THE ROLE OF TECHNOLOGIES IN THE FORMATION OF STUDENTS' DIGITAL COMPETENCE: ADAPTING TO THE REQUIREMENTS OF MODERN SOCIETY

[a]LIUDMYLA OZEROVA, [b]NATALIIA BAZYLIAK,
[c]ANTON SMIRNOV, [d]OLEKSANDRA SHAHOVA,
[e]IEVGENIIA IVANCHENKO

[a]*Pavlo Tychyna Uman State Pedagogical University, Uman, Ukraine.*
[b]*Ivan Boberskyi Lviv State Universiity of Physical Culture, Lviv, Ukraine.*
[c]*Kharkiv National University of Radio Electronics, Kharkiv, Ukraine.*
[d,e]*Odesa Military Academy, Odesa, Ukraine.*

email: [a]*l.a.ozerova@udpu.edu.ua,* [b]*nat.nataly0070@gmail.com,*
[c]*anton.smirnov@nure.ua,* [d]*andra.odessa@gmail.com,*
[e]*jekki251@gmail.com*

Abstract: The formation of digital competence among higher education seekers requires a systematic and in-depth approach. The conceptual approach to this process involves not only teaching specific technical skills but also developing the knowledge and skills necessary for effective adaptation to the digital environment and successful use of digital technologies. Digital transformation influences various aspects of education, including information, library and archival affairs. It is important to understand that this transformation is taking place in the context of the students' general competencies, in particular in the "Information, Library and Archival Science" sector, which is being implemented in Ukraine. This means that the development of digital competence should be integrated into the overall educational process in the specified specialty. The prospects of digitalization of higher education open up new opportunities for the professional development of young professionals. However, in order to achieve these benefits, it is necessary to focus the educational process on developing the ability to critically evaluate the reliability of information from the Internet. This will ensure the lifelong learning experience in today's environment, where access to information is unlimited, but its quality does not always meet the standards of reliability and objectivity.

Keywords: adaptation, development, digitalization, digital competence, education, innovation.

1 Introduction

A review of the contemporary digital landscape and its impact on education reflects significant transformations occurring in the learning process due to the implementation and development of digital technologies. Modern digital technologies such as computers, tablets, smartphones, and software have become essential tools in the educational process. They assist teachers in organizing classes more effectively while enabling students to acquire knowledge and develop skills. Learning has become more accessible and flexible thanks to digital technologies. The availability of instructional resources to students at all times and a location is crucial, especially for those who have restricted access to conventional educational establishments. The introduction of online courses and electronic learning platforms allows students to receive quality education directly over the Internet. This opens up new opportunities for distance learning and self-development. Interactive technologies, video lessons, gamification, and other innovative approaches help engage students in the learning process and increase their motivation to learn. The use of digital technologies in education helps students develop skills that are essential for successful functioning in the digital age, such as information literacy, critical thinking, problem-solving, and communication skills. However, along with the benefits, the use of digital technologies in education also faces challenges such as ensuring accessibility, the digital divide, data privacy, and cyber security. However, the proper use of digital tools can bring significant benefits to education and contribute to the development of modern society. The importance of digital literacy for students' successful adaptation to the demands of contemporary society cannot be overstated. In today's digital world, many jobs require employees to have digital skills. Students possessing digital literacy have an advantage in the job market and can more easily find and retain employment. Digital literacy helps students be more effective in the learning and research process. They can quickly find and analyze information, communicate with peers and instructors as well as create and present their work using digital tools. Digital literacy helps students better understand and perceive societal changes related to rapid technological development. They can critically evaluate new technologies and their impact on society and make informed decisions. Digital literacy opens doors to a wide range of career opportunities in modern society, from software engineering to digital marketing. Students possessing digital skills can choose career paths according to their interests and abilities. Modern society is rapidly changing under the influence of technology. Students with excellent digital literacy skills have better chances of successfully adapting to these changes and remaining competitive in the face of rapid technological development and societal changes.

The purpose of the present academic paper is to study the role of technology in shaping students' digital literacy and their adaptation to the demands of modern society. The research aims to explore the impact of various aspects of technology use on the development of digital literacy, computer skills, internet proficiency, and other digital tools, as well as students' ability to effectively interact in a digital environment.

2 Literature review

The concept of digital competence has gained considerable popularity among academic researchers and policy makers, especially in the context of higher education (Gisbert Cervera et al., 2022). With the widespread use of information and communication technologies (ICTs) in the educational process, digital competence has become a crucial factor for both teachers and students, influencing their academic performance (Godaert et al., 2022). Digital literacy encompasses a broad spectrum of knowledge, skills, and attitudes necessary for effectively utilizing digital technologies in various aspects of life. It plays a vital role in addressing contemporary challenges and issues in an educated society, providing a dynamic and cross-cutting set of skills (Núñez-Canal et al., 2022). In fact, understanding digital technology on a social and emotional level is just as vital as technical skills. According to the OECD project, digital competence involves more than the mere accumulation of knowledge and skills; it implies the ability to respond to complex demands by mobilizing psychosocial resources in a specific context (Gisbert Cervera, & Caena, 2022). Digital literacy encompasses both concrete and essential skills, emphasizing the multifaceted nature of this concept. The integration of technical, cognitive, and ethical aspects highlights the dynamic nature of evolving digital literacy and its wide range of applications in various spheres and areas of life.

2.1 Technologies in Education

Technologies play a crucial role in improving the quality of education and enriching the educational experience in the modern learning process. Technologies make education more accessible to a wide range of people, including those with limited access to traditional learning resources (Santos et al., 2022). Open online courses, webinars, and video lessons make education accessible from anywhere with an internet connection. Technologies enable the creation of interactive learning materials that engage students in their studies. The use of video, audio, animation, and other multimedia elements makes the learning process more interesting and effective. It is possible to create individualized training programs that take into account the needs of each student thanks to technologies. Adaptive learning platforms can analyse students' responses and offer them tasks based on their level of knowledge and needs (Siddiq et al., 2023). The use of modern technologies in education helps students develop key skills for the future, such as digital literacy, critical thinking, collaboration, and problem-solving. The Internet and social networks provide students with the opportunity to communicate and exchange knowledge with colleagues and experts from around the world.

2.2 Interactivity and students' engagement through the use of technologies

Interactivity and students' engagement through using technologies are important aspects of modern education. Online learning platforms often feature interactive elements such as video lessons, quizzes, graphics, and other tools that facilitate active students' participation in learning (Sabadash, & Lysko, 2023). The use of forums, chats, and social networks can stimulate active discussion and exchange of ideas among students. This makes learning more interactive and engaging as well as promotes interaction among students from different cultures and experts from various fields. The application of simulation programs and virtual reality allows students to interact with educational material in a simulated environment. For instance, they can conduct virtual experiments, solve tasks, or even reproduce practical situations. The use of technologies to work collaboratively on projects allows students to interact in real time, sharing ideas, making joint contributions, and solving problems together. This contributes to the development of communicative and collaborative skills. The use of technologies makes it possible to create individualized learning materials catering to each student's needs. Adaptive programs can adjust the material to the knowledge level and interests of each learner, creating individual learning trajectories.

2.3 The use of online resources and electronic platforms for learning and self-development

The use of online resources and electronic platforms for learning and self-development is becoming increasingly widespread in the modern world (Ostanina et al., 2023). Online learning provides access to a variety of materials, courses, and resources anytime and anywhere, making learning more flexible and accessible to a wide range of people. Students can learn at any time and place convenient for them, regardless of geographical location or schedule constraints. This is especially beneficial for those with busy schedules or working full-time. Online resources offer a wide selection of courses, video lectures, interactive assignments, and educational materials from various subjects and fields. Students can select and tailor educational material according to their needs and interests. Online resources foster self-directed learning, allowing students to develop their own

pace and style of learning. They can study material at their own pace, review complex topics, and select tasks that meet their needs (Cabero-Almenara et al., 2023). Many online platforms facilitate interaction and knowledge exchange among students through forums, chats, and collaborative projects. This stimulates active participation and interaction among participants in the learning process.

2.4 The formation of digital competence

Having reviewed the literature on the publication's topic, it is possible to identify the following key components of digital competence (Martzoukou et al., 2022). Technical Skills: these are the knowledge and abilities to work with office equipment, programs, and platforms. These include understanding how to operate computers, mobile devices, operating systems, software for word processing, spread sheets, graphics, and so on.

Information Literacy: this is the ability to effectively search for, evaluate, and use information from the internet and other sources. It involves the capability to analyze the reliability and authority of sources, as well as understanding concepts such as digital security and privacy. Media Literacy: this is the ability to critically evaluate and understand information presented through various media channels, such as websites, social networks, videos, audios, and others.

Communication Skills: these are the abilities to communicate effectively and collaborate through digital means. It includes written and oral communication, collaborative work on projects in online environments, and the ability to engage in dialogue and resolve conflicts in digital communities.
Creativity and Innovation: this is the ability to use digital tools to generate new ideas, products, and solutions. It may involve website development, multimedia presentations, video and audio materials, etc. Digital Ethics and Security: this involves knowledge of the rules for using digital technologies, including principles of digital security, confidentiality, and respect for other users. It also includes understanding the legal aspects of using digital resources and information.
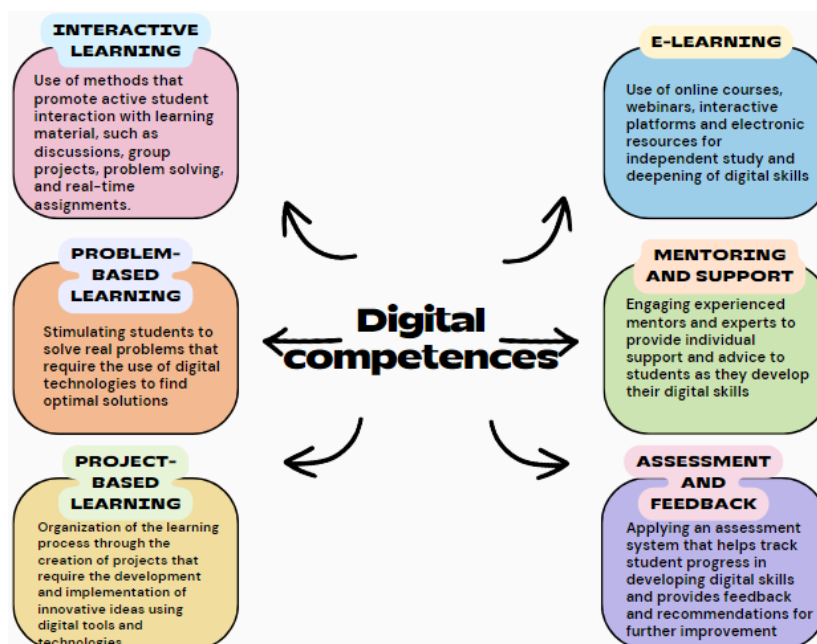

Figure 1. Methods and strategies for developing students' digital skills. Source: Author

The formation of students' digital skills (Figure 1) requires the application of various methods and strategies aimed at developing their digital competence (Budai et al., 2023). These

include: Interactive Learning: using methods that promote active interaction between students and educational materials, such as discussions, group projects, real-time task solving, and

assignments; Problem-Based Learning: stimulating students to solve real-world problems that require the application of digital technologies to find optimal solutions; Project-Based Learning: organizing the learning process through the creation of projects that involve the development and implementation of innovative ideas using digital tools and technologies; E-Learning: utilizing online courses, webinars, interactive platforms, and electronic resources for self-study and deepening of digital skills; Mentoring and Support: involving experienced mentors and experts to provide individual support and guidance to students in developing their digital skills. Assessment and Feedback: implementing an assessment system that facilitates tracking students' progress in developing digital skills, as well as providing feedback and recommendations for further improvement.

2.5 Adaptation to the requirements of modern society

Adapting to the demands of modern society involves various aspects related to the development of digital competence and its application in different life domains (Zhao et al., 2021). The contemporary job market requires workers to possess a certain level of digital competence for a successful career. Understanding and being able to use digital technologies have become necessary skills for most workplaces (de Obesso et al., 2023). In many fields of activity, digital skills are essential for effective work. They are used for various tasks, from organizing workflow to data analysis and managerial decision-making (Gutiérrez-Castillo et al., 2023). The rapid technological changes demand ongoing updating of knowledge and skills from individuals. Learning and self-education become crucial factors for successfully adapting to the digital environment, where new technologies and approaches emerge and evolve rapidly (Markauskaite et al., 2023). These aspects underscore the importance of developing digital competence for successful adaptation to modern demands and challenges in the fields of work and education.

3 Materials and methods

In order to implement the present research, we used a quantitative approach based on the survey methodology. We chose a non-experimental design, which involves selection, observation and collection of information without intervention or modification of variables, in order to address the research questions. We also conducted a descriptive analysis of the data obtained to achieve this goal (Grynova et al., 2023).

The research involved students from several Ukrainian higher educational institutions who were in their third and fourth year of study during the 2019/2020 academic year. A random sampling method was used for the sample, which resulted in 5164 people being included in the research (the margin of error $E = 1,36$, $\alpha = (100 - 95)/100 = 0,05$).

It should be noted that 223 (41%) students were in their first year, and 320 (59%) were in their fourth year. The average age was 20,5 years, and the age distribution ranged from 18 to 22 years. The sample included 44% (n = 240) females and 56% (303) males, most of whom lived in rural areas (61%, n = 333). It is also worth noting that 74% of respondents have already had experience of formal training using ICT and digital technologies, and 100% have participated in online classes.

The sections of the questionnaire included the following paragraphs:

1. Identification data: these include age, gender, year (first or fourth-year student), place of residence, and information about the specialty and the reason for choosing it.
2. Availability of information and communication technology resources: it assesses the availability of Internet connection

and the availability of own equipment and devices to access it.
3. Potential for developing digital competence: it includes frequency of internet connection and purpose of using information and communication technologies.
4. Training related to information and communication technologies and digital technologies: it measures prior training on using such technologies, approaches to improving them, as well as participation in online classes and the level of computer use.
5. Self-perception of digital competence: it includes an assessment of one's own information literacy, communication and collaboration in a digital environment, ability to create digital content, and knowledge of safety and problem-solving.
6. Attitude to information and communication technologies: it evaluates one's own attitude to the use of information and communication technologies.

Statistics data for assessing the level of students' digital competencies included the following parameters:

- Observed Value: these are the actual observed values of the dependent variable Var4 for each student;
- Predicted Value: this is the value of Var4 that the model predicted for each student based on the input data and model parameters;
- Deviation: this is the difference between the actual and predicted Var4 values. It displays how far the actual data differs from the predicted data;
- Standardized Deviation: this is a standardized deviation value that expresses how much the observed value influences the model compared to the expected value;
- Std. Err. Mahalanobis: this is a standard error that takes into account multimodality and correlation between variables.

Cook's Distance: this is a measure of the impact of each observation on the final model. We also performed multivariate cluster analysis in Statistica.

4 Results

The obtained results were focused on the analysis of communication and collaboration of students using digital technologies. Table 1 shows that university students demonstrated a high level of skills in using digital devices and programs to communicate with others (M = 3,00, SD = 0,66). Practically 60% of the students rated their digital engagement as good. Additionally, all students feel confident in collaborating with others online and in developing their digital skills. Regarding the opportunities provided by digital technologies, the majority of students (55,5%) consider them good, while 45% rate them as excellent. Concerning collaboration using digital technologies, most students have noted that they effectively use digital technologies and media for teamwork (100%), processing their activities and projects (82%), as well as for participating in online learning through collaborative environments (100%). Most students also possess in-depth knowledge of the norms of behavior and interaction in the digital environment (M = 3.05, SD = 0.69; M = 3.06, SD = 0.66; M = 3.03, SD = 0.66). Similar results were observed for digital identity management: 96% of students were confident in creating and managing their social media profiles, 83% were able to manage multiple identities in different contexts, and 59% showed good cyber security skills, 12% – good and 23% – excellent. Most students also possess in-depth knowledge of the norms of behavior and interaction in the digital environment (M = 3.05, SD = 0.69; M = 3.06, SD = 0.66; M = 3.03, SD = 0.66). Similar results were observed for digital identity management: 96% of students were confident in creating and managing their social media profiles, 83% were able to manage multiple identities in different contexts, and 59% showed good cyber security skills, 12% – good and 23% – excellent.

Table 1. Results of a survey of students of higher educational institutions on the level of digital competencies

Position	Unsatisfactory	Satisfactory	Good	Excellent	Mean	SD
The ability to connect the device to the Internet	7%	10%	42%	41%	3	0,67
Availability of the Internet in the campus network and personal equipment and devices	0%	0%	55%	45%	2,8	0,72
Quality of the Internet connection	0%	12%	37%	51%	2,71	0,74
Use of ICT tools and connection to the Internet	1%	17%	74%	8%	2,79	0,7
Skills in using information and communication technologies	1%	74%	18%	7%	2,8	0,7
Acquiring digital competencies	0%	1%	83%	17%	2,71	0,73
Approaches to improving digital competence	18%	37%	23%	22%	2,72	0,73
Participation in online classes and level of computer use	0%	0%	0%	100%	3,05	0,69
Information literacy and knowledge	0%	1%	3%	96%	3,06	0,66
Communication and collaboration in the digital environment	0%	0%	0%	100%	3,03	0,66
Digital content creation	1%	1%	82%	16%	2,87	0,72
Possessing knowledge of security and problem-solving skills	6%	59%	12%	23%	2,81	0,73
Assessment of one's own attitude to the use of information and communication technologies	3%	28%	55%	14%	3,09	0,66

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It has been revealed that only 18.4% of students believe that they possess sufficient digital competencies to create multimedia content in various formats, while 73.6% rated their skills as satisfactory. When it comes to using different media and methods to creatively express their ideas, 83% chose the "good" mark, while 1% of students believe they are poor at it. When it comes to creating new creative and relevant content by editing, modifying, improving and combining existing resources, 82% rated themselves as having good proficiency in these skills. The results have also shown that more than half of the students have a good understanding of the basics of intellectual property, legislation and licensing of information and digital content (55%). However, in the programming section, less than half of the students believe they possess a high level of knowledge (18%), and only 7% believe they can modify computer programs, settings, and equipment well if necessary. Figure 2 shows the results of the cluster analysis of university students' level of digital competencies. We can distinguish the following clusters from Figure 2.

Table 2. Results of statistical assessment of the level of university students' digital competencies

	Observed	Predicted	Deviation	Standard	Mahala Nobis	Cook &маро́с
1	0,405	0,405	0,000	-0,028	1,303	0,000
2	0,448	0,448	0,000	0,092	0,820	0,000
3	0,508	0,508	0,000	0,265	0,328	0,000
4	0,083	0,083	0,000	-0,942	1,517	0,000
5	0,068	0,068	0,000	-0,984	6,827	0,000
6	0,166	0,166	0,000	-0,707	2,396	0,000
7	0,225	0,225	0,000	-0,540	8,893	0,000
8	1,000	1,000	0,000	1,660	2,801	0,000
9	0,958	0,958	0,000	1,540	2,410	0,000
10	1,000	1,000	0,000	1,660	2,801	0,000
11	0,164	0,164	0,000	-0,712	2,270	0,000
12	0,227	0,227	0,000	-0,535	2,978	0,000
13	0,144	0,144	0,000	-0,770	0,656	0,000
Minimum	0,068	0,068	0,000	-0,984	0,328	0,000
Maximum	1,000	1,000	0,000	1,660	8,893	0,000
Mean	0,415	0,415	0,000	0,000	2,769	0,000
Median	0,227	0,227	0,000	-0,535	2,396	0,000

Summarizing this information, we can draw the following conclusions about the level of digital skills in each cluster:

I cluster: Students in this cluster possess a high level of proficiency in basic digital skills, such as participation in online classes and computer skills, and also possess information literacy and knowledge.

Cluster II: This cluster reflects students who possess an average level of technical skills, such as Internet connection and quality, as well as the availability of Internet on campus networks and personal equipment and devices.

Cluster III: Participants in this cluster demonstrate a high level of proficiency in various aspects of digital skills, such as using information and communication technologies, acquiring digital competencies, creating digital content, and assessing their own attitudes towards the use of information and communication technologies.

Cluster IV: Students in this cluster possess a variety of digital skills, including the ability to use information and communication technologies, knowledge of cyber security and problem-solving skills, and the ability to increase their level of digital competence.

Thus, a low cluster number reflects a higher level of digital skills, while a high cluster number indicates less developed skills in this area.
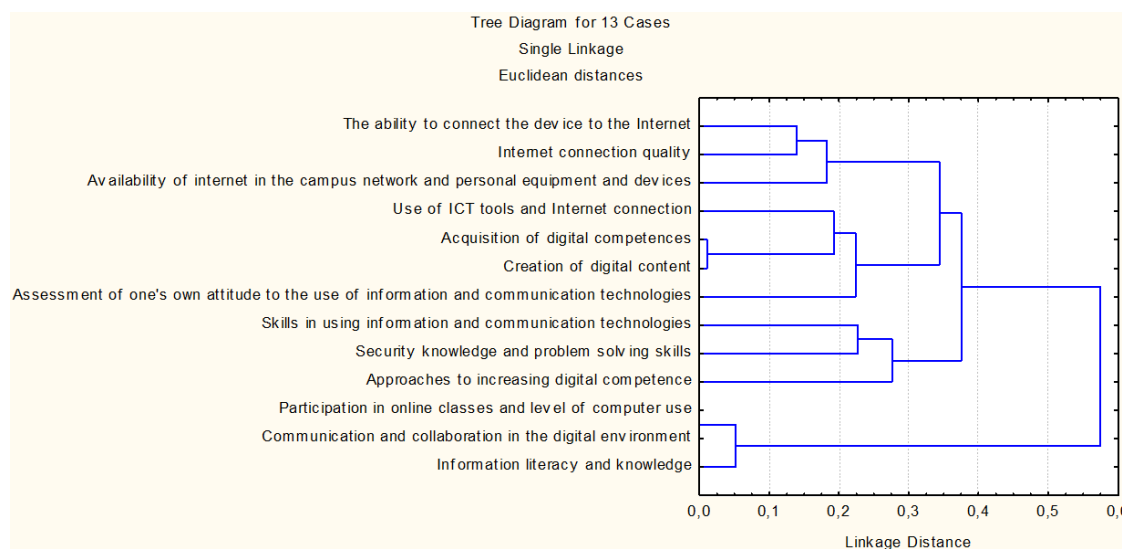

Figure 2. Dendrogram of students' digital skills assessment based on the results of multifactorial cluster analysis

5 Discussion

The role of technologies in the formation of students' digital competence and their adaptation to the requirements of modern society reflects the importance of integrating digital skills into the learning process and their impact on further academic and professional success (Ikramovich, 2023). Technologies are becoming an essential part of the modern educational environment. They allow students not only to consume information but also to actively create, communicate, and develop new ideas. The integration of technologies into the educational process creates unique opportunities for developing digital literacy, adapting students to the requirements of modern society. The role of the teacher in developing digital competence is crucial (Martzoukou et al., 2024). They should teach students how to use technology, as well as stimulate their critical thinking, effective communication, and problem-solving. Teachers are also responsible for creating a learning environment that promotes the use of technology and the development of digital skills. Rapid technological changes require students to be flexible and ready for lifelong learning. The formation of digital competence should be aimed at acquiring specific skills as well as at developing the skills to adapt to new technologies and situations. These include, for instance, opportunities to develop individualized learning and access to knowledge and challenge to ensure equal access to technology for all students (McGarr, 2023). An important part of the process of developing digital competence is collaboration and exchange of experience between students. The use of collaborative learning and joint problem-solving helps to create a student community that supports and promotes mutual learning. Various studies have examined the acquisition of digital competencies, teachers' perceptions of digital competencies, and the interconnection between different dimensions (Castaño Muñoz et al., 2023). This scientific article examines the level of digital competence of university students based on a case study. Overall, most students perceived their level of digital competence as positive. It was also observed that students demonstrated digital competence in several areas such as information and data literacy, communication and collaboration. Therefore, many students need to improve their level of competence in digital content creation and programming, as well as some of their problem-solving skills when faced with technical challenges and understanding technological trends. The obtained findings were similar to the studies conducted by other authors (Ahmed, 2023). In addition, students demonstrated their positive perceptions in the security section of digital competence, which showed results opposite to those obtained by the scholar (McGarr, 2023). In general, the level of digital competence of university students still has potential for further development. There are several studies that have examined the impact of methodological approaches on digital competence, indicating significant differences (McGarr, 2023). Therefore, due to the small age range of the university students who were the subject of the present academic paper, we examined the differences in perceptions of digital competence between third and fourth-year students. Given that the results are similar to those reported regarding age differences, it remains to be determined whether the cause of this variation is their age or the strategy of school education.

6 Conclusion

In the present research, we have explored the role of technologies in shaping students' digital competence and their adaptation to the requirements of modern society. Based on the processing of statistical data, it was revealed that the use of technologies, such as computers, the Internet, software and other digital tools, has a significant impact on the development of students' digital literacy. Participation in online classes,

information technology skills, digital content creation, and other aspects showed a positive impact on the level of digital competence. The research also showed that students with advanced digital skills are more successful in adapting to the demands of modern society. They have more opportunities for effective communication, learning, and work. The obtained results emphasize the importance of introducing digital technologies into the educational process and supporting students in developing their digital skills. In general, our research shows that technologies play a crucial role in forming students' digital competence and their successful adaptation to the modern digital environment.

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