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Digital Competencies in Ukrainian Education of the Future: Teaching and Assessment

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Abstract: The acquirement of digital competencies in the times of global digitalisation of society is an urgent task for the educational system. Being a part of the globalised world Ukraine needs to further improve the learning process based on digital technologies. The aim of the study was to determine the state of digital competencies in Ukrainian education by analysing the learning and assessing the skills of students. Quantitative and qualitative analysis were used in this paper. 120 students from different educational institutions of Ukraine were involved in the study, representing different professional fields. The students were selected based on pre-developed criteria: a student of a higher education institution, a combination of participants from different specialities and different educational levels, and experience in using digital technologies. A random sample was used in the study. Subsequently, it was stratified based on education levels and age groups in order to ensure proportional representation. The results indicated a high level of awareness of the importance of developing digital competencies for professional growth among modern students. The results showed that modern digitalisation processes have become a factor in the introduction and development of innovative teaching methods. For this reason, it is important to introduce methods of individualised learning using adaptive technologies, the use of virtual and augmented reality to improve learning. Such tools as a PC, laptop, smartphone, interactive whiteboards that have become commonplace for Ukrainian students. The conclusions noted that more than half of the respondents stated that their educational institutions created necessary conditions for digital competencies development. Forty-two percent considered that such conditions were not sufficient, which may be due to insufficient funding, lack of developed technical infrastructure. The implications influence the development of curricula in Ukrainian education, prompting the integration of digital competencies as a core component.

Keywords: digital competencies, digital skills, digital technologies, empirical research, learning, students, Ukraine

Introduction

Digital competencies of Ukrainian students are an urgent and important issue in the context of the development of the education of the future. In the era of rapid technological progress and globalisation, digital skills become a key factor for the successful functioning of society. Ukraine, based on its European integration, must meet the challenges of present time by actively introducing digital technologies into the educational process (Gryshkova, 2020). Therefore, this issue is important because digital competencies is a necessary means for students and teachers not only as a learning tool but also as an integral part of personal and professional development. Teaching digital skills will help ensuring the competitiveness of Ukrainian youth in the international labour market, as well as making the educational process more interactive and adaptive to modern requirements.

Ukraine has great potential in the development of digital education, but to do so, its role in shaping the future society needs to be reasonably defined This study is an important contribution to improving educational strategies and shaping the readiness of the educational system for the challenges of the digital age.

Modern researchers have characterised various aspects of digital literacy. Particularly, Tytova and Mereniuk (2022) identified the main components of competencies. The researchers also described the main problems of digital competencies formation through the prism of analysing the educational process that takes place during war. According to Bondarenko (2022) and Wong et al. (2021), modern technologies allow for the implementation of learning that provides flexibility for students and teachers in choosing the time and place for learning. At the same time, teachers have access to a variety of e-

courses and resources for their professional development and skills updating. These changes in education define a new context for learning and require constant adaptation (Slukhenska et al., 2019; Topuzov et al., 2021). Therefore, given the active digitalisation of education, the development of digital competencies is an important area of innovative education of the future.

The study by Almås et al. (2021) determined that digital competencies implies the ability of a person to effectively use various digital technologies in professional activities. The key role in this process is played by the introduction and application of innovative methods and forms of organising the learning space. However, the works of contemporary researchers emphasise that there are various obstacles in Ukraine that limit the full implementation of digital technologies in the educational process. Some of them include limited access to equipment, as many educational institutions may face limited access to modern computers, laptops, and other devices, which limits the use of digital technologies in education (Curry & Docherty, 2017; Rak-Młynarska, 2022; Rani et al., 2022). At the same time, the existence of different approaches and the lack of common standards can complicate the integration of digital technologies into the educational system (Bulakh & Shandruk, 2022; Kharazishvili et al., 2021). This aspect is also highlighted in Bondar et al. (2021) and Haidabrus (2022). Other researchers state that a global problem affecting the effective use of digital technologies is the lack of methodological support (Cavalcanti et al., 2021; Hesse, 2021). At the same time, according to Hillier (2018), the increasing use of digital technologies requires addressing data security issues, especially when it comes to storing and processing the personal information of current students. The results of Gregory et al. (2020) demonstrate that the use of artificial intelligence technologies is an important aspect of innovative educational development. According to the authors, the effective use of AI can solve a number of the above problems.

At the same time, contemporary studies have shown that untimely adaptation of the educational system to the requirements of the digital society can lead to a loss of competitiveness and lagging behind global trends.

Research Problem

Despite numerous studies concerning digital competencies in Ukrainian education, issues such as determining the attitude of Ukrainian students to digital competencies and the level of digital skills remain unresolved. In addition, there is a need for a thorough description of the main conditions for the development of digital competencies in modern Ukrainian education and the identification of other problems on the way to the innovative development of Ukrainian education and the formation of digital literacy of future specialists.

This led to the choice of the research topic, which is an in-depth analysis and identification of the main tools used in modern educational institutions to teach digital competencies based on the analysis of empirical data obtained from questionnaires and interviews. The paper also aimed to characterise the popularity of certain digital tools used in modern Ukrainian educational institutions. In addition, this study also aimed to identify the factors that influenced the effective implementation of digital technologies in the educational process and the formation of digital skills of Ukrainian youth. A separate important issue that requiring detailed analysis was to identify the main aspects of improving the development of digital competencies based on the obtained data.

Research Focus

Based on the analysis of modern works on the issue, digital competencies are the ability of a person to confidently use various digital technologies in professional educational activities (Almås et al.,

2021). According to Khan and Vuopala (2019) and Tsankov and Damyanov (2019), the main components of this competence are the ability to find and process information, skills in analysing and creating multimedia content, technological competence, and the basics of computer skills in the educational process. Therefore, this competence is an important part of the education of the future, i.e., it influences the formation of specialists in various fields of the future. It has been proven that in the future, specialists with extensive knowledge and skills in the use of digital technologies will be in demand in the labour market (Bondar et al., 2020). Accordingly, the main objective of this article is to determine the level of digital skills of teachers and students in Ukrainian educational institutions.

Therefore, the main focus of the paper was to analyse the state of digital competencies in Ukrainian education based on a comparison of qualitative and quantitative data obtained from surveys and interviews.

Research Aim and Research Questions

The purpose of the study was to characterise the state of digital competencies in Ukrainian education based on the analysis of learning and assessment of students' skills. This study was implemented gradually, and the following issues were covered in the process.

1. To determine the attitude of Ukrainian students to digital competencies and the level of digital skills.
2. To analyse of the main tools used to develop digital competencies
3. To characterise of the main conditions for the development of digital competencies in modern Ukrainian education.

Research Methodology

General Background

The study was based on a combination of quantitative and qualitative data. Initially, it was collected using such tools as questionnaires and interviews and then processed through quantitative and qualitative analysis of the received information.

Sample / Participants / Group

The study involved 120 students from different educational institutions in Ukraine. These students represented different professional fields in order to get a more detailed answer about the state of digital competencies of Ukrainian students.

Inclusion criteria.

1. Participants must be students of Ukrainian educational institutions.
2. The combination of participants with different educational levels (bachelor's and master's degrees).
3. Participants with different age ranges were included to cover a comprehensive perspective of digital competencies across different age groups.
4. Participants should have different levels of digital competencies to represent a broad spectrum.

The study used random sampling to create a representative sample. First, a list of potential participants was obtained from the educational institutions and the required number was randomly selected. Subsequently, the sample was stratified based on education levels and age groups to ensure proportional representation (see Table 1).

Table 1

Participant Data

Age of applicants			
17-18 years old	19-20 years	21-22 years old	Over 22 years
12%	43%	19%	26%
Education			
Level: Incomplete basic	Level: Bachelor	Level: Incomplete higher education	Level: Master
None	47%	21%	32%
Gender.			
Male - 39% of respondents		Women - 61% of the population	

Source: Compiled by the authors.

Formal invitations to potential participants were sent via email or institutional channels. All participants were given a brief overview of the study.

Instrument and Procedures

Quantitative information was collected through a survey conducted in October 2023. The survey was designed to include both closed and open-ended questions. Some data related to digital competencies, learning, and assessment preferences were collected on a 5-point scale. The survey consisted of 4 parts. The first part collected demographic information. The second part collected data about the understanding digital competencies in education. This part consists of the following questions:

1. How important do you think it is to develop digital competencies in modern education?
   a) Very important
   b) Important.
   c) I see it as something in between
   d) No matter
   e) It doesn't matter at all
2. How do you rate your digital skills?
   a) High
   b) Medium
   c) Low

The next part “Digital competencies training” consist of the following questions:

3. Where do you mainly learn digital skills: at home, at school, or in courses?
4. What tools for teaching digital competencies are used in modern educational institutions?

a) Computers and laptops
b) Tablets and smartphones
c) Interactive whiteboards
d) Electronic textbooks
e) Internet resources and online platforms
f) Does your educational institution have all the conditions for developing digital competencies?

The last part of survey consisted of one summary question: What measures are effective in improving the development of digital competencies?

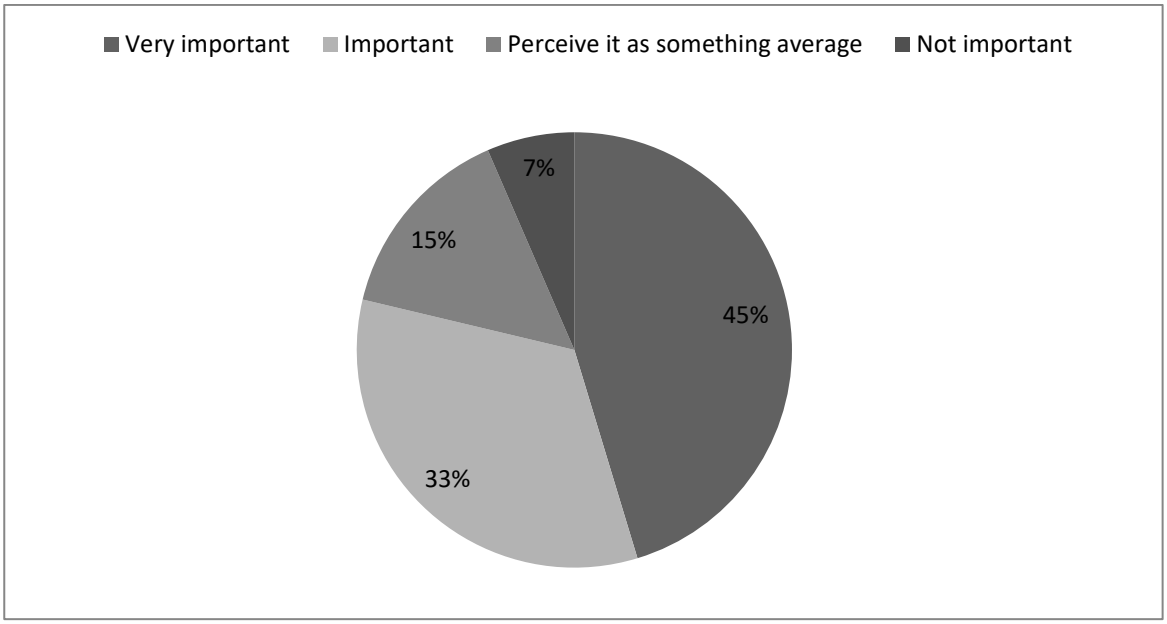
Therefore, the main instrument of this research was a questionnaire. First, demographic data were collected, later the students' attitude to digital technologies and the state of their digital communication were found out.

Research Results

Modern students are clearly aware that the development of digital competencies is important for professional growth. The frequency analysis showed that 49 respondents indicated that this process is very important, 48 respondents - important, 16 students - perceived digital skills as something not clear, only 7 students indicated that they are not important to them. Figure 1 shows a pie chart to assess the importance of digital skills development in %.

Figure 1

Pie Chart of the Importance of Developing Digital Competencies



Source: Data obtained from the survey.

When asked how modern students assess their level of digital literacy, the following data were obtained (see Table 2).

Table 2

Digital Skills Assessment Table

How do you rate your digital skills?		
Level	Number of respondents	%
High	41 respondents	26.4%
Medium	70 respondents	45.2%
Low	9 respondents	5.8%

Source: Survey data.

It has been identified that students can acquire digital skills in different places, such as at home, in an educational institution, or on courses. It depends on the individual student's choices and the availability of resources. Many universities and colleges offer special courses in digital competencies development, graphic design, where students can learn how to use certain digital tools or learn how to work with Adobe editors and other tools (Marner & Örtegren, 2014; Matei, 2022). Adobe also provides online resources and trainings for users of its products, where students can gain practical skills in using Photoshop, Illustrator, and InDesign.

In addition, some educational institutions provide access to computer labs and laboratories where students can use specialised software to develop digital skills. Students can develop digital skills on their own through online platforms such as Coursera, Udemy, or Skillshare, which offer courses in graphic design and Adobe editors. Separately, creating your own projects such as logos, posters, or illustrations can be part of self-study (Anggraini & Handayani, 2022). The theoretical analysis of the obtained data can provide insight into the trends in the use of digital competencies teaching tools in modern educational institutions. These data indicate certain priorities and the popularity of different tools.

Modern educational institutions use various means and tools that influence the development of digital competencies in students (see Table 3).

Table 3

Tools for Teaching Digital Competencies

What tools for teaching digital competencies are used in modern educational institutions?		
Tools	Number of respondents	%
Computers and laptops	117 respondents	97.5%
Tablets and smartphones	99 respondents	82.5%
Interactive whiteboards	56 respondents	46.7%
Electronic textbooks	80 respondents	66.7%
Internet resources and online platforms	105 respondents	86.7%

Source: Survey data.

According to the survey, computers and laptops are the most popular, with 97.5% of respondents using them. The use of tablets and smartphones also plays an important role. At the same time, modern educational institutions place great emphasis on the use of special online learning platforms (see Table 4).

Table 4

Table of Popularity of Digital Tools

Name of the institute	Popularity	Conclusion.
Computers and laptops	According to the analysis, computers and laptops are used in 97.5% of cases. This indicates	Computers and laptops are key tools for teaching digital competencies, integrated into

	their high popularity and widespread use in the educational process.	almost all modern educational institutions.
Tablets and smartphones	The high level of use (82.5%) indicates that tablets and smartphones are important tools for teaching digital competencies.	The increase in usage may be due to the development of mobile technologies and their increased accessibility for students.
Interactive whiteboards	The 46.7% use of interactive whiteboards may indicate that interactive whiteboards, although less popular, are still significant tools for learning. They were mostly appreciated by secondary education students.	Depending on the growing popularity of these devices among students, usage may increase.
Electronic textbooks	According to the analysis, e-textbooks are used in 66.7% of cases, which indicates their importance. However, their importance was assessed mainly by higher education students.	With the availability of electronic textbooks, students can learn the material conveniently and effectively.
Internet resources and online platforms	The high usage rate (86.7%) underlines the importance of access to online resources and online learning platforms.	Given the rapid development of technology, we can expect further growth in the use of online resources.

Source: Survey data.

The findings confirm that computers, laptops, and interactive technologies have already become standard learning tools. At the same time, the importance of mobile devices and online resources cannot be underestimated, and further development of their use in education can be expected.

The acquisition of digital competencies is extremely relevant given the emergence of new opportunities to work with design tools. Graphic design, as a separate component of art education, is developing extremely actively today, as there are a number of serious technological opportunities for this (Machiavelli & Cavalcante, 2022). Among them is the use of software from Adobe (Photoshop, Illustrator, InDesign), which makes it possible to use the potential of information technology in both distance and on-site learning. This allows for a full cycle of training, which gives future specialists the advantage of acquiring the necessary skills to gain further knowledge or a professional career. The gradual integration of artificial intelligence into design education should be emphasised. The use of various programmes (ChatGPT, Midjourney) allows students to get acquainted with the possibilities of the creative digital environment, develop specific skills in video and image processing, and reflect on and reflect on the creative sphere.

To the question “Are there conditions for the development of digital competencies in your educational institution?”. The number of respondents who answered “Yes” was 69 (57.5%), while the number of respondents who answered “No” was 51 (42.5%). Let's calculate the percentage of the data obtained.

Thus, according to the data, more than half of the respondents consider that their educational institution has the necessary conditions for the development of digital competencies. However, 42.5% still believe that such conditions are insufficient. It is worth mentioning that not all Ukrainian educational institutions have a developed technical infrastructure, and there may be problems with access to the Internet. At the same time, insufficient funding for educational institutions is an important problem. This affects the fact that not all educational institutions are equipped with modern digital tools.

For this reason, improving the development of digital competencies for students in Ukraine requires a comprehensive approach and the implementation of various measures in the educational system. Table 5 highlights the main approaches and aspects of this process.

Table 5

Aspects of Improving the Development of Digital Competencies in Future Professionals

Area 1: teacher training	
Professional training of teachers and educators	Providing teachers with basic skills in digital technologies and methods of their use in the educational process (Borysova, 2023; Laufer et al., 2021; Lengetti, 2020).
Systematic trainings and seminars	Regular trainings, scientific and methodological seminars, and conferences for teachers to learn about new digital technologies and their effective use (Bashynska et al., 2021; Passey, 2021).
Area 2: access to hardware and software	
Providing educational institutions with modern equipment	Investing in the technical infrastructure of educational institutions, including computers, laptops, tablets, and other digital devices.
Licensed software	Providing access to licensed software and learning tools, including development and creativity platforms.
Area 3: development of digital learning materials	
Creating digital textbooks and resources	The development of modern digital learning materials that meet the requirements of the modern educational environment and take into account interactivity (Mathew et al., 2021).
Area 4: expanding access to the Internet	
Measures to improve the Internet infrastructure	Developing and implementing strategies to ensure a stable and fast Internet connection in all regions of Ukraine.
Area 5: support for independent learning	
Development of self-learning platforms	Creating and supporting online platforms that allow students to learn digital skills and expand their knowledge independently (Pinheiro & Santos, 2022; van der Merwe & Pedro, 2022).
Area 6: partnership with industry	
Cooperation with IT companies and industry	Developing partnerships between educational institutions and industry to provide students with internship opportunities and real-world experience with digital technologies (Lund & Aagaard, 2020).
Area 7: security and confidentiality measures	

Education on Internet safety	Introducing digital security training that includes aspects of privacy and online security rules (Safonov et al., 2022).

Source: Compiled by the authors.

Thus, the above measures are aimed at expanding the access to digital technologies, improving teacher qualifications, and creating incentives for the development of digital competencies among students in Ukraine.

Discussion

The study concerning the state of digital competencies of Ukrainian students confirmed the conclusions about the importance of its development in the future. In this context, it is worth agreeing with the views of scientists that the development of digital literacy, which includes the professional use of digital electronic sources, is an important task, especially in the context of the Russian-Ukrainian war (Tytova & Mereniuk, 2022). As part of the conclusions of this study, the opinions of domestic researchers on this topic are of great importance Klenin et al. (2020), who determine the importance of information and communication technologies in the system of training specialists of the future. Given the latest results of Stephanidis and Antona (2022), digitalisation will also lead to innovative teaching methods: the introduction of individualised learning methods using adaptive technologies, the use of virtual and augmented reality to improve the learning.

The findings also coincide with the assertion that uneven access to the Internet is an important challenge to the further use of digital technologies, and thus to the formation of digital literacy within an educational institution (Murphy et al., 2022; Rossikhina et al., 2019). Particularly, not all regions of Ukraine have uniform access to fast and stable Internet, which makes it difficult to use online resources and interactive platforms.

At the same time, it should be borne in mind that an important challenge to the development of digital competencies among students may be the qualification of teaching staff. It is worth agreeing with Klenin et al. (2020) and Zdanevych et al. (2020) that not all teachers are ready to use technology. For example, some teachers may lack the skills or confidence to use digital technologies effectively in the classroom. This aspect is also emphasised by other researchers, such as Jena et al. (2021).

In general, each of these domestic researchers, namely, Borysova (2023), Klenin et al. (2020), Rossikhina et al. (2019), Tytova and Mereniuk (2022), and Zdanevych et al. (2020), emphasise the need to develop digital competencies among future professionals.

In addition, these researchers also state that Klenin et al. (2020), Tytova and Mereniuk (2022), Zdanevych et al. (2020), and with overcoming of some obstacles (better training of teaching staff, solving problems with technical support), Ukraine can ensure more effective and innovative use of digital technologies in the education system. At the same time, it should be noted that ensuring more effective and innovative use of technology in the education system requires a comprehensive approach, including technological, organisational, and cultural changes (Safonov et al., 2022).

Thus, in tis context Zdanevych et al. (2020) mention that teachers of new specialities should have a high level of computer literacy in order to effectively transfer relevant knowledge and skills to their students. On the other hand, reservations can be expressed about the thesis of this researcher regarding the implementation of new approaches to teaching and computerisation of educational technologies (Zdanevych et al., 2020). The researcher emphasises the widespread introduction of these technologies. For this reason, it is believed that new approaches can be important, but they need to be implemented

in a pedagogical and balanced way, as disproportionate use of technology can have a negative impact on learning and, consequently, on the outcomes of students.

In this context, the transformation of infrastructure and access to the Internet, the provision of high-speed Internet in all educational institutions, and the expansion of access to digital resources for students and teachers are urgent tasks. The next step may be the wider use of educational platforms and tools. First and foremost, it is about creating and implementing digital learning platforms that will include interactive tools, open courses, and online resources, and providing training for teachers to use new technologies and integrate them into the learning process. This will lead to the wider use of electronic textbooks and resources, the transition from traditional textbooks to electronic formats to reduce costs and ensure the relevance of materials, and the development of open educational resources to support access to innovative and effective education. The last element will be transformations in the assessment system: developing and implementing digital assessment systems that take into account students' competencies and skills, not just knowledge of facts, promoting the use of portfolios and project-based assessment methods. These transformations will take time and effort but will improve the situation in Ukraine's education system in the coming years.

Conclusions and Implications

This study concerned with the state of digital competencies of students has led to the following conclusions.

1. Today's students in Ukraine consider the development of digital competencies important for their professional growth. The data confirm a high level of awareness of the importance of digital skills, with the majority of respondents identifying them as very important or important.
2. With regard to the use of digital technologies in education, the findings show that computers, laptops, and interactive technologies have already become standard tools for learning. At the same time, mobile devices and online resources are also important, and their use may be expected to develop further in education. The importance of acquiring digital competencies is especially relevant in the context of developing design skills using Adobe software. The integration of artificial intelligence into design education is also noted, and the use of various programmes enables students to get acquainted with the technological environment and develop creative skills.
3. Regarding the conditions for the development of digital competencies in educational institutions, it is worth noting that more than half of the respondents considered that such conditions exist in their institution. However, problems with technical infrastructure, Internet access, and limited funding point to the need for additional measures to improve infrastructure and ensure access to digital technologies in all educational institutions.

Suggestions for Future Research

The study was not aimed at a comprehensive study of digital literacy in future professionals, given the limited period of this research. A separate aspect for further study of the topic is the analysis of changes and transformations in the development of digital competencies in students over a longer period of time. For example, future research could focus on a comparative analysis of the data obtained from this study. Such work could provide insight into the long-term impact of digital education on the future learning space.

In addition, a separate important aspect may be the assessment of digital literacy among employees of Ukrainian educational institutions. To this end, a comprehensive and thorough assessment of modern teachers' digital literacy level should be conducted through a questionnaire or survey. In this direction, it is worthwhile determining the effectiveness of teacher training programmes for integrating

digital competencies into their teaching methods and forms. This will make it possible to effectively assess the impact of professional development on teaching practice. Consequently, such a study will demonstrate the state of teachers' digital skills, their attitude to modern digitalisation processes, and will help to understand possible ways to improve digital competencies in general.

The third important area is the comparative analysis of teaching methods and the impact of mobile learning on the development of digital competencies. In this area, it is worth comparing the effectiveness of different teaching methods and assessment strategies in the development of digital competencies. This may include comparing traditional methods with more innovative, technological approaches and forms of delivery. This area will also explore the integration of artificial intelligence tools into educational institutions, especially in the context of digital competencies development. This will allow evaluating and researching the effectiveness of AI-driven educational tools and their impact on student outcomes. In this context, the specific impact of mobile learning on the development of digital competencies can also be explored. This area will help to understand how mobile devices and apps facilitate the learning process and whether they offer unique advantages.

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