

Digital Competencies of Future Teachers

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The present article deals with the importance of digital competencies of future teachers, highlighting the role of ICT in education. The research was conducted on a convenience sample of 328 students of the Faculty of Education, University of Maribor, in the academic year 2023/2024. The data was obtained through an online questionnaire. The results show that students feel most confident performing basic digital tasks such as searching for information on social media and using digital calendars. However, they feel less confident performing advanced tasks such as web design and using licences. Overall, students of elementary education feel more competent than students of preschool education. The findings of the research highlight the necessity of enhancing digital literacy by providing further education and training for future teachers across all levels and disciplines. Only through such initiatives can the full potential of contemporary technology in education be achieved.

Keywords: digital competencies, ICT in education, teacher training, higher education

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Introduction

The objective of educational institutions is to equip children for a life of independence and responsibility. They should impart the knowledge, skills, competencies, and values necessary for students to grow holistically as individuals and to engage actively in the development of society (Globokar, 2021). Digital technology is increasingly influencing many aspects of our lives and changing the way we communicate, learn and work. Consequently, one of the basic requirements of education is to prepare students for active participation in an information society (Hakkarainen et al., 2000). The research available informs us that there is a relationship between teachers' digital competence and their use of information and communication technology (ICT) in practice (European Commission, 2013). For this reason, it is essential

that (future) teachers are competent users of ICT, plan their professional development and actively improve their skills in this area during their studies. In addition, teacher education programmes should focus on developing the skills needed to work successfully in a digital society (Orazbayeva et al., 2024), as appropriate competencies are crucial for the effective introduction of new technologies in education (Hakkarainen et al., 2000).

Digital Competence

Due to the rapid advancement of ICT, individuals need to acquire more sophisticated digital skills that enable reliable and critical use of technology on a daily basis (Juvan et al., 2016). UNESCO (Law et al., 2018, p. 6) defines digital literacy as follows:

Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy.

This competence is crucial for the acquisition of other skills and active participation in society (Ferrari et al., 2014; Kiryakova, 2023), as it includes understanding media, critically evaluating information, and communicating using digital tools (Brečko, 2015). As it facilitates functioning in a variety of contexts, personal development, and independence, it plays an important role in work, learning, and social interaction (Javrh et al., 2018). Moreover, it helps individuals understand how digital media affects their behaviour (Tomczyk & Potyrała, 2021).

Digital Literacy in Education

In order to engage effectively and successfully within society, individuals must be digitally literate, which introduces new challenges for the education of young people. Teachers need new knowledge, skills and relevant digital competencies to effectively implement and integrate digital tools into the learning process (Kiryakova, 2023). In comparison to digital literacy in other professions, digital competence for teachers is characterized by its complexity, as it also demands pedagogical skills that enable the effective integration of technology in educational settings with children and young individuals (European Commission, 2013).

The rapid development of digital technologies, therefore, raises questions about the digital training of future teachers. Educational curricula typically incorporate ICT courses to equip students with basic skills and the confidence required to effectively utilise digital tools (Falloon, 2020). Nevertheless,

this raises the question of whether these courses are sufficient for cultivating the necessary competencies. Future teachers should integrate digital technologies into their pedagogical approaches to accomplish learning objectives and assist students in cultivating necessary digital competencies. These competencies can only be developed through targeted educational activities (Kiryakova, 2023).

Research indicates that teachers often perceive themselves as lacking adequate skills in digital literacy (Garzón-Artacho et al., 2021; Hall et al., 2014). This situation is concerning, especially considering that Juvan et al. (2016, p. 30) emphasize the importance of teachers as influential role models. The extent of teachers' knowledge of and attitudes towards technology significantly influence how students develop their ICT skills and digital competencies. Given that the development of digital competencies is closely associated with how (future) teachers perceive these competencies (Sartor Harada et al., 2022), we focused our research on exploring this issue.

Methodology

Sample

The research was conducted on a convenience sample of 356 students enrolled in elementary education or preschool education study programmes

Table 1 *Structure of the Sample of Students*

		N	%
Gender	Male	31	8.7
	Female	324	91.0
	Other	1	0.3
	Prefer not to disclose	0	0.0
Age	$M = 21.49$, $SD = 1.81$, $MIN = 19.00$, $MAX = 27.00$		
Study programme	Preschool education	129	36.2
	Elementary education	227	63.8
Degree and year of study	1 st degree	302	84.8
	1 st year	79	22.2
	2 nd year	93	26.1
	3 rd year	82	23.0
	4 th year	48	13.5
	2 nd degree	54	15.2
	1 st year	54	15.2
Average grade for the winter semester of the academic year 2023/2024	$M = 8.55$, $SD = 0.82$, $MIN = 5.00$, $MAX = 10.00$		
	Total	356	100.0

at the Faculty of Education, University of Maribor, during the academic year 2023/2024. A more detailed description of the sample is presented in Table 1 below.

In our research, we included students from elementary education (63.8%) and preschool education (36.2%). Further examination reveals that the research included students from first-degree (84.8%) and second-degree (15.2%) programmes. A detailed analysis of the student composition by year of study shows that students from all years participated in the research. It appears that the students participating in the study are, on average, successful in their academic endeavours, as their average grade is 8.55. The average age of the students is 21.49 years, reflecting a relatively young population of participants. Among the participants, the majority were female (91.0%).

Instrument

For research purposes, we developed a questionnaire that included closed-ended and open-ended questions. The questionnaire was divided into several sections, which include the following: a) demographics, b) academic performance, c) participation in training and projects related to digital literacy, d) use of digital technology, and f) digital competence. The most relevant sections for this paper include the demographic questions and those sections that are related to digital competence. The section on digital competencies was based on the Student Digital Competence Scale (SDiCoS) questionnaire, developed by Tzafilkou et al. (2022). It consists of the following six areas: a) search, find, access (five items), b) develop, apply, modify (six items), c) communicate, collaborate, share (three items), d) store, manage, delete (five items), e) evaluate (six items), and f) protect (three items). Students provided their responses on a Likert scale ranging from 1 – strongly disagree to 5 – strongly agree. The section assessing digital competencies demonstrated high overall reliability, with a Cronbach's alpha (α) higher than 0.9. The internal consistency for specific content areas was 0.7 or higher, indicating that the questionnaire is suitable for further data analysis.

Research Design

To obtain data, we created an online questionnaire at the beginning of May 2024. Personal invitations were extended to the students to participate in the research, allowing them to access the questionnaire via a QR code. The questionnaires were completed in the classroom and typically took between five to ten minutes to complete. The procedures followed ethical guidelines, ensuring anonymity and voluntary participation. Participants were also given

the option to withdraw from the study at any time without facing any consequences. The data were collected until the beginning of June 2024.

Data analysis was performed using IBM SPSS 29.0. The data processing involved both descriptive and inferential statistics. Before the analysis, a check for missing values was undertaken. Since the students completed the questionnaire in the classroom, there were a few missing values. However, most students stopped giving answers to questions in the demographics section, so we excluded nine cases from the study.

Since our objective was to compare the level of digital competence between students in preschool education and those in elementary education, we segmented the database. We conducted separate analyses of outliers and normal distribution for each group. Outliers were identified within each group by standardising the scores and checking the standardised scores for absolute values higher than 3.29. After further analysis, we determined that these outliers are not due to errors but accurately reflect the variability within the data. The univariate normal distribution of the items was assessed using the Kolmogorov-Smirnov test, as well as by analysing skewness and kurtosis coefficients. The Kolmogorov-Smirnov test revealed deviations from the normal distribution in all items ($p < 0.05$). The skewness coefficient for preschool education students ranged from -0.86 to 0.40 , and for primary education students from -0.75 to 0.30 . The kurtosis coefficient for preschool education students ranged from -0.71 to 1.26 , and for primary education students, from -0.94 to 0.80 . This also indicates a deviation from the normal distribution.

Given the deviations from normality and the presence of outliers, we used the Mann-Whitney test for subsequent analysis to compare the level of digital competencies, measured on an ordinal scale, between students enrolled in elementary education and preschool education.

At the level of descriptive statistics, the mean (M), standard deviation (SD), minimum (MIN) and maximum (MAX) values were used, as well as coefficients of skewness and kurtosis.

Results

The results are presented in six thematic sections.

Search, Find, Access

The responses reflect students' self-assessed abilities in searching, finding, and accessing information and content with the use of digital tools. Students feel most confident in their ability to search and find groups on specific topics on social media. The ability to consume content on various smart devices

Table 2 Students' Self-Assessments of their Abilities in Searching, Finding, and Accessing Information and Content Using Digital Tools

I can ...	N	M	SD	MIN	MAX	U	p
... search and find groups on a specific topic (e.g., hobby, profession, artist, science, historical event, travel destination) on various social media.	356	4.22	0.69	2.00	5.00	12213.50	0.005
... watch (read, listen, view) content in various formats on various smart devices.	356	4.18	0.60	3.00	5.00	13648.50	0.242
... search and find a specific person on various social networks using various techniques and filters (e.g., various formats of name, photo, email address, school, company, etc.).	356	4.06	0.71	2.00	5.00	12839.50	0.038
... navigate in the real-world using the advanced features of a navigator.	356	4.06	0.72	2.00	5.00	12917.00	0.048
... search and find a specific object or similar objects using various search engines (e.g., Google, Yahoo, Bing) and databases, using appropriate keywords and advanced criteria and filters.	356	3.93	0.78	2.00	5.00	14284.00	0.683

also receives a high rating. Searching for specific people on social networks and navigating in the real world using advanced navigation features are rated equally. While still highly rated, the ability to search and find specific objects or similar objects using various search engines and databases shows the lowest average among the assessed abilities. This may indicate that students find this task slightly more challenging than the others, possibly due to the complexity of effectively using advanced search criteria and filters.

In the section, 'Search, Find, and Access,' we also compared the abilities of elementary and preschool education students. The Mann-Whitney test revealed significant differences in three abilities between the two groups. Elementary education students generally ranked higher in finding people on social media, finding groups on social media, and real-life navigation. However, no significant differences were found regarding their general internet search abilities and ability to view content in various formats on smart devices.

Develop, Apply, Modify

The responses reveal students' self-assessed abilities in developing, applying, and modifying digital content and tools. Converting content from one format to another is the area where students are most confident. Creating events and setting notifications using digital calendars also ranks highly. Creating documents with advanced features such as text, diagrams, tables, and

Table 3 *Students' Self-Assessments of Their Abilities in Developing, Applying, and Modifying Digital Content and Tools*

I can ...	N	M	SD	MIN	MAX	U	p
... convert content from one format to another format.	356	4.05	0.74	2.00	5.00	12856.50	0.039
... create an event and set notifications using a digital calendar (e.g., Google Calendar, Apple Calendar, Microsoft Outlook Calendar).	356	3.99	0.81	2.00	5.00	14535.00	0.904
... create a document with text, diagrams, tables, reports, and advanced formatting.	356	3.96	0.73	2.00	5.00	13554.50	0.212
... apply statistical techniques using appropriate software (e.g., SPSS, R, MS Excel, Google Sheets) to make forecasting or predictions.	356	3.33	0.86	1.00	5.00	13474.50	0.295
... creatively design and/or develop a website using various digital tools (e.g., Wix, WordPress).	356	2.75	1.22	1.00	5.00	12628.00	0.028
... apply Creative Commons licenses to content or software that I have created.	356	2.63	1.06	1.00	5.00	13693.00	0.295

reports follows closely. Applying statistical techniques with the use of appropriate software shows moderate confidence among students. The ability to creatively design and/or develop websites using tools such as Wix or WordPress has a lower average. This indicates that students feel less confident in web design and development, which could be due to the specialised skills required for such tasks. Applying Creative Commons licenses to content or software created by students has the lowest average. This suggests that students are not as familiar with or confident in the legal and procedural aspects of applying licenses to their work, which additionally highlights an area in need of further education or training.

The Mann-Whitney test showed significant differences in two abilities between elementary and preschool education students. Elementary education students generally ranked higher in website design and development and converting content formats. However, no significant differences were found in their abilities to use digital calendars, create documents with advanced formatting, add Creative Commons licenses, or use statistical techniques for predictions.

Communicate, Collaborate, Share

The responses offer insights into students' self-assessed communication, collaboration, and sharing abilities using digital tools. Students feel most confident collaborating with others using various smart devices, platforms, and

Table 4 *Students' Self-Assessments of Their Abilities in Communicating, Collaborating, and Sharing Using Digital Tools*

I can ...	N	M	SD	MIN	MAX	U	p
... collaborate with people using various smart devices, platforms, and digital tools.	356	4.10	0.69	2.00	5.00	12311.50	0.007
... teach an e-course or an e-seminar, give a lecture or make a presentation using various digital tools.	356	3.82	0.81	2.00	5.00	11893.50	0.002
... upload and share software or app that I have developed on various social media.	356	3.74	0.90	1.00	5.00	12697.50	0.028

digital tools. Teaching an e-course or e-seminar, giving lectures, or making presentations using digital tools has a slightly lower average rating. The ability to upload and share software or apps they have developed on various social media platforms has the lowest average rating. This suggests that students feel least confident in this area, possibly due to the technical skills involved in software development and the specific knowledge needed to share such content effectively on social media.

We further compared the abilities to collaborate and share digital content between elementary and preschool education students. The Mann-Whitney test revealed significant differences in all three abilities between the two groups. Elementary education students generally ranked higher in all three abilities.

Store, Manage, Delete

The responses in this section provide insights into students' self-assessed abilities in storing, managing, and deleting digital content. Students feel most confident in copying and saving screenshots from various smart devices. The ability to delete connections or friends on social networks also ranks highly. Students are also confident in their ability to manage downloaded content efficiently. Additionally, students feel confident in organising files on their computers into a hierarchical folder structure. Taking photos or videos and saving them in various formats using smart devices and digital tools has the lowest average rating among the listed tasks. Although still high, this suggests that while students are proficient in this area, it is perceived as slightly more challenging than the other tasks.

We further compared the abilities to store, manage, and delete digital content between elementary and preschool education students. The Mann-Whitney test revealed significant differences in two abilities between the two groups. Elementary education students demonstrated greater pro-

Table 5 *Students' Self-Assessments of Their Abilities in Storing, Managing, and Deleting Digital Content*

I can ...	N	M	SD	MIN	MAX	U	p
... copy and save the screenshot from various smart devices.	356	4.34	0.61	3.00	5.00	13493.50	0.182
... delete some of my connections/friends in various social networks.	356	4.29	0.70	2.00	5.00	14545.00	0.912
... download content and save it directly to the relevant folder.	356	4.16	0.67	2.00	5.00	13155.00	0.084
... organize the files on my computer into a hierarchical folder structure.	356	4.11	0.81	2.00	5.00	11816.00	0.001
... take a photo or a video and save it in various formats (mp4, wmv, avi, qt, gif, jpg, etc.) using various smart devices and digital recording tools.	356	4.08	0.76	2.00	5.00	12378.00	0.010

ficiency in recording and saving photos or videos in various formats, as well as in organising files into a hierarchical system of folders on their computers. However, no significant differences were observed in their abilities to transfer and save content directly to specific folders, take and save screenshots on various smart devices, or remove friends/connections on social media.

Evaluate

The responses in this section reveal students' self-assessed abilities in evaluating digital content and devices. Students feel most confident in evaluating whether an email is spam, adware, phishing, or fraud. Evaluating whether information is a hoax, fake, scam, or fraud also ranks highly, indicating that students are quite confident in their ability to discern the credibility of on-line information. Critiquing objects or smart devices on relevant social media platforms and evaluating objects and smart devices using appropriate quality criteria have the same average rating. Evaluating whether a website is secure and trusted is another area where students feel confident, although slightly less so than in identifying email fraud or evaluating information credibility. Identifying online content's intellectual property rights (IPRs) has the lowest average rating among the tasks listed. Although still moderately confident, students perceive this task as more challenging than others, possibly due to the complexity and specialised knowledge required to understand and identify IPRs.

The Mann-Whitney test revealed significant differences in three abilities between elementary and preschool education students. Elementary education students generally ranked higher in their ability to judge whether an email

Table 6 *Students' Self-Assessments of Their Abilities in Evaluating Digital Content and Devices*

I can ...	N	M	SD	MIN	MAX	U	p
... evaluate whether an email is spam, adware, phishing, or fraud.	356	4.14	0.71	2.00	5.00	12208.50	0.005
... evaluate whether some information is hoax, fake, scam, or fraud.	356	3.91	0.73	2.00	5.00	12912.50	0.047
... evaluate an object and/or a smart device using appropriate quality criteria (e.g., authenticity, utility, easy to use, appearance, functionality, enjoyment).	356	3.84	0.77	2.00	5.00	13011.50	0.063
... critique an object and/or a smart device on relevant social media (e.g., TripAdvisor, YouTube, Amazon).	356	3.84	0.74	2.00	5.00	13293.50	0.121
... evaluate whether a website is secure and trusted.	356	3.81	0.74	2.00	5.00	13637.00	0.247
... identify the intellectual property rights (IPRs) of content that I have found on Internet.	356	3.59	0.83	1.00	5.00	12666.00	0.026

is spam, adware, phishing, or fraud, recognize intellectual property rights of online content, and determine if a piece of information is fake or fraudulent. However, no significant differences were found in their abilities to assess the quality of a product or smart device, critically review items on social media platforms, or evaluate the safety and trustworthiness of websites.

Protect

The responses provide insights into students' self-assessed abilities in protecting their digital identities and devices. Students feel most confident in regularly changing passwords and settings on their smart devices and internet accounts. The ability to protect various smart devices and e-accounts using different passwords and frequently changing them also ranks highly. Students show moderate confidence in their ability to protect themselves and others against identity theft, harassment, bullying, or slander, which has the lowest average rating among the tasks listed. While they feel capable in this area, the lower rating indicates that students perceive this task as more complex and challenging than managing passwords and device settings.

The Mann-Whitney test revealed significant differences in one ability, as elementary education students ranked higher in their ability to protect themselves and others from identity theft, harassment, bullying, or defamation. However, no significant differences were found between elementary and preschool education students in their abilities to regularly change passwords and settings on their smart devices and internet accounts, or to protect var-

Table 7 *Students' Self-Assessments of Their Abilities in Protecting Their Digital Identities and Devices*

I can ...	N	M	SD	MIN	MAX	U	p
... regularly change my passwords and settings of my smart devices and Internet accounts.	356	3.77	0.91	1.00	5.00	14594.50	0.958
... protect various smart devices and e-accounts using different passwords and frequently changing them.	356	3.72	0.91	1.00	5.00	13842.50	0.373
... protect myself and others against identity theft, harassment, bullying, or slander.	356	3.59	0.83	1.00	5.00	12162.50	0.005

ious smart devices and e-accounts with different and frequently changed passwords.

Discussion

Teachers with greater confidence in their digital skills are more motivated to pursue further education and integrate ICT into their teaching practice. Their use of ICT is strongly related to the assessment of their own digital competencies and judgements about the appropriateness of ICT use, making professional development in this area crucial (European Commission, 2013). In order to cultivate independence and confidence among future teachers, they should acquire new skills while they are still engaged in their studies.

Our study shows that students feel most confident in their abilities to search and find groups on social networks, view content on various smart devices, convert content from one format to another, use digital calendars, and collaborate with people with the use of ICT. They also feel confident in their abilities to copy and save screenshots on various smart devices, delete connections on social networks, identify false information and fraud, and protect their devices.

In contrast, students feel less confident in their abilities to find specific objects with the use of advanced search criteria, to design or develop a website and to apply licences to the content they have created. Additionally, they lack confidence in sharing software and applications on social media, taking and saving pictures and videos in various formats, and identifying the intellectual property rights of content they find online. Such uncertainty might be the result of the complexity of these tasks and the lack of technical skills.

One of the fundamental tasks associated with digital literacy is training teachers to fully utilize digital technologies to enhance and improve teaching (Redecker, 2017). Considering the highlighted weaknesses related to the use

of ICT among future teachers, there is no doubt that additional training and education in these areas is necessary, as this will allow them to fully exploit the benefits of modern technology in education.

Furthermore, we find that elementary education students assess themselves as more competent than preschool education students. It is clear from this finding that the quality of education for future preschool teachers needs to be improved, especially because Kontkane et al. (2023) also observe that children are not sufficiently engaged during the preschool years in their acquisition of digital competencies. This fact further emphasises the need to integrate more digital literacy content into preschool education curricula, which is vital for the development of children's digital skills from an early age, as teachers play a crucial role in the successful development of these competencies, as Juvan et al. (2016) confirm.

Teacher education programmes around the world continue to face the challenges of providing future teachers with the necessary skills to effectively integrate digital technologies into their future teaching practice (Instefjord, 2015). Hence, it is imperative that education programmes for future teachers are continuously updated and adapted to current technological trends to prepare them for the challenges of the digital age.

Conclusion

To conclude, the development of digital competencies is critical for ensuring quality in educational endeavours, as only teachers with adequate digital skills are capable of providing effective and high-quality teaching (Trujillo-Torres et al., 2020).

The value of our research lies in identifying digital literacy among future teachers and raising awareness of its importance. The research also bears some limitations, namely that the findings cannot be generalised, as only students of the Faculty of Education at the University of Maribor were included in the study. It should also be borne in mind that the findings are based on the subjective assessments of future teachers, thus not necessarily reflecting the reality of the situation.

In the future, the focus on developing digital competencies should continue through effective strategies that aid individuals in taking advantage of the benefits of digital technology. ICT training should become a mandatory component of all initial teacher education programmes (European Commission, 2013) to ensure that future teachers are adequately prepared to teach and prepare students for life in the digital age.

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Digitalne kompetence bodočih učiteljev

Članek obravnava pomen digitalnih kompetenc bodočih učiteljev, pri čemer poudarja vlogo informacijsko-komunikacijske tehnologije (IKT) v vzgojno-izobraževalnem procesu. Raziskava je bila izvedena na priložnostnem vzorcu 328 študentov Pedagoške fakultete Univerze v Mariboru v študijskem letu 2023/2024. Podatki so bili zbrani s spletnim vprašalnikom. Rezultati raziskave so pokazali, da se študenti najsamozavestnejše počutijo pri osnovnih digitalnih nalogah, kot sta iskanje informacij na družbenih omrežjih in uporaba digitalnih koledarjev. Kljub temu pa so manj samozavestni pri naprednih nalogah, kot sta spletno oblikovanje in uporaba licenc. Ugotavljamo, da se študentje razrednega pouka v primerjavi s študenti predšolske vzgoje počutijo kompetentnejše.

Rezultati raziskave poudarjajo, da so za izboljšanje digitalne pismenosti nujno potrebna dodatna izobraževanja in usposabljanja bodočih učiteljev na vseh stopnjah ter smereh izobraževanja, saj se lahko le tako izkoristijo prednosti sodobne tehnologije v izobraževalnem procesu.

Ključne besede: digitalne kompetence, IKT v izobraževanju, izobraževanje učiteljev, visoko šolstvo