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DIGITAL SKILLS ASSESSMENT AND DIGITAL COMPETENCE SELF-ASSESSMENT AMONG STUDENTS AT THE UNIVERSITY OF SPLIT

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Abstract/Izvleček

The aim of the study was to determine the self-assessment of digital competences and assessment of skills among students of professional and university studies at the University of Split (N=466), as well as to check whether there is a significant difference between them in terms of their year of study, gender, and scientific field of study. The results showed that senior students claim a higher level of digital skills, and that first-year students of humanities and social studies achieve better results than senior students on the digital skills test.
Key words: digital literacy; higher education; national curriculum

Ocenjevanje digitalnih veščin in samoocenjevanje digitalnih kompetenc med študenti Univerze v Splitu

Cilj raziskave je bila primerjava samoocene digitalnih kompetenc in ocene veščin med študenti strokovnih in univerzitetnih študijev Univerze v Splitu (N=466) ter preveriti ali med njimi obstaja pomembna razlika, upoštevaje letnik, spol in znanstveno smer. Rezultati so pokazali, da študentje višjih letnikov izkazujejo višjo raven digitalnih veščin, kot tudi da študentje 1. letnika humanistike in družboslovja na preizkusu digitalnih veščin dosegajo boljše rezultate od študentov višjih letnikov iste smeri.

Keywords:
digital literacy;
higher education;
national curriculum

Ključne besede:
digitalna pismenost;
visoka izobrazba;
nacionalni
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Introduction

The term digital competence has become one of the most frequently used terms in the world of modern education. Taking into consideration that we live in the 21st century and that technology is a constituent part of our lives, the importance of digital competences is obvious.

Digital competence can be defined as the ability to use digital tools, media and resources to provide an efficient and responsible solution to practical tasks, such as seeking and processing information, designing digital products and communicating content (Norwegian Directorate for Education and Training, 2013, as cited in Engen et al., 2014). Gallardo-Echenique at al. (2015) studied 73 papers on the digital competence concept published between 1990 and 2014. They concluded that digital competence has multiple meanings and that it is an unstable concept that cannot be evaluated since currently there are not enough clear instructions.

Considering the term's breadth and the numerous definitions of digital competence available in the literature, it is clear that the term includes different literacy types: information, communication, computer, technological, Internet, media, and digital literacy (or e-literacy). The above literacy types significantly overlap. Simultaneously, each has features that make it a component part of the digital competence concept (Žuvić et al., 2016).

Although the term digital competence is hard to define, we can divide it into several smaller sections. This was done in *A Framework for Developing and Understanding Digital Competence in Europe*, known as DIGCOMP 1.0 (Ferrari, Brecko, and Punie, 2014) and DIGCOMP 2.0 (Vuorikari, Punie, Carretero, and Van de Brande, 2016), which list 21 competences in the following five areas, describing what it means to be a "digital expert": Information and data literacy, Communication and collaboration, Content creation, Safety, and Problem solving.

The Digital Competence Framework in the Republic of Croatia

All digital competence features comply with Bloom's taxonomy (Bloom, 1956) and Bloom's revised taxonomy (Anderson, 2001) such that they are expressed with active verbs in cognitive, psychomotor, and affective areas in 6 levels: beginner, researcher, integrator, expert, leader, and innovator. The digital competence features per complexity level comply with the guidelines for describing learning outcomes at a

suitable qualification level for both the European and the Croatian higher education system.

Having in mind the fact that students enrol at the faculty after having finished elementary and secondary school education, it can be concluded that the digital competences necessary when enrolling must comply with the learning outcomes for digital competence in elementary and secondary school. After finishing elementary school education, students can effectively use computer programs and the Internet. The National Grammar School Curriculum (2018) defines logical and efficient communication as one of the generic competences. This includes adopting and exchanging symbolic content, interacting with others at different levels, and using media and technical gadgets. The National Vocational Education Curriculum (2018) defines forms of work and tool usage as one of three units comprising generic competences. This unit includes communication, collaboration, information and digital literacy.

When enrolling at the faculty in Croatia, students' digital competence level usually is not tested. Acquisition of digital competences in higher education in Croatia is not defined by any documents. Therefore, this study includes a survey to examine the connection between self-assessment and objective assessment of students' digital competences.

Previous Research into Digital Competences Assessment and Self-Assessment in the Republic of Croatia and the World

Considering the breadth of the digital competence concept, it is clear that assessment and self-assessment of someone's digital competence level are not easy tasks. Nevertheless, with a clear digital competence definition and division of this definition into levels and areas, research, including assessment and self-assessment of digital competences and skills, has been successfully implemented in Croatia and the rest of the world.

Li and Ranieri (2010) researched whether digital natives (Prensky, 2001) were really digitally competent. In their study, they tested the digital competence levels of a randomly chosen group of Chinese teenagers (ninth graders). Students' digital competence was tested with the help of a digital competence assessment tool (Instant Digital Competence Assessment - iDCA), developed by a research group at the University of Florence. Results revealed that most ninth graders who took part in the study (n=317) had owned personal computers with access to the Internet at

home for around 5 years. IDCA results indicated that the students had an average passing grade. This might mean that digital natives in China are not necessarily digitally competent.

Similar research was implemented among Russian students. The research into the digital competence level needed by Russian students in second year of the Institute for Foreign Languages and Literature for distance learning indicated that Russian students still lack the appropriate level of competences and motivation for distance learning (Kozhevnikova, 2013). Kozhevnikova (2013) thinks that the reason might be found in the fact that the Russian educational system encourages the development of only a few digital competence components – computer and technological literacy. On the other hand, the development of the third important component – information literacy – is insufficiently encouraged. Information literacy implies critical thinking, searching, analysis, and synthesis of data, as well as the capacity to evaluate the reliability of Internet sources.

Engen et al. (2014) also researched the difference between digital competence self-assessment and the real level of skills necessary for using digital tools and applications. The study was implemented among Norwegian students in their first year of teacher education studies. The results indicated that although the frequency of digital technology usage correlated with the level of digital competence self-assessment, it did not necessarily correlate with efficient use of digital tools and applications.

Sciumbata (2020) surveyed the digital skills of Italian students from the latest generation of digital natives enrolled in university humanities courses. Results show that participants tend to overestimate their digital skills and that they lack knowledge of basic topics. Besides outlining the digital competences, this study points out digital skills that should be strengthened, and which are often taken for granted by teachers and institutions, although students need those skills in their university and professional life, but also for their daily digital needs.

Therefore, according to Eurostat (2019), the questionnaire results can be considered as an indicator of an individual's digital competences and skills. It is important to emphasize that, among EU member states, Croatia had the largest portion of individuals aged 16 to 24 with well-developed digital skills: 97 %. For the age group from 25 to 29 years of age, Croatia took third place, with 92 % of persons with digital skills, right after Iceland and Finland. However, Croatia is at the bottom of the table,

with 64 % of persons with digital skills, if we consider the group aged 35 to 44 (Eurostat, 2019). A study conducted among students at China's Gansu Agricultural University in 2019 (Zhao et al.) investigated students' perceptions of their level of digital competence in the context of higher education. The majority of surveyed students consider their level of digital competence to be high, especially in the areas of information and data literacy and communication and collaboration. The results of the study also showed that student self-assessment of digital competence decreased when the complexity of the tasks offered to them increased, and the authors concluded that the level of digital competence among these university students in China still had room and potential for further development.

Tzafilkou et al. (2022) created an instrument for measuring the digital competences of students in higher education. The instrument includes components of online learning and collaboration, social media, smart and mobile devices, security and data protection and was applied to a sample of 156 undergraduate and postgraduate students immediately before and at the beginning of the crisis caused by the coronavirus in 2020. It revealed that individual factors such as field of study, computer experience and student age had a significant relationship with the components of the instrument, while no significant relationship was revealed with regard to student gender.

Research Goal

The research goal is to determine the digital competence and skills self-assessment among first-year and senior students. An additional goal is to examine whether there is any significant difference between the groups by students' gender and scientific field of study.

Research Questions

1. Are there any differences in digital competence self-assessment between first-year and senior students with respect to students' scientific field of study?
2. Are there gender differences in relation to the students' digital competence and skills self-assessment?
3. How successful are the students in the field of digital skills with respect to study year and type of study?

Hypotheses

1. Senior students are expected to achieve higher levels of self-assessment of digital competences regardless of the type of study.
2. It is expected that there will be no differences among students in self-assessment of digital competences and digital skills with regards to gender.
3. Senior students are expected to be more successful in digital skills regardless of the type of study.

Research Methodology

Sample of Respondents

Students from professional and university studies at the University of Split participated in the study. Participation was voluntary, anonymous and free of charge. Data collection was conducted in groups, with the size of the groups varying from 20 to 40 participants. A total of 547 students, joined the study, of whom 466 completed the questionnaire and had their results further processed. The respondents' age was between 18 and 30 years. There were 247 (53.01%) students from the social sciences and humanities and 219 (46.99%) students from science and technical studies. There were 169 first-year students (36.26%), and 297 students in all other years of study (63.74%). A total of 352 (75.54%) female students and 114 (24.46%) male students participated in the study.

Procedure

The research was conducted from January to April 2020, using an online version of the Digital Competences Self-Assessment Questionnaire and the Digital Skills Assessment Questionnaire on a sample of 466 students from the University of Split. The questionnaire was distributed through the online channels of the University of Split, and in the introductory part of the questionnaire, participants were informed about the purpose of the survey and that they could withdraw at any time. A total of 81 students withdrew from the survey, and their results were not taken into account when processing the results. In data analysis, the statistical software STATISTICA14 (Tibco Software Inc) was used to analyse the data.

Instruments

For the purposes of the research, a questionnaire was modified according to the following online sources: Online Self-Assessment Tool (European e-Learning Institute, 2019), which is harmonized with the DIGCOMP research project and test materials of the ITdesk.info -a project of computer e-education with open access (2011). The questionnaire consisted of two parts.The first part was the Digital Competences Self-Assessment Questionnaire, which included 21 statements consisting of 5 subscales or five areas of digital competence. The areas of digital competence were as follows: the communication and collaboration area (DC1) (including the following competences: interaction via technology, information and content sharing, joining Internet citizenship, cooperation via digital channels, acceptable behaviour on the Internet); the information and data literacy area (DC2) (including the following competences: browsing, searching, and filtering information, evaluating information, and storing and obtaining information); the digital content creation area (DC3) (including the following competences: developing content, integrating and processing content and knowledge, understanding copyright and licenses, and programming); the safety area (DC4) (including the following competences: device protection, personal data protection, health protection and environmental protection), and the problem solving area (DC5) (including the following competences: technical problem solving, identifying needs and technological responses, innovative and creative use of technology and recognizing digital competence insufficiency).In the Digital Competences Self-Assessment Questionnaire, the respondents marked their competence assessments on a Likert-type scale, with 1 meaning poor, 2 average, 3 good, and 4 very good. Table 1 includes descriptive parameters of the Digital Competences Questionnaire.

Table 1 Descriptive parameters of the Digital Competences Questionnaire subscale (N=466)

Subscales	N	M	SD	MIN	MAX	CRONBACH'S ALFA	INTER-ITEM r
DC1	6	19.16	3.65	8	24	.86	.52
DC2	3	9.75	1.82	4	12	.84	.63
DC3	4	10.65	2.68	4	16	.74	.45
DC4	4	11.97	2.86	4	16	.85	.61
DC5	4	10.44	2.93	4	16	.88	.65

Legend: DC1: communication and collaboration area; DC2; information and data literacy area; DC3: digital content creation area; DC4: safety area; DC5: problem solving area.

The reliability coefficient for all subscales ranges from .74 to .88 and indicates an appropriate level of reliability for all subscales.
The second part was the Digital Skills Questionnaire consisting of 15 questions. It included the following questions: Arrange in proper order the steps in saving a file (DS1); How do we select an entire document? (DS2); Which program would you use for computer data processing? (DS3); Indicate how we sit properly in front of the computer (DS4); Mark the programming languages for creating a website (DS5); What are the functions of a firewall? (DS6); What part of the address http://itdesk.info do we call the protocol (transfer rules)? (DS7); Indicate whether the statement is true or false: The message with an attachment that we send as a reply that also contains that attachment to the received message has the prefix "Fw:" (DS8); What is the name of the database line in which we enter the content (text, number, date)? (DS9); Write in correct order the phases you go through when you need to convert a task to a computer-acceptable format (DS10); Choose a digital tool for online collaboration and communication (DS11); What procedure do you use to increase data security? (DS12); If the Internet address starts with "https", it is about ... (DS13); What do we call text files that web pages save to a computer using an Internet browser? (DS14); and What is e-waste? (DS15). The respondents' task was to select the answer they deemed correct/true. The results were structured so that the correct answers were marked with 1 and incorrect with 0. Questions referred to information literacy and examined students' digital skills.

Results

To respond to the first research question and check whether there are differences between digital competences self-assessment by study year and type of study, t-tests were calculated. The results are shown in Table 2.
The results show a significant difference in the subscales self-assessment of digital competence and collaboration (DC1), information and data literacy (DC2), creation of digital content (DC3), and security in the form of device protection, problem solving (DC5) between 1st year students and senior students in the social sciences and humanities. Senior students achieve significantly higher results on almost all subscales, as well as on the overall score of digital self-assessment. By testing the difference in digital competences self-assessment among students in science and

technical studies, a statistically significant difference was determined only in relation to the problem-solving self-assessment subscale (DC5).

Table 2: T-tests for the testing difference in the digital competences among students in the humanities and social studies

Subscales	First year of study (N=56) M (SD)	Senior students (N=191) M (SD)	t (df)
DC1	2,77 (,65)	3,35 (,54)	6,60* (245)
DC2	2,77 (,64)	3,38 (,54)	7,00* (245)
DC3	2,33 (,61)	2,73 (,67)	3,96* (245)
DC5	2,26 (,65)	2,57 (,70)	2,94* (245)
DC in total	6,60 (1,02)	7,42 (1,01)	5,07* (239)

Note: *p<.01

Legend: DC1: communication and collaboration area; DC2: information and data literacy area; DC3: digital content creation area; DC5: problem solving area

Senior students are significantly better at assessing competences referring to technical problem solving, identifying needs and technological responses, innovative and creative technology usage and recognizing digital competence insufficiency $t(217)=-2.06$, $p<.05$. Differences in all other subscales as well as in the total result of digital self-assessment are not statistically significant. Given these results and the evident differences in the self-assessment of digital competences between first-year students and senior students, regardless of the type of study, the first hypothesis was partially confirmed.

To respond to the second question, gender differences in relation to digital competences self-assessment and digital skills assessment were tested among students in all study areas (N=466). The t-tests indicated significant gender differences only in the area of problem-solving self-assessment (DC5). Male students achieve higher results than female students in this field $t(464)=-5.21$, $p<.001$. In other words, male students assess their problem-solving competences as significantly greater than do female students. This partially confirmed the second hypothesis.

Furthermore, to respond to the third research question and to test whether there are any differences among students' digital skills by year and type of study, Chi-squared tests were implemented, as presented in Table 3 and Table 4.

Table 3: Chi-squared test to examine the differences in relation to digital skills between first-year and senior students in the humanities and social studies

Questions	Students, 1st year (N=56)		Senior students (N=191)		Chi squared
	% Correct	% Incorrect	% Correct	% Incorrect	df (1)
DS1	96.43	3.57	81.28	18.32	7.40**
DS2	92.86	7.14	98.43	1.57	4.88*
DS3	5.36	94.64	6.81	93.19	.15
DS4	60	40	43.46	56.54	4.49*
DS5	44.64	55.36	15.71	84.29	20.94**
DS6	31.37	68.63	67.02	32.98	21.22**
DS7	60.71	39.29	47.64	52.36	2.95
DS8	44.64	55.36	24.08	75.92	8.93**
DS9	50	50	41.88	58.12	1.15
DS10	92.86	7.14*	92.15	7.85	.03
DS11	69.64	30.36	78.02	21.99	1.66
DS12	30.36	69.64	13.09	86.91	9.14**
DS13	32.14	67.86	16.75	83.25	6.35*
DS14	57.14	42.86	37.70	62.30	6.71**
DS15	57.14	42.86	32.98	67.02	10.67**
DS16	33.93	66.07	14.14	85.86	11.19**

Legend: DS1 - DS16: Questions Note: *p<.05 **p<.01

Table 4: Chi-squared test to examine the differences in relation to digital skills between first-year and senior students in science and technical studies

Subscales	Students, 1st year (N=113)		Senior students (N=106)		Chi squared
	% Correct	% Incorrect	% Correct	% Incorrect	df (1)
DS1	84.07	15.93	83.96	16.04	.00
DS2	93.81	6.19	98.11	1.89	2.57
DS3	47.79	52.21	40.57	59.43	1.15
DS4	41.59	58.41	37.74	62.26	.33
DS5	**73.45**	**26.55**	**84.76**	**15.24**	**4.18***
DS6	57.52	42.48	42.45	57.55	4.96
DS7	2.65	97.45	5.66	94.34	1.25
DS8	34.51	65.49	30.19	69.81	.46
DS9	61.06	38.94	60.38	39.62	.01
DS10	87.61	12.39	88.68	11.32	.05
DS11	71.43	28.57	65.09	34.91	1.01
DS12	26.55	73.45	28.30	71.70	.08
DS13	28.32	71.68	29.25	70.75	.02
DS14	45.13	54.87	40.57	59.43	.46
DS15	47.79	52.21	52.83	47.17	.55
DS16	28.32	71.68	27.36	72.64	.02

Legend: DS1 - DS16: subscale, Note: *p<.05 **p<.01

Discussion

The main goal of this research was to establish the level of digital competences and skills self-assessment among first-year students and senior students. An additional goal was to examine whether there was any significant difference among students depending on gender and scientific field of study (social sciences and humanities, and science and technical studies).

Senior students achieve significantly better results on almost all subscales and in the total digital self-assessment result. This indicates that the studying process has a relevant impact on digital competences self-assessment. Performing study tasks that require the use of digital technology over the course of years impacts the sense of possessing digital competences.

Similar results were obtained in the research on attitudes related to technological possibilities in future work conducted on students of the 5th year from various teacher study programs at the University of Zagreb in the academic year 2017/18 (Brčić, 2020).

Among other things, the research examined the self-assessment of students' digital competences. The results showed that final year students considered themselves digitally competent both for the use of technology in private life and for the use of technology in their future teaching work. Students at the University of Zagreb stated that during their studies they did not practice teaching with IT equipment, but they would like to enrich the performance of their lessons with additional content if the technical conditions were fulfilled.

Results of research conducted at the University of Split and the University of Zagreb can be related to the experience gained by senior students during their years of study and to tasks that require digital competences such as writing seminar papers, searching the Internet to collect information, sending emails and similar. In this manner, they often use digital technology; they increase their digital skills and acquire digital competences. The above also impacts their self-assessment.

After examining the differences in digital competences self-assessment among students of science and technical studies, a statistically relevant difference was established only in relation to the problem-solving self-assessment subscale (DC5). Senior students are much better at assessing their competences necessary for technical problem solving, identifying needs and technological responses, innovative and creative use of technology, and recognizing digital competence insufficiency. This is partially in line with the first hypothesis. This result can be explained by the

fact that senior students in science and technical studies have greater knowledge of the technical problem-solving process, which they acquired while studying. Consequently, this results in a greater level of skill in relation to creative and innovative use of technology and better digital competences self-assessment in relation to this area. Furthermore, the comparison of digital competences self-assessment between female and male students indicated that there were relevant gender differences only in relation to the problem-solving self-assessment (DC5).
Male students achieve better results than female students; in other words, they assess digital competences needed for problem solving as significantly greater than female students do. This is partially in line with the second hypothesis.
The results of this comparison correspond to the Eurostat research results on digital skills among young people in Europe. In accordance with the above research, Croatian female students aged 16 to 24 had the worst result precisely in the field of problem solving (Eurostat, 2019).
Research on the level of digital competences among students and high school students from vocational schools in Germany (Wild and Schulze Heuling, 2020) also showed that male respondents achieved better results than females on the dimension "problem solving and security". An insight into the digital competence self-assessment research on gender differences among undergraduate students of social pedagogy at the University of Salamanca (Spain) also reveals that the gender variable impacts the research results. The results of this study indicated that, among future social instructors, male students achieved better results than female students in relation to knowledge and application. On the other hand, female students indicated better results in the attitude towards ICT (Cabezas González and Casillas Martín, 2018). Gender differences are an ongoing topic in the digital world. Women are encouraged to take an active part in the digital sector at the level of the European Union. Therefore, upon the proposal made by the European Commission, on 9 April 2019, 27 EU member states and Norway signed the Declaration of Commitment on Women in Digital. With this Declaration, the signatory states obliged themselves to encourage an active and important role for women in the digital world and to contribute to gender equality in the IT sector by cooperating with the public and private sector and civil society organizations (European Commission, 2019).

By comparing digital skills between first year and senior students in the humanities and social studies, a significant difference was established. First-year students achieve much better results than senior students in relation to the following skills: ordering the steps for saving a file from the first step to the last (DS1); knowing which program to use for computer data processing (DS3); identifying the correct manner of sitting at a computer (DS4); knowing website names, protocols and transfer rules (DS7); selecting digital tool for online collaboration and communication (DS11); knowing which procedure to use to increase data safety (DS12); knowing website address markings (DS13); naming text files saved by websites on a computer with the help of an Internet browser (DS14), and knowing what e-waste is (DS15). This result can be explained by the fact that students in humanities and social studies do not attend enough courses through which they are able to acquire digital skills.

The digital skills they acquire during their studies while performing student tasks are not formally defined. Therefore, we can conclude that their development largely depends on individual effort. Since the first-year students attended IT lessons during secondary school education, we can conclude that they still remembered their acquired skills and therefore achieved better results than senior students.

Unlike in the case of the students from humanities and social studies, the results of the comparison between first year and senior students in science and technical studies do not show any relevant difference in digital skills. The only significant difference in favour of the senior students can be seen in the area of knowing which programming languages to use for website development (DS5). Therefore, we can conclude that senior students acquired knowledge on programming languages during their studies and that this is why they showed better skills in this area. We can thus conclude the third hypothesis is only partially confirmed.

Conclusion

These students use digital technologies for fun, informal learning and communication, but also during their studies to perform a range of tasks. The development of digital competences and skills is mentioned in different forms in the curriculums for elementary and secondary school education. Nevertheless, after finishing secondary school education and during the procedure of enrolling in a faculty in Croatia, the digital competence level of future students is not tested.

The acquisition of digital competences and skills in higher education in Croatia is not defined by any national documents.

Pursuant to these facts, we can conclude that any development of digital competences and skills after secondary school education depends exclusively on the individual's will and interest and on the representation of that content in certain courses and faculties, a situation which impacts the development of digital competences and skills. It is important to emphasize that the lack of formal education aiming at increasing digital competences and skills is a problem not exclusively among students. It is also a problem among teachers in the higher education system. Teachers are offered numerous professional training sessions aimed at the development of digital competences and skills.

However, these are not obligatory, and the acquisition of such competences and skills is not defined by any national document. Kukulska-Hulme (2012) discussed this issue and stated that the faculties and their teaching staff must accept technology, not only as a technological assistance tool in their teaching, but also as a tool for research and professional development. Considering that one of the most important roles of teachers is to present a professional role-model for their students, this could encourage students to develop their own digital competences and skills (Kukulska-Hulme, 2012). Considering the fact that, in this study, senior students, regardless of the type of study, showed greater digital competence self-assessment, but not significantly better digital skills than their first-year student colleagues, we can conclude that students do not sufficiently develop their digital skills during their studies. Having in mind the importance of this problem, the development of a relevant national document is advised. Such a national document would determine the acquisition of a high level of digital competences and skills during the study period and define it as one of the key learning outcomes in higher education.

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