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DIFFERENT USER GROUPS OF UNIVERSITY STUDENTS AND THEIR ICT COMPETENCE: EVIDENCE FROM THREE COUNTRIES IN CENTRAL EUROPE

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Abstract. *The preferences in the use of ICT at school and at home are varied among young people due to development of ICT in the 21st century environment. Educators need to pay attention to differences among groups of ICT users and their influence on teaching and the learning process. The purpose of this research was to identify the levels of ICT competence of university students and to assess differences in their use of ICT with special focus on social networks and mobile phones. The questionnaire survey at four universities in three countries was conducted to identify how university students use ICT for learning and out-of-school activities. The participants were 1348 university students. The obtained results only partially confirmed the general assumption that young people (Millennials) in contemporary society are characterized by skilled use of ICT in their everyday life. The application of cluster analysis found four different user groups according to their use of ICT in their life. Educators should be aware of the user groups' differences among students and take them into account when planning, implementing and evaluating the teaching and learning process.*

Keywords: *ICT competence, university students, ICT use, user groups.*

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Introduction

Students around the world today are becoming increasingly familiar with computers and Internet. The progress of ICT has a major impact on their school and home related activities and future life.

The importance of the integration of ICT into university education has been emphasised by UNESCO since the end of the twentieth century, considering ICT to be essential both to innovative curricular practices and the general public's access to higher education (UNESCO, 1998; Schneckenberg, 2005). The permeation of technology in society has forced changes in employment, education (Siddiq, Gochyyev, & Wilson, 2017) and in leisure time. It has been stated that the role of ICTs in education is becoming more important in the 21st century. ICT-based education causes changes in the educational objectives in the conception of the teaching and learning process. ICT allows higher education institutions to reach disadvantaged groups and new international educational markets (Toro & Joshi, 2012).

The purpose of this research is to identify the levels of ICT competencies of students from universities and to understand how students realy use ICT and to assess whether the new generation is really ready to participate in different domains in the knowledge society in the 21st century using ICTs.

Problem of Research

ICT competence has become an essential aspect of the teaching and learning toolkit in the 21st century and the last two decades have also witnessed the dynamic inclusion of ICT in higher education systems in Visegrad countries, that are EU members since 2004, have quite similar educational system and ICT development index (Measuring the information society report, 2017).

It is also clear that the current higher education environment at universities demands ICT skills. Without basic (better without advanced) ICT skills, students are not able to successfully study at current universities. Baleo and Mayo (2010) argue that the integration of ICT into universities is essential

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for the development of a university system in line with the requirements of the knowledge society. Based on the evaluation of many sources, Toro and Joshi (2012, p. 22) summarize: "ICT provides student support services such as course outlines, digitally recorded classroom material, discussion groups, laboratory manuals and lab assignments, lecture notes, live lectures for later viewing and re-viewing, links to course specific websites, online tutorials, supplementary readings, and virtual office hours for teacher-student consultations." Current students at universities commonly use approaches to virtual libraries and scientific databases with textbooks, journals and other resources. It is generally assumed that social networks and the use of smartphones play a very important new role. This argument is in line with new students' competences needed in solving problems, communicating and collaborating through digital channels (Siddiq, Gochyyev, & Wilson, 2017).

Many national and international authorities describe the key points of the educational development of ICT-literate students (Australian Council for Educational Research, 2016; European Commission, 2018; Kiss, 2017; Siddiq, Gochyyev, & Wilson, 2017). Computer and information literacy is described (ICILS, Fraillon, et al, 2015, p. 17) as students' achievement with technology in different contexts, as the "ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace, and in society." ICT literacy comprises the abilities to process digital information, communicate with others and solve given problems (Rothagi, Scherer, & Hatlevik, 2016). Development of ICT literacy requires more than fundamental technical knowledge and skills. Similarly, the International ICT Literacy Panel (2002, p. 2) states that ICT literacy enables individuals to use "digital technology, communication tools, and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society".

Competence in using and dealing with ICT is considered as a prerequisite for ICT literacy development (Rohatgi, Scherer, & Hatlevik, 2016). This is in line with Guzmán-Simón, García-Jiménez, and López-Cobo (2017), who define competence as the set of knowledge, skills and attitudes that are necessary for personal and professional development in different contexts.

Research Focus

In order to identify what, and how, students use and learn with ICT, various concepts are used in the literature. For example: ICT skills, ICT or digital competence and ICT or digital literacy (some of them were mentioned above). It is emphasized (similar to Hatlewik, Gudmundsdóttir, & Loi, 2015) the importance of ICT competence when analysing and understanding what students are able to do with technology.

The importance of digital competence was recognised by the European Parliament and the European Council in 2006. Digital competence was identified as one of the eight key competences for lifelong learning and involves the confident and critical use of Information Society Technology (IST) for work, leisure, learning and communication (European Commission, 2014). Experts do not completely agree on the subject of digital competence and some models are really very complex (Janssen et al, 2013). According to Hatlewik, Gudmundsdóttir, and Loi (2015) digital competence contains the skills, knowledge and attitudes that make students able to use digital media for participation, work and problem solving, independently or in collaboration with others in a critical, responsible and creative manner. This means that digital competence is a broader concept that contains a student's understanding and critical reflection in addition to skills. Competence includes skills, knowledge and attitudes (Hatlewik, Gudmundsdóttir, & Loi, 2015, p. 346). This understanding emphasizes the student's ability to not only be skilled but also critical, responsible and creative in their use of ICT. Digital competence is developed in various domains (at home, at school, among peers, in professional or leisure time settings) that interact with each other (cf. Guzmán-Simón, García-Jiménez, & López-Cobo, 2017). The emerging concept of digital competence consists of a variety of skills and competences, and its scope covers several areas: media and communication, technology and computing, literacy, and information science (Ilomäki, Kantosalo, & Lakkala, 2011).

The above-mentioned sources were taken into account when preparing this research. Thus, basic items of scale follow the indicators which use surveys such as ICILS (2013), the report by the European Commission (2014) or the Eurostat Database (2017). However, for example, ICILS 2013 was not focused on phone or smartphone use and smartphone use is recognized as an important part of students' current ICT literacy.

Millennials at universities

Young people at universities in contemporary society are commonly labelled as Millennials characterized by habitual use of ICT in their everyday life. Demographers and researchers define Millennials as born from 1981-1996, some of them end the generation in the late 1990s or early 2000s (cf. Howe & Straus, 2000). Due to the context

of development (social, economic, technological) in these three countries, students born in the early 2000s are considered as Millenials.

It is supposed that Millennials frequently and intensely work with computers, mobile devices, and the Internet. They are also assumed to have experience with a broad range of software tools and applications on mobile devices (De Wit, Heerwegh, & Verhoven, 2014; Salomon & Kolikant, 2016). The rapid growth and common availability of computers, mobile phones and other devices facilitate web browsing, allow them access to social media and support their everyday communication.

Previous researches (e.g., from the USA, the UK, and South Africa, Jones et al. 2010) noted that young students (digital natives) may have very different levels of command of ICT. As statistical data show (Eurostat Database, 2017), all Millennials, university students, own a computer and a mobile phone. They frequently stick to word processing or browsing the Internet but they are not particularly skilled when it comes to less popular ICT skills, instruments, or programs. Similarly, Bruneel, De Wit, Verhoeven, and Elen (2013) observed that students with more ICT experience did not show increased levels of expertise with all types of ICT.

In the light of the characteristics of ICT competence and ICT literacy and of the current importance of ICT in higher education as described above, the following research questions relating to the ICT competence were posed:

Q1: What is the level of ICT competence of university students from selected universities in the Czech Republic, Poland and Slovakia?

Q2: Are there any differences in ICT competence between first-year students (bachelor´s level) and students before graduation at master´s level?

Q3: Why are some bachelor's and master´s students more proficient in ICT competence and use computers, the Internet and mobile phones more frequently than other students?

Methodology of Research

General Background

This was a quantitative research focused on university students and their ICT use for learning and out-of-school activities. Cross-national research on ICT literacy assesses the ICT competence of university students in a comparative manner. Attention was paid to the rapid increase in the use of social networks and mobile phones as the first devices and tools for students´ communication. Research was conducted at four selected universities in the fall semester of 2017/2018 academic year.

In the past two decades, ICT has progressively acquired a prominent role in teaching and learning in our primary and secondary schools. The results of measuring first-year students' ICT skills are evidence of how graduates of secondary schools are ready to study at university and to use ICT when learning. The results of measuring students' ICT skills before graduation at master´s level are evidence of how university graduates are ready to use ICT in their future life and how they are competent in this area.

It is expected that a similar culture and similar ICT use at school as at home in the three mentioned countries (all joined to the EU in 2004) and not very different ICT development index (Measuring the information society report, 2017) have a similar positive influence on the ICT competence of university students.

H1: The selected characteristics of digital competence of university students from selected universities in the Czech Republic, Poland and Slovakia are on the same level.

H2: Frequent use of ICT by students before graduation at master´s level is significantly higher than by first-year students.

Specifically, it is expected a positive relation among the results in partial parts of the ICT competence framework and the level on which students use ICT skills for everyday activities at school and out of school. As pointed out earlier, this expectation is in line with existing research on the role of ICT self-efficacy for students' ICT use (Rothagi, Scherer, & Hatlevik, 2016) and assumes positive beliefs that students use their ICT skills in their everyday activities in current society, not only at school but also during leisure time (Salomon & Kolikant, 2016). The purpose of this research is also to examine what students do on their computers and mobile phones and to find out how their ICT skills are associated with the ways in which they apply their ICT competence.

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H3: New ICT activities of university students (connected with social networks and mobile phones) influence the ways in which they apply their ICT competence.

It is assumed, regarding the relation between ICT use for different purposes, a positive relation between use of social networks (Eger, 2015; Miloševič et al., 2015; Thongmak, 2014) and mobile phones and the above basic ICT skills that both create + ICT competence and students' communication skills. Skilled students with higher results in using ICT for selected purposes use ICT not only more frequently but are on a higher level of ICT competence. ICILS (2013) focused on computers and excluded mobile phones. From this point of view, the research filled the gap and brings new information on how university students use social networks and mobile phones. In addition, research finds whether the use of social networks and mobile phones has a significant impact on the use of ICT for learning purposes.

Sample

This was a cross-national research focused on ICT competence of university students. A sample of 583 full-time first-year students (bachelor´s level) and 205 students before graduation at master´s level from two public universities in the Czech Republic (in Plzeň and in Olomouc) participated in this research (27.8 % male). Also, a sample of 246 full-time first-year students (bachelor´s level) and 95 students before graduation at master´s level from a public university in Poland (in Cracow) participated in this research (10.3 % male) and a sample of 132 full-time first-year students (bachelor´s level) and 87 students before graduation at master´s level from a public university in Slovakia (in Nitra) participated in this research (11.4 % male).

The participants ranged from 19 to 27 years old. They were studying at faculties of economics, and of education. All students provided informed consent and the research was approved by the heads of the selected faculties.

Instrument and Procedures

The data were collected using a self-report questionnaire. The instrument for measuring students´ ICT competence and +ICT competence is composed of 37 items grouped in 6 different parts (sections) and two items focused on gender and age. The composite indicators are based on selected activities related to computer and software use, on Internet-related tasks except social networks use and on mobile phone use for selected activities. The composite indicator and its parts were inspired by the Eurostat Database (2017) and by tools developed before to measure ICT literacy (Ivanković, Špinarec, & Miljko, 2013; Kiss, 2017; Kiss & Castelú, 2015). The instrument design meets recommendations by Gray (2009).

The measurement is focused on several parts:

Information skills, activities used for calculating information skills:

O1-1: I search for information about goods and services

O1-2: I obtain information from public authorities/ services websites

O1-3: I read and download information from online newspapers and journals

O1-4: I copy information and I create files and folders

X-1: I search for travel-related information

In this part of the ICT basic competence framework emphasis searching for, obtaining, downloading and seeking information. The number of items and their focus are the same as in Digital skills of individuals, information skills, Eurostat (2017).

Communication skills, activities used for calculating information skills:

O2-1: I send and receive emails

O2-2: I make video calls over the Internet

O2-3: I send messages to chat rooms (I chat)

O2-4: I upload self-created content to any website to be shared

O2-5: I participate in social networks

Basic ICT skills are sending emails, making calls via the Internet, participating in social networks and uploading self-created content. Items represent the skills needed for communication in a digital environment. The number of items and their focus are similar to Eurostat survey (2017).

Software skills (for content manipulation), activities used for calculating information skills:

O3-1: I edit paragraphs, align text, edit font
O3-2: I copy files or move parts of documents
O3-3: I use simple formulas and I create tables
O3-5: I create presentation using software and integrate text, pictures, graphs and videos
O3-6: I use software to edit photos

This part contains items focused on creating and editing new content. Eurostat used two lists, each with 3 items. A list of 5 items was used.

Problem solving skills, activities used for calculating this variable are:
O5-1: I connect and install new IT devices
O5-2: I install or reinstall operating systems
O5-3: I modify and configure software parameters
O4-1: I use some security software (anti-virus, firewall, etc.)
O4-2: I periodically back up the data from my computer (at least once every 3 months)

Periodically backing up data or using security software are really basic activities. Basic activities with software and operating systems are also included in this part. Eurostat used two lists, one with 3 items and the second with 4 items. A list of 5 items was used.

The above presented items in four parts of the ICT competence framework (see Figure 1) meet all the core activities stated in the International ICT Literacy Panel (2002). As is mentioned above, competence includes not only knowledge, skills, attention but also experience.

In the survey are used two additional important areas to assess the current ICT competence of university students. Information about these areas and their items follows:

Advanced activities, activities used for calculating this variable are:
O1-5: I actively use bookmarks in my browser
O3-7: I edit web pages or blog
O3-4: I can create a pivot table in Excel
O3-9: I have created and edited video
O4-3: I use different passwords for different Internet services
O6-4: I create a hotspot for connecting mobile devices
O6-5: I back up my mobile phone to the cloud
O6-8: I create and upload video onto social networks

Activities that represent advanced skills are focused on searching for, editing, creating and saving activities that correlate with the above basic skills from Eurostat survey (2017).

Social networks and mobile phone, activities used for calculating this variable are:
O6-1:I use the Internet on my mobile
O6-2: I send and receive emails on my mobile
O6-3: I send photos from my mobile
O6-7: I create and upload messages onto social networks
O9-9: I use some services to share files with other users

Current university students use their mobile devices not only for everyday communication but also for integrating new mobile devices (smartphones) in their learning process. These devices provide them informal learning contexts. They use social networks for the same purpose (e.g., Eger, 2015; Harris, 2015; Mazman & Usluel, 2010). Thus, in our construct of +ICT competence, advanced activities and social networks and mobile phones play an important role (Figure. 1).

In the below presented construct, additional items are not included which are used in cluster analysis. These are the items:

O3-8: I write code in a programming language
O4-4: I respect the rules of safe use of ICT (I take breaks, I use the right lighting, I use the right table and chair)
O4-5: I have to respond to cyber attacks on my accounts
O4:6: I choose electronic devices (e.g., PC or notebook) with respect to ecological parameters

One important feature of the instrument is its focus on the "doing" approach (c.f. Lee, Chen, & Lin, 2015). A common limitation in similar surveys is that they use self-reported data. Instruments usually measure "knowing" rather than "doing". The frequency type of measure refers to how often the individuals engaged (Junco, 2012) in a certain activity or experienced a phenomenon.

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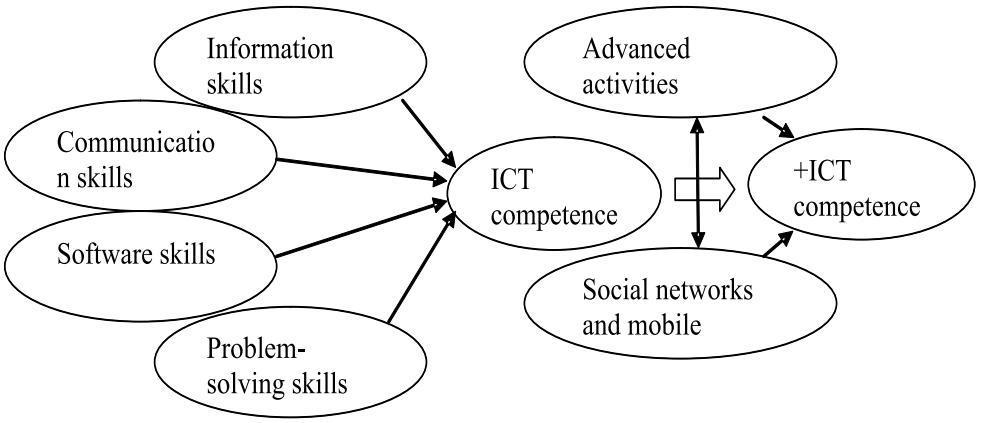

Figure 1. Conceptual framework, ICT competence and +ICT competence.

Regarding the scale reliabilities, not all partial scales showed acceptable values above 0.70 (Nunnally & Bernstein, 1994). The answers from the Czech student sample (n = 788 students from three different fields of study) were used to calculate Cronbach's alpha. Sections that copied the Eurostat tool (Eurostat, 2017) received a lower result, Information skills (0.6), Communication skills (0.6). Modified sections such as Software skills (0.8), Problem solving skills (0.7) and the new section Social networks and mobile phone (0.8) showed acceptable values. It should also be noted that the new, difficult and emerging section Advanced skills (0.6) indicates a level of consistency below the expected level. Six independent experts from three countries validated the choice of partial items during the pilot phase. They checked wording of the questions, contains, sequencing of the questions and design of the questionnaire (cf. Gray, 2009).

Data Analysis

That data analysis was done as follows. First, a descriptive and correlational analysis was conducted to explore actual ICT competence of university students with focus on their use of social networks and mobile phones. Second, the comparison of ICT use by first-year students and students before graduation at master´s level was investigated using the Mann–Whitney *U* test. Third, confirmatory factor analysis was used to identify individual groups of respondents from the research sample (961 first-year university students from three countries) that have the same or similar measure of answers to the questionnaire items.

Results of Research

Descriptive Statistics and Relations among Variables of Conceptual Framework of ICT Competence

Before testing hypotheses, the descriptive statistics and reliabilities of the scales measuring the above presented construct (Figure 1) were examined. The results are shown in Tables 1-3.

Because existing research has indicated that the frequencies of ICT use for school and leisure-related tasks are crucial determinants of students' ICT competence, it was decided to use the suitable Likert scale to measure features of the construct. The frequency type of measure (from 1 = never to 5 = always) refers to how often the individuals engaged in a certain activity or experienced a phenomenon (Lee, Chen, & Lin, 2015, p. 87). Analysis of the bivariate correlation between selected variables = section of conceptual framework of ICT competence was computed (see Table 1-4)

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Table 1. Descriptive statistics, intercorrelations between the selected areas, first-year university students from the Czech Republic.

Variables	1	2	3	4	5	6
1 Information skills	-					
2 Communication skills	.321	-				
3 Software skills	.405	.322	-			
4 Problem-solving skills	.236	,187	.438	-		
5 Social networks and mobile	.214	.564	.287	.207	-	
6 Advanced skills	.229	.331	.363	.611	.299	-
Mean	3.21	3.67	3.31	2.84	3.61	2.55
SD	.60	.64	.77	.82	.83	.60

Note. p < .05.

The results indicate a moderate positive correlation between the areas social networks and mobile and communication skills. The next positive moderate correlation is between the areas advanced skills and problem-solving skills. The average scores of area 2 Communication skills and area 5 Social networks and mobile show that these areas are strengths in first-year university students from the Czech Republic. The respondents expressed more activity in the mentioned areas.

Table 2. Descriptive statistics, intercorrelations between the selected areas, first-year university students from Slovakia.

Variables	1	2	3	4	5	6
1 Information skills	-					
2 Communication skills	.306	-				
3 Software skills	.159	.140	-			
4 Problem-solving skills	.387	.082	.329	-		
5 Social networks and mobile	.101	.334	.045	.185	-	
6 Advanced skills	.263	.391	.471	.518	.401	-
Mean	3.08	3.51	3.06	2.62	3.66	2.52
SD	.51	.52	.80	.72	1.11	.57

Note. p < .05.

The results in Table 2 indicate a moderate positive correlation only between advanced skills and problem-solving skills. The average score of area 2 Communication skills and area 5 Social networks and mobile shows that these areas are strengths in first-year university students from Slovakia similar to the results from the Czech Republic. The respondents expressed more activity in the mentioned areas.

Table 3. Descriptive statistics, intercorrelations between the selected areas, first-year university students from Poland.

Variables	1	2	3	4	5	6
1 Information skills	-					
2 Communication skills	.389	-				
3 Software skills	.359	.398	-			

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Variables	1	2	3	4	5	6
4 Problem-solving skills	.318	.286	.421	-		
5 Social networks and mobile	.403	.453	.289	.300	-	
6 Advanced skills	.364	.393	.455	.610	.524	-
Mean	3.25	3.42	3.12	2.63	3.46	2.12
SD	.58	.66	.80	.91	.68	.68

Note. p < .05.

The results in Table 3 indicate a moderate positive correlation among advanced skills with two other areas: problem-solving skills and social networks and mobile. The average scores of area 2 Communication skills and area 5 Social networks and mobile show the same results for first-year university students from all three countries.

Table 4. Descriptive statistics, students before graduation at master´s level from Czech Republic and Slovakia and Poland.

Items	Czech students		Slovak students		Polish students	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Information skills	3.53	.57	3.21	.56	3.25	.48
Communication skills	3.47	.68	3.49	.38	3.72	.71
Software skills	3.72	.72	3.32	.69	3.34	.79
Problem-solving skills	2.94	.78	2.69	.57	2.77	.84
Social networks and mobile	3.47	.89	3.58	.72	3.57	.63
Advanced skills	2.34	.59	2.26	.50	3.33	.62

The results of students before graduation at master´s level from Poland indicated moderate positive correlation between the areas social networks and mobile and communication skills and between the areas advanced skills and software skills. No correlations were found in groups of students before graduation at master´s level from the Czech Republic and Slovakia. Therefore, only the means and standard deviations are shown for areas of construct for these groups. The average scores of area 2 Communication skills and area 5 Social networks and mobile show that students before graduation at master´s level from all three countries expressed more activity in the mentioned areas.

Regarding the first hypothesis, positive and significant correlations were found between the communication skills and social networks for three groups of students. The findings show how social networks and mobile phone use play an important role in the ICT competence framework of today's university students. On the contrary, the mean of the area problem-solving skills is the lowest and the area advanced skills also shows a low activity rating by groups of students.

To evaluate hypothesis no. 2, the Mann–Whitney *U* test was used, which is a non-parametric alternative to the t-test. The Mann-Whitney *U* test is a nonparametric test that allows two groups or conditions or treatments to be compared without making the assumption that values are normally distributed. Monitoring was held at the $p < .05$ significance level in the whole analysing process. The test was conducted to check the statistical differences between the results of the responses of first-year university students and students before graduation at master´s level in selected areas of ICT competence. The results are shown in the following Table 5.

Table 5. Comparison of ICT use by first-year students and students before graduation at master´s level.

Students	Czech			Slovak			Polish		
Areas	Z-Score	*p*	Ho	Z-Score	*p*	Ho	Z-Score	*p*	Ho
1 Information skills	-6.022	.001	R	-1.593	.112	A	.150	.881	A
2 Communication skills	0.430	.667	A	-.740	.459	A	-1.935	.052	A
3 Software skills	-6.449	.001	R	-2.977	.003	R	-2.429	.003	R
4 Problem-solving skills	-1.719	.084	A	-.955	.342	A	-1.794	.073	A
5 Social networks and mobile	1.974	.048	R	.783	.435	A	-1.342	.180	A
6 Advanced skills	-1.071	.284	A	3.994	.001	R	-1.749	.001	A

Note. A = H_o is accepted, R = H_o is rejected.

The objective of this test was to verify hypothesis no. 2: There is no statistically significant difference in ICT competence in selected areas between first-year students and students before graduation at master´s level. As the results show, there is a statistical difference in the area software skills for groups of students from three countries.

Students before graduation at master´s level use ICT significantly more to edit documents, copy files, create tables, create presentations, etc. It is obvious that this is related to the educational process at universities.

The findings showed partial differences in the areas information skills and social network and mobile for Czech students. Very interesting was the finding in the area advanced skills, where a higher result was achieved by first-year university students in Slovakia. Overall, the findings show that hypothesis no. 2 is only partially supported.

Classification of First-year University Students according to Their Use of ICT (Cluster Analysis)

Research assumption

The dispersion of the results of the students' answers from three selected countries in ICT use can be explained by 4 groups of factors which express their level of ICT competence. This means, their preference in how to apply ICT in practice.

The aim in this part of the research was to identify individual groups of respondents from the research sample (961 first-year university students) from three countries (Czech Republic, Poland, Slovakia) that have the same or similar measure of answers to the questionnaire items. Consequently, their characteristics are described. For this purpose, cluster analysis is used (Everitt, 2011). The aim of cluster analysis is to divide objects (in this case, students) into clusters so that the objects assigned to one cluster are close (similar) to one another, and objects assigned to different clusters are distant, i.e., dissimilar, to one another. The cluster analysis uses findings selected from areas focused on communication, problem solving and software skills, and identifies what homogeneous groups exist among first-year university students according to their ICT use.

Sample size is important in factor analysis. General guides include, Tabachnick´s rule of thumb (Tabachnick & Fidell, 2007) that suggests having at least 300 cases are needed for factor analysis.

Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin Test (KMO) examined preliminary agreement to determine the suitability and relevance of the data.

Table 6. KMO test and Bartlett's test.

KMO		.834
Bartlett's Test of Sphericity	Approx. Chi Square	5598.8361
	df	253
	Sig	.0001

Finding in Table 3 shows that the correlation between items is sufficient to run the factor analysis. Bartlett's Test of Sphericity showed significant value of .0001, indicating $p < 0.05$.

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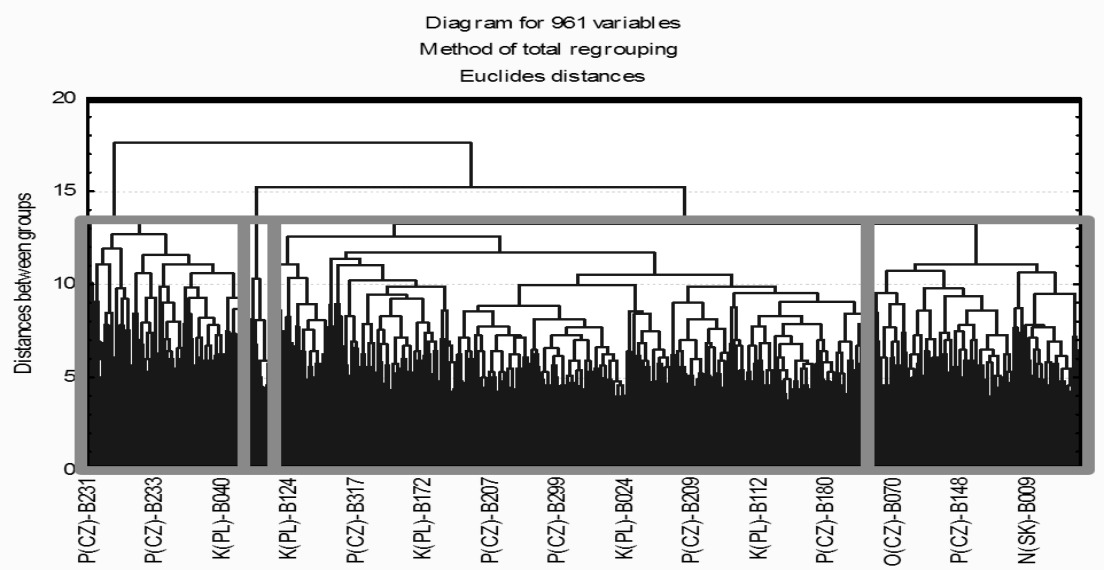

Figure 2. Cluster analysis, groups of students according to their use of ICTs, first-year students.

The cluster dendrogram presented in Figure 2 shows that students according to their ICT use have a strong tendency to split into 4 separate clusters. This fact can be observed at distances connected around the value 14 (shown in the picture by the horizontal line).

To prove with certainty that there is no student subgroup that explicitly rejects all activities associated with the use of ICTs, it is used the k-means clustering technique to identify subgroups of students. The aim was to identify and describe the characteristics of individual groups of respondents.

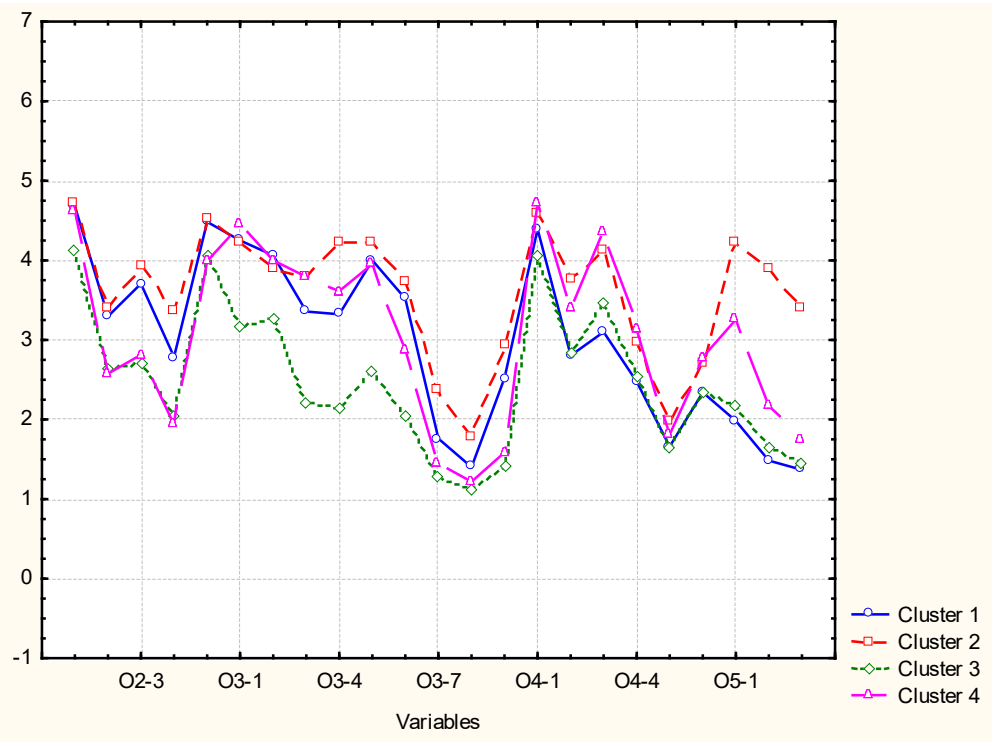

Figure 3. Cluster analysis, group of students according to their ICT use.

As can be seen in figure 3, the assumption was confirmed. The group of respondents, first-year university students from three countries, is divided into four relatively separate groups according to their answers to individual questionnaire items. Furthermore, figure 3 shows that none of the respondents' groups shows a significantly lower rate of students' answers in selected questionnaire items which were aimed at the use of ICTs by students than other groups.

For completeness of the analysis, individual groups were described and the number of respondents to the group was determined. An overview of the number of respondents belonging to the 4 identified groups is given in Table 7.

Table 7. Number of students in each group according to the similarity of the questionnaire item evaluation, first-year students.

Respondents n = 961					
	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total
Count	229	281	176	275	961
Count in %	23.75	29.27	18.33	28.65	100

In order to confirm the research assumption, confirmatory factor analysis (CFA) is used to test whether the data fit a hypothesized measurement model. The dispersion of the results of the students' answers from three selected countries in ICT use can be explained by 4 groups of factors which express the preference of the students in the different ways of ICT use in practice. For the sake of completeness, the method of factor extraction is used in research when it is necessary to reduce the high number of variables to a smaller number of latent variables. The aim of the method is therefore to make each factor represent the maximum scatter. The cumulative value, calculated on the basis of minimizing the sum of the quadratic differences between the observed and the estimated correlation matrix, should explain at least 50 % of the total scatter in order for the found result to be considered statistically demonstrable (Marček, 2009, p. 196). The table shows the scatter percentage explained by individual extracted factors.

Table 8. Eigenvalues and variance percentage explained by factors, first-year students.

Factor	Eigenvalues: Number of variables – 23 Extraction: Main components; Rotation: Varimax normal			
	Eigenvalue	Total percentage variance	Cumulative eigenvalue	Cumulative variance percentage
1	5.128	22.296	5.128	22.296
2	3.798	16.514	8.926	38.810
3	1.884	8.193	10.811	47.003
4	1.518	6.598	12.328	53.601

In total, these 4 factors (which identify subgroups of students) explain 53.60 % of the dispersion. According to the eigenvalue criterion, components with eigenvalues greater than 1 were selected. It was again possible to extract 4 factors and calculate the factor charge values of the individual criteria, as shown in Table 8.

CFA is a way to specify which variables load onto which factors. The result of the confirmatory factor analysis is the so-called rotated factor matrix, whose calculated items are called factor loadings. Factor loadings (ranging from -1 through 0 to +1) indicate the degree of correlation (correlation coefficient) between the individual items (statements) investigated and the relevant factors. The factor loading +1 would mean that the item is totally saturated with (totally loads on) the given factor (so-called net factor loadig), whereas the value of 0 would mean that the item is not affected by the factor whatsoever. Consequently, a negative value of the factor charge would mean that the given item is saturated by (loads on) the factor in a negative way. Therefore, in order to be able to regard the calculated factor load as statistically significant, its value should be at least +0.5 and/or higher. This condition

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being met, the correlation between an item and the corresponding factor loading can be considered as reliable (Larsen & Warne, 2010).

It is used a principal component analysis with Raw Varimax rotation and included items with higher loadings (at least 0.5) in the final scale.

The table shows how many percent of variance is explained by individual extracted factors.

Table 9. Eigenvalues and variance percentage explained by factors, first-year students.

Item	Factor loadings Rotation: Varimax Standardized, Extraction: Main Components, (Labelled loads are > 0.500000)			
	Factor 1	Factor 2	Factor 3	Factor 4
O2-1	-0.07	0.44	0.65	0.27
O2-2	0.20	0.02	0.51	0.09
O2-3	-0.02	0.09	0.77	-0.01
O2-4	0.28	0.03	0.57	0.05
O2-5	-0.07	0.09	0.70	-0.10
O3-1	0.01	0.80	0.06	0.06
O3-2	0.03	0.74	0.18	0.06
O3-3	0.23	0.75	-0.09	0.15
O3-4	0.36	0.43	-0.18	0.14
O3-5	0.28	0.60	0.12	0.04
O3-6	0.47	0.37	0.25	0.05
O3-7	0.66	0.16	0.14	-0.02
O3-8	0.66	0.06	-0.04	0.01
O3-9	0.62	0.16	0.17	-0.06
O4-1	-0.05	0.25	0.15	0.47
O4-2	0.22	0.10	0.15	0.60
O4-3	0.08	0.08	0.07	0.64
O4-4	0.07	0.04	-0.12	0.70
O4-5	0.37	-0.07	0.06	0.14
O4-6	0.12	0.01	-0.14	0.58
O5-1	0.63	0.29	0.05	0.17
O5-2	0.78	0.07	0.03	0.17
O5-3	0.78	0.02	-0.03	0.17

It can be seen from Table 9 above that the extracted factors are always influenced by questionnaire responses for a certain group of students. Based on this finding, it is possible to state that the dispersion of the questionnaire administered to the students can be explained by 4 factors representing 4 groups of first-year university students from 3 selected countries. This corresponds to the established research assumption that could be accepted.

In the summary of partial results, it is possible to describe the characteristic behaviour of groups of students with regard to their use of ICT. Table 10 below shows the overview. It is possible to differentiate and characterize individual groups according to their preferences.

Table 10. Characteristic behaviour of groups of students, first-year students.

Group of students	Characteristic ICT skills	Overall group characteristic
4 – expert level	I edit web pages or a blog I write code in a programming language I have created and edited video I connect and install new IT devices I install or reinstall operating systems I modify and configure software parameters	Students are able to fulfil even the most demanding types of ICT-related tasks, including creating software applications, websites, video presentations, and managing ICT resources for school or home-related tasks.

Group of students	Characteristic ICT skills	Overall group characteristic
2 – user level	I edit paragraphs, align text, edit font I copy files or move parts of documents I use simple formulas and create tables I create presentations using software and integrate text, pictures, graphs and videos	Students are able to use ICT to perform basic and complex user tasks consisting mainly in creating and editing documents, presentations, tables or simple graphics.
1 – basic level	I send and receive emails I make video calls over the Internet I send messages to chat rooms (I chat) I upload self-created content to any website to be Sharp I create and upload messages onto social networks I participate in social networks	Students are able to use ICT only at the basic communication level without the effort to create or edit. Specifically, ICT is primarily used to establish and maintain social contacts.
3 – advanced level	I periodically back up the data on my computer (at least once every 3 months) I use different passwords for different Internet services I respect the rules of safe use of ICT (I take breaks, I use the right lighting, I use the right table and chair) I choose electronic devices (e.g., PC or notebook) with respect to ecological parameters	Students are highly oriented in the use of ICT tools, but they are not able to perform more demanding tasks related to software applications or IT management. They pay special attention to security.

The cluster analysis identified four different groups of university students according to their use of ICT in their life. Group descriptions can be found in Table 9 and the conclusions are listed in the following section of the article.

Discussion

The research was aimed at examining how first-year university students and students before graduation at master´s level actually use ICTs. The findings of the first group are also related to the results of the teaching and learning process in ICT at secondary schools and to their out-of-school activities. The aim of the research was to expand our knowledge about the ICT competence of university students from three countries. Previous studies (e.g., ICILS 2013; report by European Commission, 2014 or survey by Eurostat Database, 2017) pay little attention to higher education students and their use of social networks and new mobile devices in their life. In order to address these aims, three hypotheses were developed on the specific relations and were tested with the application of descriptive statistic, Mann–Whitney U test and cluster analysis.

The first hypothesis on the selected characteristics of the ICT competence of university students from selected universities in the Czech Republic, Poland and Slovakia was first examined by the descriptive statistics. The results show a moderate positive correlation only between advanced skills and problem-solving skills for three groups of students. The findings also show that in the areas communication skills and social networks and mobile ICT competence framework, all groups of first-year university students and students before graduation at master´s level obtained the highest values (means of selected areas). Overall, lower values were obtained in the areas problem-solving skills and advanced skills. The following cluster analysis (H3) showed that students can be divided into several groups according to their use of ICT.

The second hypothesis assumes that "selected characteristics of ICT competence of university students from selected universities in the Czech Republic, Poland and Slovakia are on the same level." To evaluate hypothesis H2, the Mann–Whitney U test was used to compare differences between two independent groups of students when the dependent variables were ordinal and not normally distributed. The findings help us understand whether students´ responses towards selected areas of our ICT conceptual framework differ based on their time spent at university (first-year students x students before graduation at master´s level). The findings show that hypothesis H2 is only partially supported. Students before graduation at master´s level use ICT significantly more to edit documents, copy files, create tables, create presentations, etc. It is obvious that this is related to the educational process at universities. In other areas, the results were not significant for students from all countries.

The third hypothesis is focused on ways in which students apply their ICT competence in everyday life. The obtained results only partially confirmed the general assumption that young people (Millennials) in contemporary society are characterized by skilled use of ICT in their everyday life. On the contrary, the application of cluster analysis

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helps us find four different user groups. The findings in Table 9 show how groups of users different and what, on the contrary, are their common features. Analysis of the data indicates a considerable variation in what students do and are able to perform with ICT. This result has a significant impact on education and should be reflected by teachers at secondary and high schools, and at universities.

The first group of students uses ICT only at the basic communication level without the effort to create or edit information. ICT is primarily used to establish and maintain social contacts.

The second group is called the "user level group". Students are able to use ICT to perform basic and complex user tasks consisting mainly in creating and editing documents, presentations, tables or simple graphics. This group successfully meets both levels of skills ("basic" and "above basic") by Eurostat, digital skills of individuals (2017).

The third group of students ("advanced level") is highly oriented in the use of ICT tools, but they are not able to perform more demanding tasks related to software applications or IT management. They pay special attention to security. The difference between the first and the third group is already very significant and should be reflected in the application of ICT in the teaching and learning process.

Students from the fourth group are able to fulfil the most demanding types of ICT-related tasks, including creating software applications, websites, video presentations, and managing ICT resources for school and home-related tasks. These students may, compared to the first group, serve as experts for ICT application in educational process (the respondents in this survey were not students of IT study programs).

Evidently, educators should pay attention to differences among groups of ICT users and their influence on the teaching and learning process. The findings are in line with the findings by Hatlewik, Gudmundsdóttir, and Loi, (2015); Jones et al. (2010); Margaryan, Littlejohn, and Vojtb, (2011) or De Wit, Verhoeven, and Elen (2013). Not all students with more ICT experience showed increased levels of expertise in all types of ICT skills and the results indicate a variation in ICT competence. Future research could also focus on the habitual use of social networks and mobile phones and their not only positive but also negative influence on the learning process (Gaudreau, Miranda, & Gareau, 2014; Flanighan & Babchuk, 2015; Junco, 2012; Lamanauskas et al, 2018; Lau, 2017). On the other hand, research confirms that innovative teaching methods supported by modern information and communication technology have a positive effect on teaching and learning (Flogie, Lakota, & Aberšek, 2018). It is needed to look for ways in which to improve ICT competence for the first group of students and show them that they will need it for life in Society 4.0.

The present research has certain limitations. First, this research focused on the ICT competence of university students and the research used a self-report questionnaire with the instrument focusing on the "doing" approach (Lee, Chen, & Lin, 2015). The frequency type of measure refers to how often the individuals engaged (Junco, 2012) in a certain activity. Second, the sample of students is from three countries but only from four universities and from economics and education study programs. Therefore, to be able to generalize the results, the research should have involved more participants and students of other study programs except IT study programs. Finally, the scope and depth of the discussion in the research is compromised by being confined to the selected resources. For future research it is important to consider other items of the ICT competence framework that can help us to improve our understanding of students' behaviour when using ICT for learning purposes and leisure-time activities.

Conclusions

The results of this research have theoretical and practical implications. The research indicated that the frequencies of ICT use for school and leisure-related tasks are crucial determinants of students' ICT competence. The level and structure of the ICT competence of university students have a decisive influence on ICT application in students´ everyday activities. Significant differences between first-year students (bachelor´s level) and students before graduation at master´s level were found only in the area software skills for all groups from three countries. The findings of the research show that social networks and mobile phone use play an important role in the ICT competence of today's university students. The obtained results confirmed that young people, university students, are not a homogenous group of ICT users. The results of this research suggest that the effectiveness of ICT use at university and at home depends on the actual practice that students make of it and on their ability to integrate ICT into their learning process and their everyday lives. Educators should be aware of the above-mentioned four user groups' differences and take them into account when planning, implementing and evaluating the teaching and learning process. The different levels of ICT competence of university students will influence their employment, further education (lifelong learning) and their activities in leisure time.

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