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Self-assessment of Student Digital Competences in Serbia

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Abstract: *The updated Digital Competence Framework, DigComp 2.0, defines five key areas of digital competences that every citizen needs to be able to use ICT in a critical, creative and collaborative manner for business, learning, entertainment, inclusion or social participation. This paper examines digital competences of students in Serbia, and the general aim of the research is to determine how students in Serbia self-assess their digital competences, whether their self-assessment is determined by specific socio-demographic characteristics, such as: university, field of study, year of study, frequency of use of ICT devices in teaching, and everyday activities. Two research instruments were created for the purposes of this research: Questionnaire on Socio-demographic Characteristics, and Digital Competence Assessment Scale, which is based on the European Digital Competence Framework – DigComp 2.0. Students from 22 faculties (N=183) from four administrative districts in Serbia (Moravica, Zlatibor, Južna Bačka and the City of Belgrade District) participated in the research. The research determined that students assess their digital competences as highly developed, both in relation to the scale and its integral subscales, and confirmed that there are significant differences in student self-assessments with regard to independent research variables: university and frequency of use of technical devices (smartphones) in teaching and everyday activities.*

Keywords: *self-assessment; DigComp 2.0; digital competence; higher education; lifelong learning.*

1. INTRODUCTION

In a rapidly changing world which is largely characterized by uncertainty and unpredictability, developing and improving citizens' digital competences is crucial. Digital devices (computers, tablets, smartphones, etc.) are an integral part of everyday life, because they ensure professional, social and entertainment functions to every individual. Everyone, young and old alike, must adapt to the changing world without exception, continuously learn and improve their digital competences in order to successfully accomplish their personal and professional tasks.

The future, competitiveness, and prosperity of every country depend on the readiness of its citizens to successfully tackle the challenges of the fourth industrial revolution in the 21st century, increased technological and scientific development, globalization, health and social crises (e.g. COVID-19 pandemic). In this regard, the readiness of different countries to take advantage of modern information and communication technologies in order to raise the quality of life of their citizens, improve effectiveness and efficiency of business and labor, and economic growth of their society depends on the digital competences of their population [1][2]. Given that the only certainty is unpredictability of changes and society's progress in the future, the higher education system should strive toward building the competences of young people for independent life and work in the 21st century [2]. Digital competences occupy a special place among numerous competences that young people need to master. In this way, higher education should directly contribute to the sustainable development of a society, which is based on knowledge and innovation, technology development and critical thinking.

The use of ICT has grown exponentially in recent years, and experts predict that over 90% of the jobs in the future will require highly developed digital competences [2]. Previous analyses indicate that almost half of the population of the European Union does not possess sufficiently developed digital skills, whereas 1/5 does not possess any digital skills whatsoever. The conclusion is that EU member states must make additional efforts to raise the level of digital skills in the general population, throughout the entire sector of education and professional training. The analysis [3] also focuses on the issue of social and economic inequality that arises due to differences in ICT infrastructure in educational institutions, science, culture and society as a whole.

Strategic national documents that define the question of development of digital skills of the Serbian population [2][3] emphasize that education is the key sector for the development of

digital competences and skills of the population through formal and non-formal education, continuous adaptation and modernization of the curricula, and learning 21st-century skills. Notwithstanding the fact that digital competences occupy a special place in the strategic national and international documents, their assessment has significant implications for educational decision makers, educational institutions, as well as for participants in the educational process [5]. In general, reliable data regarding the position of a country on the DigComp index can provide guidelines for improving citizens' digital competences and achieving goals related to employment, communication, learning, leisure, and participation in society [6][7].

1.1. Digital competence – approaches to definition and research/assessment

Digital competence encompasses a set of skills, knowledge, values, abilities and strategies needed for critical, creative, ethical and flexible use of information and communication technologies and digital media for professional work, leisure, learning and participation [8]. It is also defined as the ability to access, manage, understand, communicate, create and evaluate information in a safe and appropriate way for the purpose of employment, work and entrepreneurship [9]. Similarly to the above definitions, in the context of teaching and learning, digital competence integrates the knowledge, abilities, skills, values and strategies related to the teaching profession needed to use information and communication technologies and digital media in a creative, thoughtful, flexible and safe way in an online and offline environment [10] [11]. Policy-based definitions and reports point out that digital competence integrates digital skills with the social and emotional aspects of using and understanding digital devices [12].

Digital competence is recognized as one of the key competences for lifelong learning, necessary to all citizens for employment, professional work, active citizenship, social inclusion, and leisure. The concept of digital competence was developed by the European Commission in 2006 [13]. As it is a constantly evolving concept, it was redefined in 2018, and among other things, it now encompasses critical and responsible use and implementation of digital technologies for learning, work and participation in society. It involves information and data literacy (ability to understand, communicate and create data as information), communication and collaboration (interaction through digital technologies, participation in society through the use of public and private services, participatory citizenship), digital content creation (programming), safety and competences related to cyber security, issues related to intellectual property, and problem solving [7].

Some definitions of digital competence can be seen in the views of certain authors [14][15][16]. Digital competence involves confident and critical use of electronic media for work, communication and leisure [16]. These competences refer to logical and critical thinking, communication skills and information management skills.

However, in addition to the problem of defining the concept of digital competences, open issues also arise regarding their operationalization and measurement, which gave rise to different digital competence frameworks, both at national and international level. Numerous instruments for the assessment and self-assessment of digital competences, based on different theoretical and strategic frameworks, have been developed in the research field [17][18][5]. In addition to DigComp 1.0 and DigComp 2.0, there are other international frameworks as well, including the European Competence Framework for Educators, or DigCompEdu. The first reference framework that defines digital competence as a combination of 21 individual competences. A new reference framework that operationalizes this concept in five areas was developed and accepted in 2016: information and data literacy; communication and collaboration; digital content creation; safety; and problem solving [19].

Regardless of the approach to their definition, it can be noted that digital competences represent a combination of knowledge, skills and values related to digital technologies. Specifically, the basic constituents of digital competence are: knowledge, skills (e.g. ability to implement processes) and values (e.g. mindset, assessment).

1.2. Digital competence Framework DigComp 2.0

The European Digital Competence Framework – DigComp 2.0 – provides a matrix for understanding the core competences needed by all citizens to adapt and actively participate in the digital world. Namely, modern technologies, such as robots, artificial intelligence, virtual and augmented reality, as well as numerous negative phenomena arising from them (e.g. misinformation and digital bullying) have given rise to new demands for the development of citizens' digital competences [19]. The updated European Digital Competence Framework considers the knowledge, skills and values needed by citizens of the 21st century.

The DigComp 2.0 defines five areas of competences that operationalize the concept of digital competence both in scope (extension) and content (intensity). They are the following competence areas: (1) Information and data literacy; (2) Communication and collaboration; (3) Digital content; (4) Safety; and (5) Problem solving. The first three areas cover competences that are applied within specific activities and uses, whereas

the remaining two are applicable to any activity performed through digital technologies. For example, problem solving is highlighted as a special and final area of competence to emphasize the importance of this aspect for the appropriation of technology and digital practice.

The structure of the updated model of digital competences for citizens is presented below, according to the defined areas of competence [19].

1. Information and data literacy
   - 1.1. Browsing, searching and filtering data, information and digital content involves articulating information needs; searching for data, information and content in digital environments; creating and updating personal search strategies.
   - 1.2. Evaluating data, information and digital content involves analysis, comparison and critical evaluation of the credibility and reliability of sources of data, information and digital content; analysis, interpretation and critical evaluation of the data, information and digital content.
   - 1.3. Managing data, information and digital content involves organizing, storing and retrieving data, information and content in digital environments, as well as their organization and processing into a structured environment.
2. Communication and collaboration
   - 2.1. Interacting through digital technologies - interaction through a variety of digital technologies and understanding appropriate digital communication means for a given context.
   - 2.2. Sharing through digital technologies - sharing data, information and digital content with others through appropriate digital technologies;
   - 2.3. Engaging in citizenship through digital technologies - participating in society through the use of public and private digital services; seeking opportunities for self-empowerment and for participatory citizenship.
   - 2.4. Collaborating through digital technologies - using digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.
   - 2.5. Netiquette – being aware of behavioral norms and know-how while using digital technologies and interacting in digital environments; adapting communication strategies to the specific audience; awareness of cultural and generational diversity in digital environments.
   - 2.6. Managing digital identity – creating and managing one or multiple digital identities to protect one's own reputation.
3. Digital content creation
   - 3.1. Developing digital content – creating and editing digital content in different formats, to express oneself through digital means.
   - 3.2. Integrating and re-elaborating digital content – modifying, refining, improving and integrating information and content into an existing body of knowledge to create new, original and relevant content and knowledge.
   - 3.3. Copyright and licenses – understanding how copyright and licenses apply to data, information and digital content.
   - 3.4. Programming – planning and developing a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.
4. Safety
   - 4.1. Protecting devices - involves protecting devices and digital content, and understanding risks and threats in digital environments, as well as safety and security measures.
   - 4.2. Protecting personal data and privacy – involves protecting personal data and privacy in digital environments, understanding how to use and share personally identifiable information while being able to protect oneself and others from damages.
   - 4.3. Protecting health and well-being – ability to avoid health-risks and threats to physical and psychological well-being while using digital technologies; ability to protect oneself and others from possible dangers in digital environments (e.g. cyber bullying), and awareness of digital technologies for social well-being and social inclusion.
   - 4.4. Protecting the environment – awareness of the environmental impact of digital technologies and their use.
5. Problem solving
   - 5.1. Solving technical problems – identifying technical problems when operating devices and using digital environments, and solving them.
   - 5.2. Identifying needs and technological responses – assessing needs and identifying, evaluating, selecting and using digital tools and possible technological responses to solve them, as well as adjusting and customizing digital environments to personal needs (e.g. accessibility).
   - 5.3. Creatively using digital technologies involves using digital tools and technologies to create

knowledge and innovate processes and products.

5.4. Identifying digital competence gaps – ability to understand where one's own digital competence needs to be improved or updated, as well as supporting others with their digital competence development (keeping up-to-date with the digital evolution).

2. RESEARCH METHODOLOGY

2.1. Research aims and tasks

The survey aimed to identify the level of digital competences of students in Serbia. The aim was implemented through two research tasks:

(1) Examine how students in Serbia assess the level of their digital competence in relation to the areas defined in DigComp 2.0 (information and data literacy, digital content creation, communication and collaboration, safety, and problem solving);

(2) Determine whether there are differences in the students' self-assessment of digital competences with regard to university, scientific field of study, year of study, frequency of use of ICT devices (computer, tablet, smartphone) in teaching and everyday activities.

2.2. Research methods, techniques and instruments

A descriptive method, and techniques of surveying and scaling were used in the research. A questionnaire was created to examine the socio-demographic characteristics of students. An assessment scale (DigComp 2.0 Assessment Scale), which includes 23 items categorized into five subscales, in line with the defined areas in the Digital Competence Framework for Citizens DigComp 2.0, was created for the purpose of examining students' digital competences. These are the following areas: information and data literacy, digital content creation, communication and collaboration, safety, and problem solving. The development of digital competences was assessed on a three-point scale (3 – I'm confident I know/can do, 2 – I'm somewhat confident I know/can do, and 1- Idon't know/cannot do), whereby a higher score indicates more developed digital competences of a student. The reliability of the assessment scale on the student sample was 0,86 expressed by Cronbach's alpha.

The first subscale, information and data literacy, included three items (item 2: "I can evaluate which information on the Internet is reliable, and which is not".) The second subscale – digital content creation – included seven items (item 6: "I can create simple digital material (text, images, and presentations"). The third subscale – communication and collaboration – included five items (item 14: "I use digital technologies to make bank and doctor's appointments, etc"). The fourth subscale – safety – included five items (item 16: "I can protect my personal data, and am aware of the risk and dangers in the digital environment (e.g. I use antivirus software, passwords, etc.)"). The fifth subscale - problem solving – included three items (item 22: "I know how to solve routine problems that arise when working on a computer/laptop (e.g. close a program, restart the computer, reinstall a program, and connect to the Internet)"). The values for Cronbach's Alpha (Table 2) indicate varying internal reliability of the subscales, from questionable to satisfactory (values ranged from 0,54 to 0,71).

2.3. Research sample

The survey was conducted on a suitable sample of 183 students from four administrative districts in Serbia (Moravica, Zlatibor, Južna Bačka and City of Belgrade). The structure of the sample by the selected socio-demographic characteristics is given in Table 1.

2.4. Organization and research process

The survey was conducted during April and May 2022, in two ways: electronically (Google forms) and directly, by distributing the questionnaire in print form to the respondents.

2.5. Data processing

The collected data were processed in the IBM SPSS Statistics 20 statistical software suite and analyzed descriptive (arithmetic mean, standard deviation, frequencies, percentages) and inferential statistics (one-sample t-test, one-way ANOVA non-repeated measures).

3. RESULTS AND DISCUSSION

The first research task is aimed at assessing the level of digital competences from the perspective of students. The average value of the level of digital competences of students on the scale M=59,96; SD=5,01) indicates a moderately high level (Table 2), which is also visible when the result is divided by the total number of items on the scale (M=2,71; SD=0,23).

Table 1. *Socio-demographic characteristics of student sample (N=183)*

Socio-demographic characteristics	Modalities	(f)	(%)
University	University of Kragujevac	92	50,3
	University of Belgrade	72	39,3
	University of Novi Sad	19	10,4
Field of study	Social sciences and humanities	109	59,6
	Technical sciences	23	12,6
	Biotechnical sciences	22	12,0
	Medical science	16	8,7
	Natural sciences	10	5,5
	Arts	3	1,6
Year of study	One	12	6,6
	Two	26	14,2
	Three	77	42,1
	Four	50	27,3
	Other (five, six)	18	9,8
Frequency of using computer in teaching	Every week	18	9,8
	Once a week	27	14,8
	Once a month	65	35,5
	Never	73	39,9
Frequency of using smartphone in teaching	Every day	150	82,0
	Once a week	19	10,4
	Once a month	3	1,6
	Never	11	6,0
Frequency of using computer in everyday activities	Every day	12	6,6
	Once a week	32	17,5
	Once a month	59	32,2
	Never	80	43,7
Frequency of using smartphone in everyday activities	Every day	167	91,3
	Once a week	9	4,9
	Once a month	0	0,0
	Never	7	3,8

The results of the one-sample t-test indicate that the level of students' digital competences (min.=46; max.=66; AS=59,96; SD=5,01) is significantly higher than the theoretical mean of the scale (min.=8; max.=69; $t(137)=37,733$, $p<0,01$).

In this way, the results unequivocally show that students assess their digital competences as highly developed, while their assessments differ significantly from the theoretical mean of the scale.

Table 2. *Descriptive parameters for scale of digital competences as a whole and subscales (students' self-assessment)*

	M	SD	N	α
Total scale Digital competences	2,71	0,23	23	0,86
Information and data literacy	2,81	0,24	3	0,54
Digital content creation	2,79	0,24	7	0,70
Communication and collaboration	2,74	0,29	5	0,67
Safety	2,62	0,36	5	0,71
Problem solving	2,56	0,43	3	0,71
Legend: M – arithmetic mean; SD – standard deviation; N– number of items; α - Cronbach's Alpha				

The obtained results are consistent with related research. Analysis results [20] show that students in Serbia possess satisfactory level of digital skills, especially in the domain of information and communication technologies, but also that there is significant room for further development of these skills in the domain of problem solving and software use. In addition, the results of this study indicate that the observed digital skills of Serbian students are at a somewhat lower level than the skills of their fellow students from the EU, especially in the domain of more complex digital skills (problem solving and software use) and their application.

When the defined areas of digital competences are considered, the obtained results indicate that students in Serbia believe that their digital competences are most developed in the following areas: information and data literacy (M=2,81; SD=0,24), digital content creation (M=2,79; SD=0,24), and communication and collaboration (M=2,74; SD=0,29). On the other hand, students assess their digital competences as less developed in the remaining two areas: safety (M=2,62; SD=0,36) and problem solving (M=2,56; SD=0,43). It can be assumed that students perceive competences related to solving technical problems, and ensuring the protection of device, data, health and the environment as more complex competences that require additional work, and whose successful implementation implies help and support of others. It is also possible that study programs and teaching material at different faculties do not sufficiently incorporate elements from the last two areas of competence, given that they cover different scientific fields. Some previous research [21] shows that librarianship students assess their digital competences as most developed in the field of information and data literacy, followed by communication and collaboration, while on the other hand, they perceive their competences in the domain of solving technical problems and

involvement in active citizenship through digital technologies as least developed, similarly to our own findings.

The second research task aims to examine the significance of differences in the perceived level of digital competences between students, in relation to the university where they study, field of study, year of study, and frequency of use of ICT devices in teaching and everyday activities.

Table 3. *Significance of differences in the perceived level of digital competences between students*

Variables	Modalities	F
University	University of Kragujevac	F=3,907 p=0,02*
	University of Belgrade	1-2
	University of Novi Sad	1-3
Frequency of using smartphone in teaching	Every (work) day	F=3,869 p=0,01**
	Once a week	1-4
	Once a month	2-4
	Never	
Frequency of using smartphone in everyday activities	Every day	F=10,095
	Once a week	p=0,00**
	Never	1-2 2-3
Note: *statistically significant at 0,05 level; ** statistically significant at 0,01 level.		

As suggested by the results presented in Table 3, it is established that the university where a student studies significantly determines their self-assessment of digital competences (F=3,907; p=0,02). At the level of pairwise comparison (LSD), significant differences between the students of the University of Kragujevac (M=59,96; SD=5,05) and the University of Belgrade (M=59,80; SD=5,12) were identified, as well as between students of the University of Kragujevac (M=59,96; SD=5,05), and those from the University of Novi Sad (M=59,54; SD=4,86). The assumption is that the identified differences arose as a result of the sample structure, but also due to the lack of standardized teaching content referring to the use of modern digital technologies.

Moreover, according to the results of this research, students who use smartphones more frequently in teaching assess themselves as far more digitally competent than their fellow students who do not use smarthphones for learning purposes (F=3,869; p=0,01). Specifically, students who use smartphones in teaching on a daily basis for learning purposes (M=59,98; SD=4,94), as well as those who use it once a week (M=59,89; SD=4,93) assess the level of their digital competences as significantly higher than students who never use smartphones for the same purposes (M=54,72; SD=6,13). In addition to the above, the frequency of using the smartphone in everyday activities represents a significant determinant of self-assessment of one's digital competences (F=10,095; p=0,00). Significant differences were identified between two pair groups: (1) between students who use the smartphone every day (M=59,91; SD=4,92), and those who never use it (M=51,42; SD=5,59); as well as between (2) students who use the smartphone once a week (M=59,00; SD=5,33), and those who never use it (M=51,42; SD=5,59). These results are consistent with similar research on the relationship between the use of ICT technology and ICT competencies [22][23][24][25]. Eger et al. [22] discovered that there are large variations in student ICT competencies, and the application of digital devices (primarily smartphones) in leisure activities, and in learning. Although not unequivocal, a significant and positive relationship was established between the use of ICT in different contexts and student digital literacy, expressed as a measure of self-efficacy in the use of information and communication technologies [23][24], or a measure of performance on ICT competency tests [25]. Students who frequently use ICT in social communication achieve higher scores in computer and information literacy than those who use ICT less frequently for the same purpose (e.g. once a week, or never), and the direction of this effect was consistent across the 21 countries surveyed [25]. More frequent use of smartphones in one's free time has a positive effect on the increase of student digital competences, and consequently, on the frequency of ICT use in teaching, for learning purposes. On the other hand, the improved digital competencies of students have a positive effect on the frequency of ICT use in different contexts (learning, free time, work, etc.).

4. CONCLUSION

The development of digital competences not only improves the quality of life of citizens in the general population, but also strengthens local and regional development, as well as the development of society as a whole. Due to the fact that digital competence is inseparable from other lifelong learning competences needed to live and work in the 21st century, the modified European Competence Framework DigComp 2.0 is an important reference framework for understanding and assessing digital competences of students, as well as current and future citizens.

The results of the research give rise to two conclusions:

First, that students assess their digital competences as highly developed, both at scale level, and at the level of observed areas of competence (information and data literacy; digital content creation; communication and collaboration; safety; and problem solving); and

Second, data that refer to the impact of certain socio-demographic variables indicate that there are significant differences in the self-assessment of digital competences between students from different universities, in relation to the frequency of using the smartphone in teaching and everyday activities.

It is encouraging that students consider themselves competent enough to live and work in the digital world and environment, but we must not overlook potential subjectivity in the assessment of one's own competence. Some authors [17] suggest an alternative - using objective research instruments to determine the level of students' digital competence, based on the performance and demonstration of digital competence (knowledge, skills and values), in addition to self-assessment and self-reporting. A potential factor that can influence the results of the ANOVA test, and at the same time represents the limiting factor of this study, is the difference in the number of samples across the compared student groups.

Given the multidimensionality and fluidity of the concept of digital competence, as well as results of this research, there is a need to improve students' digital competences in the domain of safety and problem solving while they are still at university, especially because these competences are applicable in all activities supported by digital technologies. Understanding and observing the principles of safe use of digital content, and solving problems related to the use of digital devices and technologies are necessary competences on a personal, professional and social level. In the system of higher education, the assessment and development of students' digital competences remains a great challenge, but also an opportunity to adequately and critically respond to the challenges of society's transformation and overall digitalization.

REFERENCES

[1] OECD (2019). *OECD Skills Outlook 2019: Thriving in a Digital World*, OECD Publishing, Paris, https://doi.org/10.1787/df80bc12-en.

[2] Strategija razvoja digitalnih veština u Republici Srbiji za period od 2020. do 2024. godine ("Sl. glasnik RS", br. 21/2020)

[3] García-Vandewalle García, J. M., García Carmon, M., Trujillo Torres, J. M., Moya Fernández, P. (2021). Analysis of digital competence of educators (DigCompEdu) in teacher trainees: the context of Melilla, Spain. Technology, Knowledge and Learning, https://doi.org/10.1007/s10758-021-09546-

[4] Strategija razvoja obrazovanja i vaspitanja u Republici Srbiji do 2030. godine. "Sl. glasnik RS", br. /2020.

[5] Tzafilkou, K., Perifanou, M. & Economides, A. A. (2022). Development and validation of students' digital competence scale (SDiCoS). *International Journal of Educational Technology in Higher Education*, 19, 30. https://doi.org/10.1186/s41239-022-00330-0

[6] European Commission (2010). *A Digital Agenda for Europe (DAE).* Brussels, 19.05.2010, COM(2010) 245, Retrieved fromhttp://eur-lex.europa.eu/LexUriServ/LexUrierv.Do?uri=COM:2010:0245:FIN:EN:HTML

[7] European Union (2018). *Council Recommendation on Key Competences for Lifelong Learning* (ST/9009/2018/INIT). https:// eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2018.189.01.0001.01.ENG

[8] Ferrari, A., (2012). *Digital Competence in Practice: An Analysis of Frameworks*, Institute for Prospective Technological Studies, European Commission Joint Research Centre.

[9] UNESCO (2018). *A Global Framework of Reference on Digital Literacy Skills for Indicator 4.4.2.* Montreal: UNESCO Institute for Statistics.

[10] Ministarstvo prosvete, naukei tehnološkog razvoja (2017). *Okvir digitalnih kompetencija – Nastavnik za digitalno doba – nacrt*. Republika Srbija.

[11] Ministarstvo prosvete, nauke i tehnološkog razvoja (2019). *Okvir digitalnih kompetencija – Nastavnik za digitalno doba 2019.* Beograd: Republika Srbija.

[12] Ilomäki, L., Kantosalo, A., & Lakkala, M. (2011). What is digital competence? In Linked portal. Brussels: European Schoolnet.http://linked.eun.org/web/guest/in-depth3

[13] European Parliament and the Council (2006). Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. *Official Journal of the European Union*, L394/310

[14] Cartelli, A. (2010). Frameworks for digital competence assessment: Proposals, instruments, and evaluation. Paper presented at the Informing Science & IT Education Conference (INSITE), Cassino, Italy.

[15] Plachkov, S. (2011). Digital Competence in the Professional Profile of the Technology Education Teacher. *A Journal for Information Technology, Education Development and Teaching Methods of Technical and Natural Sciences,* 1(1), 1-4.

[16] Calvani A., Fini A., & Ranieri M. (2009). Assessing Digital Competence in Secondary

Education. Issues, Models and Instruments. In M. Leaning (ed.). *Issues in Information and Media Literacy: Education, Practice and Pedagogy* (pp. 153–172). Santa Rosa, California: Informing Science Press.

[17] Maderick, J. A., Zhang, S., & Hartley, K., & Marchand, G. (2015). Preservice Teachers and Self-Assessing Digital Competence. *Journal of Educational Computing Research,* 0(0), 1–26. doi: 10.1177/0735633115620432

[18] Tsankov, N., & Damyanov, I. (2019). The Digital Competence of Future Teachers: Self-Assessment in the Context of Their Development. *International Journal of Interactive Mobile Technologies* (iJIM), 13(12), 4–18. https://doi.org/10.3991/ijim.v13i12.11068

[19] Vuorikari, R., Kluzer, S. & Punie, Y., (2022). DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes, EUR 31006 EN, Publications Office of the European Union, Luxembourg. doi:10.2760/490274, JRC128415.

[20] Bradić-Martinović, A., Pavlovic, D., i Zdravković, A. (2019). Digitalne veštine studenata u Srbiji. XXV Skup trendovi razvoja: "Kvalitet visokog obrazovanja", Kopaonik, 11. -14. 02. 2019, 1-4.

[21] Černý, M. (2021). Digital Competences of Students of Library Studies: Comparison of Research Results for 2018–2020. *Education Sciences*, 11(11), 729. doi:10.3390/educsci11110729

[22] Eger, L., Tomczyk, L., Klement, M., Pisoňová, M., & Petrová, G. (2020). How do first year university students use ICT in their leisure time and for learning purposes? *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 8(2), 35-52.

[23] Hatlevik, O. E., Gudmundsdóttir, G. B., & Loi, M. (2015). Digital diversity among upper secondary students: A multilevel analysis of the relationship between cultural capital, self-efficacy, strategic use of information and digital competence. *Computers & Education*, 81, 345–353. doi:10.1016/j.compedu.2014.10.019.

[24] Rothagi, A., Scherer, R., & Hatlevik, O. E. (2016). The role of ICT selfefficacy for students' ICT use and their achievement in a computer and information literacy test. *Computers & Education*, 102, 103–116. doi:10.1016/j. compedu.2016.08.001.

[25] Alkan, M., & Meinck, S. (2016). The relationship between students' use of ICT for social communication and their computer and information literacy. *Large-scale Assessments in Education*, 4 (15), 2–17. doi:10.1186/s40536-016-0029-z