002). Table 3 shows that students of natural, technical and computer sciences most often reported that they use educational portals a few times a month (33.3%) and they are followed by students, who said that they use educational portals several times a week or even every day (28.7%). Students of social studies and humanities most often stated that they use educational portals less than once a month (43.9%) and they are followed by students who said that they use educational portals a few times a month (24.5%). Students of the department of elementary education provided the following answers: the majority (32.8%) stated that they use educational portals a few times a month (32.8%) and these are followed by students who use these portals less than once a month (26.9%). Among students of natural, technical and computer sciences, the number of students, who reported that they do not use educational portals (13.8%), was the smallest, while among students of social studies and humanities and students of the department of elementary education, the smallest number reported that they use educational portals several times a week or even every day (9.2% and 16.4% respectively). On the basis of such answers, it can be said that students of natural, technical and computer sciences use educational portals more

often than students of social studies and humanities and students of the department of elementary education. Such answers were expected and are in line with the answers obtained from the previous question, where the tendency of a more frequent use of the computer for study purposes was evident with students of natural, technical and computer sciences. A more frequent use of the computer for study purposes probably influences also a more frequent possibility of using educational portals.
It might be somewhat surprising that there is still a relatively high percentage of student teachers (19.8%), who have almost concluded their studies and who (still) do not use educational portals. We can only hope that this does not mean that they will also not use educational portals as future teachers. Educational portals are an excellent source of new information and also enable the communication between teachers of related fields, which is very useful for new teachers.

Within the framework of the last research question, we were interested which educational portals students of different fields of study used. Students could chose among five known educational portals. They could choose several portals and also add other educational portals. Their answers are presented in Table 4.

Table 4: Frequency of using individual educational portals with regard to the field of study[a]

| | Students of natural, technical and computer sciences | Students of social studies and humanities | Students of the department of elementary education | Total | $\chi^2$, df, $p$ |
|---|---|---|---|---|---|
| **Distance learning (Moodle portal Faculty of Education, Faculty of Arts and Faculty of Natural Sciences and Mathematics)** | 58<br>66.7% | 56<br>57.1% | 18<br>26.9% | 132<br>52.4% | $\chi^2 = 25.496$ df = 2<br>$p = 0.000$ |
| **Uciteljska.net** | 28<br>32.2% | 23<br>23.5% | 49<br>73.1% | 100<br>39.7% | $\chi^2 = 44.130$ df = 2<br>$p = 0.000$ |
| **Svarog.org[d]** | 16<br>18.4% | 18<br>18.4% | 13<br>19.4% | 47<br>18.7% | $\chi^2 = 0.034$<br>df = 2<br>$p = 0.983$ |
| **Naravoslovna.net** | 27<br>31.0% | 2<br>2.0% | 2<br>3.0% | 31<br>12.3% | $\chi^2 = 43.254$ df = 2<br>$p = 0.000$ |
| **Other** | 5<br>5.7% | 4<br>4.1% | 4<br>6.0% | 13<br>5.2% | |

[a]The table includes answers provided by students, who stated that they use educational portals (202 or 80.2%).

It is evident from the table that the majority of students, more than one half (52.4%), use the Distance learning portal. The second and also quite frequently used is the učiteljska.net educational portal (39.7%). The third most commonly used educational portal is Svarog.org (18.7%) and the fourth naravoslovna.net (12.3%). In addition to the already listed portals, the students also listed other portals, which they use (5.2%):

- students of natural, technical and computer sciences: Sparknotes.com, Wikipedia.org, E-um.si, Sbaza.net, Dijaski.net, Nil.si, Kemija.org;
- students of social studies and humanities: Sparknotes.com, and
- students of the department of elementary education: Otroci.org, Pedagoska.net, Zupca.net, Izum.si.

We were again interested in the differences among individual fields of study. There was a statistically significant difference among students of different fields of study with regard to the use of three out of four educational portals: Distance learning (Moodle portal Faculty of Education, Faculty of Arts and Faculty of Natural Sciences and Mathematics) ( = 25.496, df = 2, p = 0.000), Učiteljska.net ( = 44.130, df = 2, p = 0.000) and Naravoslovna.net ( = 43.254, df = 2, p = 0.000). It is evident from the table that the Distance learning (Moodle portal Faculty of Education, Faculty of Arts and Faculty of Natural Sciences and Mathematics) portal is more often used by students of natural, technical and computer sciences (66.7%) and students of social studies and humanities (57.1%) than students of the department of elementary education (26.9%). The situation is reversed with the Učiteljska.net portal, as this portal is more often used by students of the

department of elementary education (73.1%) than by students of natural, technical and computer sciences (32.2%) and students of social studies and humanities (23.5%). As expected, students of natural, technical and computer sciences more often (31.0%) use the Naravoslovna.net portal than students of social studies and humanities (2.0%) and students of the department of elementary education (3.0%). With regard to the use of the Svarog.org portal, there were no statistically significant differences among students of different fields of study ( = 0.034, df = 2, p = 0.983).

***How do the students evaluate the conditions of using the computer at the faculty?***

With relation to the stated facts, we were interested how student teachers evaluate the conditions of using the computer at the faculty. We were interested if they see the conditions as supporting or hindering the use of the computer. It was for this purpose that we prepared a list with 5 statements which related to individual conditions of using the computer for study purposes. Specifically, we were interested in what the students – future teachers think about the following conditions that might be more or less favourable for the use of the computer:

- 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.

These conditions are probably the important factors influencing the use of the computer among students not only for their everyday use but also for study purposes. 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.

Table 5: Mean of Rating Scores[a], Standard Deviations and Rank Orders[b] 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 | Rang 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 |

[a]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)

[b]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).

As evident from Table 5, 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 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.

Such a low opinion of student teachers regarding the use of the computer at the faculty for study purposes is alarming. The main reason is that these faculties educate future teachers. We already said in the introduction /19/ that teachers today no longer need only conventional competencies but also other competencies, among them also the use of ICT. This undoubtedly raises the question how student teachers can be educated

to use ICT in their job if (according to them) the faculties do not provide sufficient available computers and the same computers also lack in performance.
We were further interested if 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 6.

Table 6: Results of the Kruskal-Wallis test of differences in individual statements with regard to the field of study

| | **Field of study** | $\overline{R}$ | $\chi^2$ | $p$ |
|---|---|---|---|---|
| At the faculty, there are enough computers available for study purposes. | Natural[a] | 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 | | |

[a]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.

We used the Kruskal-Wallis test to verify whether there are any statistically significant differences among students of different fields of study. Table 6 shows that such differences are evident among all statements and among all students of different fields of study. If we evaluate the answers with regard to the field of study, Table 6 clearly shows that students of natural, technical and computer science provided the most positive feedback for all statements, which means than 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 students of the department of elementary education than by students of social studies and humanities, while students 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 students of the department of elementary education. The reasons why students of natural science, technical and computer science were more positive towards the conditions of using the computer for study purposes than were students of social studies and humanities and students of the department of elementary education are probably different and we will try to explain them in more detail. The three faculties, which were included in the research, are located in the same facility, which also means that part of the computers within the facility is available to students of all three faculties or fields of study. There are also several wireless access points in the building, which enable students of all three faculties unhindered Internet access. However, we cannot neglect the fact that due to the nature of their study field, students of natural, technical and computer science also have additional and well equipped computer classrooms at their disposal, which they can per agreement use also outside the time of the actual study process. Furthermore, the nature of the study at the majority of study programmes at the Faculty of Natural Sciences and Mathematics also means that a study without the use of the computer is virtually impossible. If we consider the two-discipline teacher training programme of "Computer Science and…" (in combination with other disciplines), even a brief look at the subjects covered in this field shows that the majority or many of the professional subjects

include computer-related content. This means that already due to the nature of their study, students of natural, technical and computer science are more proficient in their computer knowledge and use of computers than students of the other two faculties. This might help them to be more inventive in the use of computers and computer equipment and it is therefore possible that they would evaluate the given conditions more positively.

## Discussion

Our research has confirmed that student teachers often use the computer for private purposes, while use of the computer for study purposes is less frequent but still surprisingly high. There is a correlation indicating that students, who use the computer for private purposes more often, use it also more often for study purposes. Such results are in line with the results of individual other studies /12/. Students of elementary education use the computer least often. We believe the reasons for this to be in these students working with younger pupils who are not yet as proficient in using the computer as older pupils. On the other hand, it is precisely the mentioned work specifics of elementary teachers which offer an opportunity to use ICT as a means of additional motivation of pupils. 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. We see a solution to this question in 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.

We also conducted 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. These results will be covered by future articles. Our 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. 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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