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Research paper

Optimization of The Educational Environment Using Digital Tools and Technologies

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Abstract

The purpose of the study is to evaluate the effectiveness of using digital tools and technologies in the educational process to optimise learning. The methodology includes an experiment with 200 students who were divided into control and experimental groups. The experiment consists of three stages: collecting data from participants for the experiment, using digital technologies by the experimental group, and re-evaluating learning success by comparing the academic results of both groups. The technologies are adapted by integrating with curricula, personalising content, using analytics to monitor progress, providing flexible learning formats, and implementing student feedback. The control group used traditional teaching methods, while the experimental group used modern digital tools. The experimental study found that the use of digital technologies in the learning process contributes to improving academic performance and student engagement. After one semester of study, the average score of students in the experimental group increased from 75.3 to 89.7, while in the control group it increased only from 74.5 to 84.1. Attendance in the digital group increased from 88 to 92 academic hours, and the number of active responses increased from 17 to 25. Participation in group projects increased by 20%, and the frequency of participation in tests increased by 25% compared to the control group. The analysis of the obtained data confirms that the integration of modern digital tools into the educational process not only increases the efficiency of mastering the material but also reduces the time spent on learning compared to the old methods.

Keywords: *Adaptation of Educational Applicants; Assessment System; Educational Platforms; Learning Process; Motivation.*

1. Introduction

Digital technologies began to develop actively with the advent of computers in educational institutions and the introduction of the Internet. Among the main tools used in education are learning management software, electronic libraries, interactive educational platforms, video conferencing services, and online tests. Digital technologies and tools contribute to interactivity and student engagement in the learning process. Adaptation of digital technologies in the educational space is an important task for modern educational institutions. This includes providing technical infrastructure, access to the Internet and computer equipment, and training teachers to effectively use new learning tools. This involves not only learning how to work with technologies but also adapting curricula and programmes to consider the capabilities of digital tools. A key aspect of adaptation is to create an interactive and personalised learning environment that considers the individual needs of students. The use of data analytics allows teachers to monitor students' progress, identify their strengths and weaknesses, and adjust the learning process in accordance with the results obtained. The introduction of digital technologies in education opens up new horizons for the development of the educational process, increases its effectiveness, and provides a more flexible approach to learning.
Continuous development and research of digital technologies are necessary to optimise the educational environment, as they allow for improving educational methods and increasing their effectiveness. Due to new technologies, learning becomes more interactive, which contributes to the active involvement of students and increases their motivation (Susanti et al. 2025). Examining the impact of digital tools (video and multimedia tools, interactive collaboration platforms, assessment and testing platforms, self-learning platforms, etc.) on the learning process helps to identify the most effective approaches to learning and provide personalised solutions that meet the individual needs of students. In addition, such analysis allows identifying barriers to the introduction of new technologies and developing strategies to overcome them, which contributes to ensuring equal access to education for all students.
Various researchers have investigated the development of digital tools in the educational process and methods of integrating technologies into teaching, particularly the paper of Hogan et al. (2022) dealt with the introduction of technology in classrooms and the impact of these changes on traditional teaching methods. The author determined that the integration of these resources substantially increases the level of

motivation of students and contributes to more active involvement in the learning process. Wang & Li (2023) investigated the use of digital platforms for distance learning and proposed a five-step online learning model that helps optimise the educational environment by gradually adapting students to the use of digital technologies.

Anamova et al. (2020) focus on cloud technologies and their role in the educational environment. These researchers established that using cloud services not only simplifies access to information but also promotes better organisation of educational materials and collaboration between students. Lin & Yu (2023) assessed the concept of Technological Pedagogical Content Knowledge, which describes the integration of technology with educational processes through the interaction between pedagogical knowledge and content knowledge.

Slavko et al. (2022) investigated how digital tools can affect the quality of teaching and learning. In addition, they noted that technology alone does not guarantee an improvement in the educational process. It is important that their use is strategically justified and meets pedagogical goals. They emphasised that digital tools should not only be implemented but also effectively integrated into teaching, providing improved teacher-student interaction. This contributes to better communication, access to learning resources, a personalised approach to learning, and the ability to actively engage students in the learning process, as noted by Suhaimi et al. (2024). The study determined that multimedia tools (video and interactive simulations) can greatly facilitate the process of understanding complex concepts and subjects, especially in the natural sciences. Due to multimedia content, students get the opportunity to better visualise abstract ideas and experiment with material in a virtual environment, which contributes to a deeper understanding and assimilation of information (Shults & Annenkov 2023; Mariukhnich & Mokliak 2024). Tekesbaeva et al. (2023) emphasised the importance of actively engaging students through interactive elements, which makes learning more dynamic and effective.

One of the aspects of the study by Kulkarni & Harne (2024) was the examination of the impact of educational technology, demonstrating that technology can contribute to higher achievements, but only if it is used in appropriate pedagogical strategies. Questions about the role of social networks in learning were considered by Wang & Sheng (2023). Their study showed that the integration of social platforms into the learning process helps to increase student activity and develop collaboration skills, which in turn has a positive impact on overall learning outcomes. Despite a vast amount of research, the problem of the long-term impact of digital technologies on the development of critical thinking remains insufficiently investigated. It is necessary to analyse exactly how digital tools can contribute to improving the level of social interaction in study groups.

The study aimed to determine the effectiveness of implementing digital technologies in the educational process to optimise the educational environment. The objectives of the study were:

1. Analyse existing digital tools and their impact on the quality of training.
2. Conduct an experimental study to assess the effectiveness of using digital technologies in comparison with traditional methods.
3. Based on the conducted research, determine the advantages of using digital technologies.

2. Materials and methods

Firstly, a theoretical analysis of modern digital technologies and tools in modern circumstances, conditions for their optimisation and impact on the quality of training is conducted. Further, this study used an experiment that helped to examine the experience of using digital tools and technologies in the educational environment to improve the effectiveness of learning and reduce the time required to achieve educational goals. The experiment was conducted with the participation of 200 students, including 100 men and 100 women. The average age of participants was 20 years. The participants were students of various specialities: psychology, economics, and architecture in four universities of Ukraine, which included the National University of Kyiv-Mohyla Academy, Lviv Polytechnic National University, Chernihiv Polytechnic National University, and Dragomanov Ukrainian State University, as well as in institutions of higher education in Kyrgyzstan: I.K. Akhunbaev Kyrgyz State Medical Academy and Osh State University.

The study involved 200 students, who were divided into two groups: control and experimental. In the initial stage, the academic achievements of all participants before the introduction of new digital technologies were collected. The average score of the control group for 1 semester before the start of the study was 74.5 out of 100 possible, and the experimental group – 75.3 (Fig. 1).

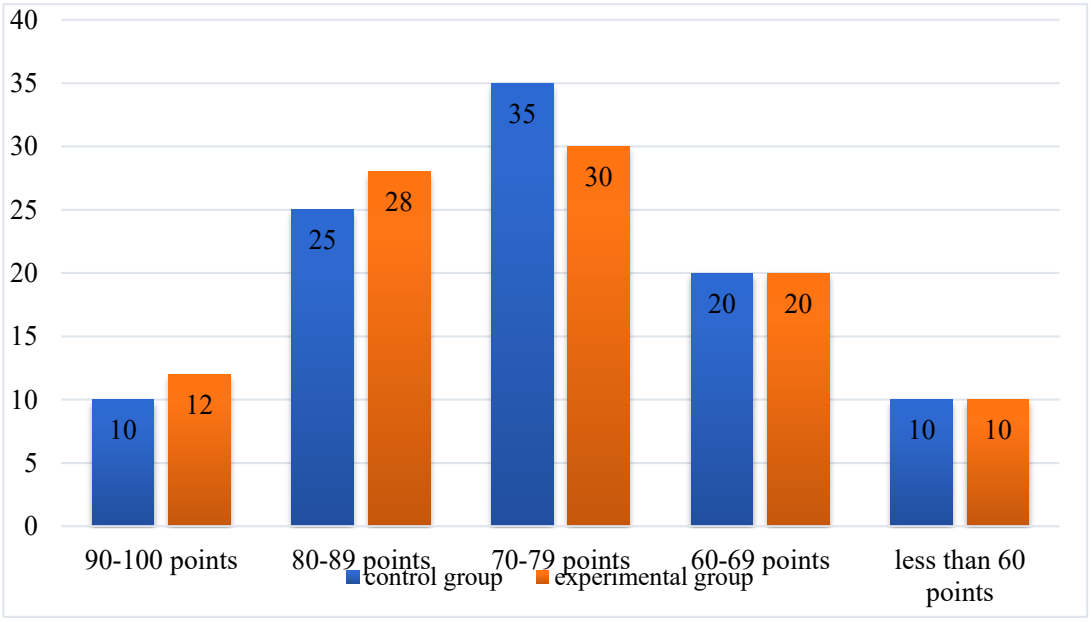

Fig. 1: Distribution of the number of students in both groups by the average score calculated at the beginning of the experiment

Source: compiled by the authors.

The average number of visits (academic hours) to classes (per semester) in the control group was 85 visits out of 100 possible. This indicates a stable attendance, but there are a certain number of classes skipped that can affect overall academic performance. The average number of active answers or questions during classes for the entire group was 15 times per semester. This indicates a relatively moderate level of activity in the learning process, which may indicate a passive perception of information and less interest in discussions. As for the experimental group, the average number of class visits was 88 academic hours. Attendance is slightly higher compared to the control group, which may indicate a greater responsibility of students in this group. The average number of active answers or questions during classes was 17. Although the difference is small, it indicates a greater interest and activity of students in the educational process. These data will be compared in the future with the results after the introduction of new technologies in the educational process to assess whether the technologies have affected the improvement of academic performance and student activity.

Active answers referred to any verbal or written student contributions during classes, such as responses to questions, participation in discussions, or engagement in group tasks. Before the experiment, these were recorded manually by instructors during traditional sessions and averaged per student over the semester. During the experimental phase, activity was tracked both through live observation in online classes (e.g., via Zoom) and through digital logs on platforms like Moodle and Google Classroom. This ensured consistent data collection across both formats for accurate comparison.

The experiment consisted of three stages. In the initial stage, participants were divided into two groups: control (100 participants) and experimental (100 participants). Further, data from study participants on their academic performance (average scores), learning activity (number of class visits, participation in discussions), and the use of new technologies were collected. This was followed by an assessment of the current use of digital tools in teaching, including a survey of students about their experience and satisfaction.

During the main stage, in the experimental group, traditional methods were not entirely excluded but were rather supplemented and transformed through digital integration. Participants primarily relied on digital platforms such as Moodle and Google Classroom to access study materials, submit assignments, and receive feedback, which replaced the regular use of printed textbooks. However, core educational content was still based on the university syllabi and included textbook-based readings, albeit in digitized form. Offline classes were largely replaced with online lectures and seminars conducted via video conferencing tools like Zoom and Microsoft Teams, which enabled synchronous communication with instructors. These virtual sessions preserved many features of traditional in-person teaching, including real-time explanations, discussions, and opportunities for students to ask questions. Instructors also maintained a consultative role through scheduled online consultations, where students could clarify complex topics or receive individual support. Thus, while the experimental group operated within a predominantly digital environment, the pedagogical structure retained certain traditional components adapted to the online format.

The final stage included re-evaluating the effectiveness of training by comparing the results of both groups before and after the introduction of new technologies for the same indicators. It was important to determine whether there was a substantial increase in results in the experimental group compared to the control group. A general assessment of digital tools and technologies was conducted according to several criteria:

- academic performance, which determined the change in the level of knowledge of students before and after the introduction of tools, as well as their ability to apply the acquired knowledge in practice;
- time for mastering the material, which measured the time required to complete training modules, compared to traditional methods;
- participants' satisfaction with the use of digital technologies, their impact on motivation, and interest in learning;
- accessibility, which determined the ease of access to tools and resources, as well as their integration into the educational process;
- interactivity, which analysed the possibility of interaction of students with the material, colleagues, and teachers;
- adaptability, which revealed the ability of tools to adapt to students' individual needs, including different learning styles.

The above criteria allowed comprehensively assessing the impact of digital tools on the educational process and identifying the most effective solutions for optimising the educational environment. The study allowed determining barriers to the introduction of new technologies and developing strategies to overcome them, which contributes to ensuring equal access to education for all students.

3. Results

3.1 Theoretical aspects of digital technologies in the educational process

The emergence of digital technologies in Ukraine had its own characteristics, as the country was at the stage of economic and social transition, which affected the pace and scale of digital infrastructure development. However, with the development of the IT sector, Ukraine was able to create the basis for the introduction of digital technologies in various industries, including education. The introduction of technologies in the educational process not only simplifies the process of knowledge transfer but also promotes deeper assimilation of the material, developing critical thinking, creativity, and digital literacy. Kyrgyzstan, like Ukraine, is on the path of digital transformation. In recent years, the country has been actively working on the development of digital infrastructure, paying considerable attention to the introduction of technologies in education. Electronic textbooks, distance learning platforms, and initiatives to improve digital literacy among students and teachers are being introduced in schools. Such projects encourage the development of digital skills, which are becoming critical for success in the modern world. Table 1 shows the most popular and convenient digital tools and their impact on the quality of training.

Despite the clear advantages of digital technologies in the educational process, their widespread implementation in Kyrgyzstan is accompanied by several complications caused by both infrastructural and social factors. One of the key problems remains uneven access to the internet, especially in rural areas, where many schools do not have a stable connection or the appropriate technical equipment. This complicates not only the use of video conferencing platforms (Zoom, Microsoft Teams), but also basic work with cloud services for sharing educational materials, such as Google Drive or Dropbox. Even with national initiatives to boost digital literacy, a lot of teachers, especially in rural areas, are having a hard time adapting to digital teaching methods because they don't have much experience or access to professional support. In addition, insufficient technical support and limited funding for educational institutions reduce the effectiveness of integrating new digital tools. These factors can reduce the motivation of both teachers and students, exacerbating educational inequality. As a result, although digital technologies open new opportunities for the educational environment in Kyrgyzstan, their effective implementation requires a comprehensive approach that includes not only technical support but also human resource development, digital infrastructure development, and ensuring sustainable access to resources for all participants in the educational process (Bilyk et al. 2024).

One of the key factors that substantially accelerated the introduction of digital tools in the educational process was COVID-19. In 2020, the pandemic forced educational institutions around the world to quickly switch to distance learning. There has also been a dramatic

transformation in Ukraine, with most schools and universities starting to work online. This required educational institutions to quickly adapt and use various digital platforms and technologies to ensure the educational process. One of the most popular platforms for distance learning in Ukraine was Zoom, which provided an opportunity to conduct online lectures and seminars in real-time (Plakhotnyk & Burian 2024; Danylevskyi 2024). According to the study by Slavko et al. (2022), up to 75% of Ukrainian schools and universities used Zoom during quarantine to ensure the educational process. In addition to Zoom, other digital platforms and tools were also widely used. Google Classroom and Microsoft Teams were actively used to organise distance learning. These platforms help to host video classes, organise educational materials, conduct tests, and maintain constant communication between teachers and students. According to the above-mentioned experts, about 60% of educational institutions in Ukraine used Google Classroom during the pandemic. The pandemic has reinforced the importance of using interactive tools to ensure active student interaction. One of these tools is Kahoot! platform, which allows creating interactive tests and quizzes. About 40% of teachers used Kahoot! to involve students in the educational process during distance learning. Other interactive platforms, such as Quizizz, Mentimeter, and Nearpod, also helped create a dynamic and engaging atmosphere during classes.

Table 1: Characteristics of well-known and common digital tools

Digital tools	Examples	Impact on quality		
		Organisation and accessibility	Feedback	Adaptability
Learning management systems	Moodle, Google Classroom, Blackboard, Canvas, etc.	They allow storing all the study materials in one place, making them available to students at any time. This greatly simplifies the process of preparing for classes and exams	The ability to easily evaluate students' work and provide detailed comments, which contributes to an individualised approach to each student	They allow creating adaptive courses that can be adjusted to the individual needs of students, which increases motivation and engagement
		Visualisation of the material	Increased interest	Distance learning
Video and multimedia tools	Youtube, Vimeo, etc.	The ability to stop and review the material several times allows students to better assimilate the information	They make learning more interactive and interesting, increasing the level of students' involvement in the learning process	Students can participate in classes from anywhere in the world
		Collaboration	Instant feedback	Developing digital skills
Interactive collaboration platforms	Google Docs, Microsoft OneDrive, Trello, etc.	Make it easy to create joint documents and projects	Teachers can monitor students' work processes in real-time by providing recommendations	Using such tools teaches students modern project management techniques
		Evaluation speed	Motivation	Progress analysis
Evaluation and testing tools	Kahoot! Quizlet, Google Forms, etc.	They allow teachers to quickly obtain test results, which saves time and helps them to plan the learning process more flexibly	Encourage students to take an active part in lessons and increase their motivation to learn	Easy tracking of the students' progress, which identifies problems promptly
		Access to world knowledge	Learning flexibility	Personalised approach
Independent learning platforms	Coursera, edX, Udemy, Duolingo, etc.	Through self-learning platforms, students gain access to courses from leading universities and experts from around the world	Students can choose the pace of learning according to their capabilities, which contributes to a deeper assimilation of the material	Platforms allow the creation of individual educational routes, which increases the effectiveness of training
		Personalisation	Increases efficiency	Automating routine tasks
Artificial intelligence and adaptive learning systems	Dreambox, Smart Sparrow	They can provide each student with individual tasks and resources	They help identify gaps in students' knowledge	Automate evaluation, which frees up more time for creative and analytical work

Source: compiled by the authors based on data of Xavier et al. (2019), Zhou et al. (2023), and Sorokolit et al. (2024).

Another impetus for the mass introduction of digital technologies was the beginning of a full-scale war in Ukraine in 2022 (Savytska et al. 2023). The war made substantial adjustments to the educational process, forcing many students and teachers to look for new ways to continue their studies in conditions of constant restrictions and danger (Bezshyyko et al. 2008; Diachuk 2024). The use of digital tools has become vital as many educational institutions have been forced to evacuate or operate remotely. Online platforms have become the main means of supporting the educational process (Malik 2024). According to UNICEF Ukraine, up to 80% of students and 99.8% of higher education institutions switched to distance learning during the war, thus forcing teachers and students to adapt to new conditions, when flexible forms of education and the ability to work regardless of physical location came to the fore (Analytical note on... 2023). Digital platforms allowed continuing the educational process even in those regions where security was threatened due to military operations (Spytska 2024; Vishnikina et al. 2024). This contributed to further optimisation of the educational environment using digital tools.

The COVID-19 pandemic has substantially affected the introduction of digital tools in Kyrgyzstan's educational process (Dashko 2023). During the quarantine, the government of the country took several measures to ensure the continuity of education. Trainings were conducted for more than 18,000 teachers of secondary schools, TV lessons and educational materials were prepared, and educational platforms were developed (UNESCO, 2021). The government, together with private companies, ensured discounts on mobile communications and provided low-income families with televisions and mobile phones. The Ministry of Education organised a national competition "Digital Pedagogy" to motivate teachers, the winners of which received prizes and certificates. Rural school teachers have difficulty using internet communication tools such as Skype, Zoom, and Microsoft Teams, as well as web applications for sharing and storing digital content such as Dropbox and Google Drive.

An important point was the introduction of technologies that provided flexibility and accessibility of training for all students. One of these technologies is mobile learning applications, which allow students to access materials even in conditions where they do not have constant access to a computer or the Internet. Apps like Duolingo, Coursera, etc. have become popular with students. In addition, the use of cloud technologies for storing and sharing educational materials is growing. Google Drive, Dropbox, and other cloud services have become an integral part of the educational process, ensuring the safety of data and the ability to access it at any time. Higher education institutions actively use cloud technologies to organise distance learning and exchange materials (Pavlova et al. 2024; Porkodi & Raman 2025). Many educational institutions that actively use cloud technologies to organise distance learning and exchange materials have been identified. These technologies ensure the availability of educational materials, make the learning process flexible, and improve the quality of education (Wezom 2024).

Currently, the most common digital tools used by educational applicants are Zoom, Google Classroom, Microsoft Teams, Kahoot, and various mobile applications for self-study. According to statistics, Zoom is used in 75% of cases, Google Classroom – in 60%, Microsoft Teams – 55%, and Kahoot – 40%. Mobile apps like Duolingo and Coursera have an approximately 50% usage rate among students (Thongkoo et al. 2020; Melnykov 2023).

Digital technologies have become an indispensable element of modern education. They not only help optimise the learning process but also ensure the continuity of education even in extreme conditions, such as a pandemic or war. Digital tools allow creating a flexible, adaptive, and inclusive educational environment that considers the needs of each student and teacher. However, despite the rapid development of digital technologies, there are still several challenges that require further research and solutions. It is necessary to continue working to ensure equal access to digital resources for all participants in the educational process, especially for those who are in conditions of limited access to the internet or computer equipment. It is important to improve the methods of integrating digital tools with curricula so that the results of integration not only complement traditional methods but also become an integral part of the educational process. Overall, digital technologies are a powerful tool for optimising the educational environment, and their use continues to grow. The importance of this area is confirmed by the fact that even in extreme conditions, digital solutions provide an opportunity to maintain a high-quality educational process and achieve high results in training.

3.2 Empirical examination of the effectiveness of using digital technologies in the educational process

The main stage of the study lasted one academic semester in higher education institutions, which allowed for evaluating the effectiveness of each of the methods and tools used in both groups. The control group used traditional teaching tools and technologies, such as textbooks, offline lectures and seminars, and text editors to write term papers. Students received study materials in printed form, participated in classes in a classical classroom, and wrote papers using text editing programmes such as Microsoft Word. The experimental group, on the contrary, used modern digital technologies. They worked with online learning platforms such as Moodle and Google Classroom, which allowed them to organise distance learning, submit assignments, and receive feedback. Interactive tools were also used Kahoot! and Quizizz, which were used for real-time quizzes and tests. In addition, students of the experimental group used Zoom and Microsoft Teams video conferencing services to conduct lectures and seminars in a remote format. Resources such as Canva and Prezi were used to create training materials, which allowed for the preparation of presentations and other materials in a convenient and visual form.

The final stage of the study was the re-evaluation of the training effectiveness, where the results of both groups were compared before and after the introduction of new technologies for the same indicators. The main task was to determine whether there was a substantial increase in academic performance in the experimental group that used modern digital tools, compared with the control group that was trained using traditional methods. The participants' achievements after the introduction of new digital technologies showed that the average score of the control group was 84.1 out of 100 possible, and the experimental group – 89.7 (Fig. 2).

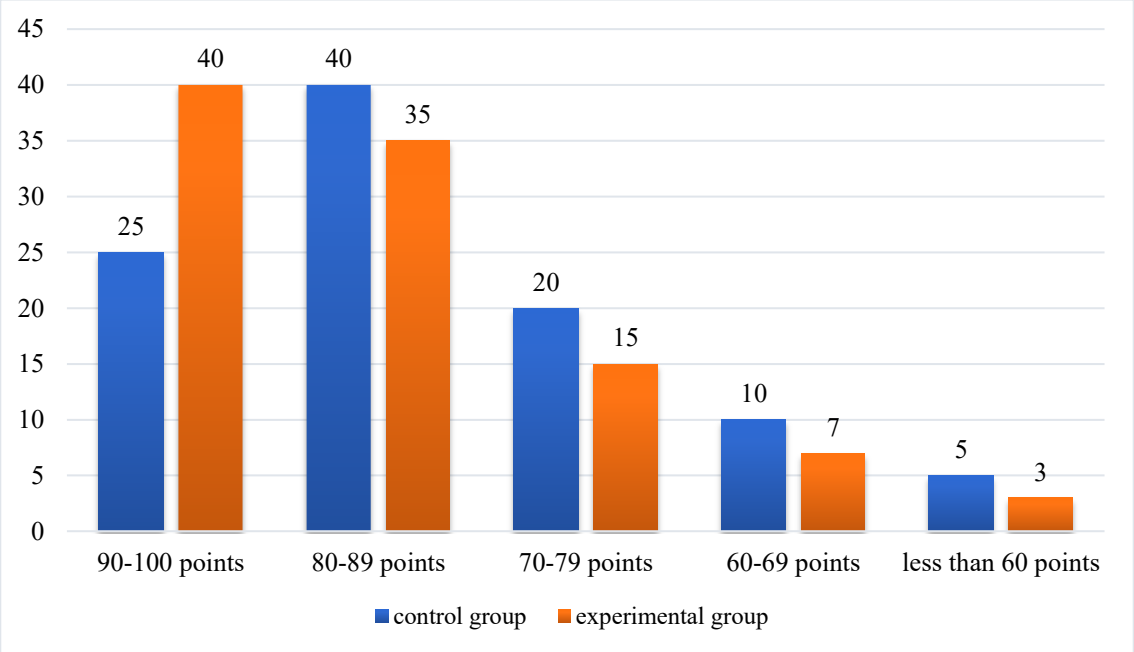

Fig. 2: Distribution of the number of students in both groups by average score after the introduction of new digital technologies

Source: compiled by the authors.

The results of the study showed that students in the experimental group who used modern digital tools demonstrated a significant increase in overall academic performance, as reflected in both higher average scores and a greater number of students achieving top marks (90-100 points). Their final scores were higher than those of the control group students who studied according to traditional methods. The participants of the experiment provided feedback indicating that the most noticeable improvement was observed in the performance of tasks that required creativity and interactivity of work. The use of tools such as Kahoot and Quizizz allowed students to participate 20% more actively in the learning process, involving them in problem-solving through interactive quizzes and tests. In addition, the use of digital platforms to create educational materials, such as Canva and Prezi, contributed to the development of creative skills, as students were able to develop more creative and visually appealing presentations. In addition to improving results in creative tasks, students of the experimental group showed greater activity in cooperation during group projects, although among some applicants of the control group, activity was also observed, which was measured by how effectively students mastered the material when answering questions from teachers. According to this, students of the experimental group could do it faster. Online learning platforms such as Moodle and Google Classroom have made it

easier for students and teachers to communicate, helping them complete tasks faster and better (Onyshchenko & Serdiuk, 2025). Due to video conferencing services such as Zoom and Microsoft Teams, students had the opportunity to discuss tasks and projects in real-time, organising collaboration more efficiently, regardless of their physical location.

Another important advantage of the experimental group was the improvement of skills in independent information retrieval and problem-solving. Digital technologies provided access to a wide range of resources, which helped students find information more quickly and conveniently than was available to the control group (Rexhepi et al. 2023; Azieva et al. 2021). Students were able to use a variety of online libraries, databases, and resources for in-depth study of the material, which improved their overall awareness and quality of assignments.

The results of the experimental group showed improvements in several aspects of student attendance and activity during classes. In the control group, the average attendance in the group remained at 85 out of 100 possible, which indicates a stable, but not ideal, participation. Absences can affect students' overall academic performance. These students showed medium activity in the form of 17 active answers or questions per semester, indicating a moderate level of participation in discussions and possible passive perception of the material.

In the experimental group, there was some improvement, because the average number of visits became higher and amounted to 92 out of 100 possible. This increase indicates that students in the experimental group were more disciplined and responsible, which can be attributed to the use of digital technologies that made the learning process more convenient and accessible. As for activity during classes, the average number of answers or questions in the experimental group was 25 per semester, which is 10 more than in the control group.

The use of modern digital tools has substantially affected the increase in students' involvement in the educational process. The main quantitative indicators confirm that the involvement (number of presentations in classes and attendance) of students of the experimental group in discussions and interactive classes increased by 30% compared to the control group. This was made possible using interactive tools that made the learning process more dynamic and interesting for students. The level of interaction with students and teachers was high in terms of accessibility and openness among participants and accounted for 90% of all participants in the experimental group, due to constant support in online platforms such as Moodle and Google Classroom. This allowed students to communicate more effectively with teachers and receive feedback faster, which had a positive impact on the overall learning process. The increase in the efficiency of group projects is notable. The use of video conferencing tools increased the number of successfully completed group tasks by 20%. This suggests that digital tools have made communication between students easier and collaboration – more productive. Another important indicator was the increase in the frequency of students' participation in quizzes and online tests (Fig. 3).

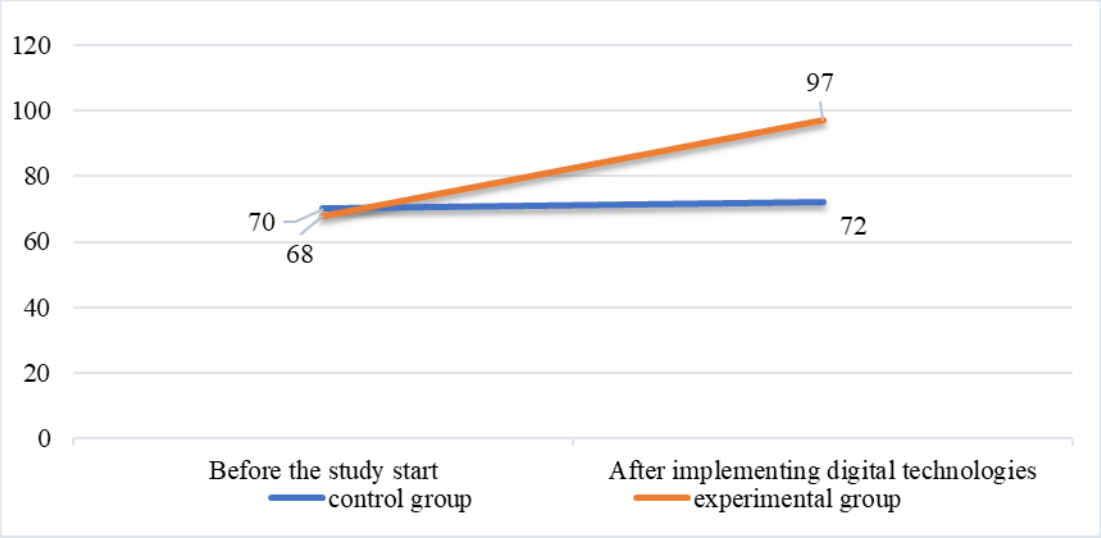

Fig. 3: Distribution of the number of students in both groups by the frequency of participation in the tasks set, %

Source: compiled by the authors.

The participation of students in the experimental group in such events organised through Quizizz was 25% higher than in the control group. This indicates that interactive tools have increased interest in educational material and motivation to participate in the educational process. The control group also experienced some improvements, but they were less pronounced. Students who used traditional teaching methods showed stable results, but they lacked the flexibility and dynamics provided by digital tools. Notably, the experimental team showed better skills in finding information and solving problems independently through access to a wider range of training resources.

After the study, all participants were re-interviewed to assess their experience and satisfaction with the learning process (Table 2).

Table 2: Results of the survey of both groups before and after the introduction of digital technologies

Indicators	Before implementation (n=200)	After implementation, 100 people per group	
		Control group	Experimental group
Average assessment of learning satisfaction	70%	72%	89%
Percentage of students who rated the tools positively	60%	65%	90%
Proportion of students who find learning useful	65%	70%	87%
Percentage of students who consider learning interactive	55%	60%	92%
Average level of participation in group projects	75%	78%	90%
Proportion of students who reported improved communication skills	62%	68%	86%
Share of students who apply knowledge in practice	56%	59%	87%

Source: compiled by the authors.

Before the introduction of new technologies in the educational process, both groups of students showed similar results, which indicates a certain stability of traditional teaching methods. Only slightly more than half of the students considered learning interactive, which is a low indicator for the educational environment, which is aimed at attracting educational applicants through active interaction. This indicates the use of outdated or inefficient pedagogical approaches that do not meet modern requirements for education. Training was not perceived by

all students as useful from the standpoint of practical application of the acquired knowledge. This is an important aspect because, in the modern world, students strive to acquire not only theoretical knowledge but also skills that they can apply in practice in their professional activities. Insufficient focus of training on the real needs of the professional environment may be one of the reasons for insufficient motivation of students to actively participate in the learning process (Onipko & Yaprynets, 2024; Pavliuchenko, 2023).

After the introduction of new technologies, the results of the control and experimental groups show varying degrees of improvement. In the control group, which continued to use traditional training methods, there was a certain increase in all indicators. However, despite the positive dynamics, all these improvements remained relatively insubstantial and did not allow the control group to achieve the indicators of the experimental group.

The experimental group in which digital tools were implemented showed more substantial results. These technologies have had a positive impact on students' overall learning satisfaction. Almost all students in the experimental group rated the use of digital technologies positively, which underlines the importance of innovative approaches in modern education. Especially substantial was the increase in the perception of interactivity of learning, from the initial 55% to 92%. This shows that the introduction of digital tools has made the learning process substantially more dynamic, interactive, and engaging, which in turn has had a positive impact on the overall student experience.

The results of evaluating digital tools according to six main criteria showed a substantial positive impact on the educational process. The analysis of the technologies used by the experimental group is presented in Table 3.

Table 3: Evaluation of the digital technologies used according to the set criteria

Criteria	Moodle	Google Classroom	Kahoot!	Quizizz	Zoom
Academic performance	Improving the level of knowledge through structured courses and tests, and applying it in practice	Improving the level of knowledge, but without developed tools for practical application	Increased knowledge through interactive quizzes, but limited practical application	Like Kahoot! with an interactive approach, but with more detailed analytical capabilities	Mixed results. Practical application is limited
Time to learn the material	Effective for long-term modules, which facilitates self-education	Fast learning due to ease of use, but fewer self-learning tools	Fast learning due to short interactive sessions	The time depends on the depth of the material	Less structured learning time, more synchronous interaction
Participant satisfaction	High because of the ability to work offline and a rich set of features	High due to ease of use and integration with Google services	Very high, interactive tests increase motivation and interest	Very high and with additional elements of competition	Mixed reviews due to communication stability issues and sometimes limited interactivity
Availability	High availability for various devices and training formats	Easy integration with Google services, high availability for users	Affordable, easy to use	Available to a wide audience	Available for all platforms, but requires a stable internet connection
Interactivity	High, because there are interactive tasks, forums, and collaboration	Medium, because the tools for commenting and collaboration are limited.	High, because quizzes and game elements encourage active interaction	High, with the possibility of independent completion	Limited, because there is synchronous interaction without the possibility of deep integration with content
Adaptability	It can be configured for different learning styles, but it requires settings	Basic personalisation features	Focus on group interaction, and individual adaptation is minimal	Slightly higher than Kahoot! with analytics to assess progress	Limited ability to adapt to the individual needs of students

Source: compiled by the authors.

The use of interactive platforms allowed for an increase in the level of satisfaction among students of the experimental group. They appreciated the positive dynamics of the educational process due to the possibility of more active interaction with materials, receiving feedback, and participating in interactive tasks. The results of evaluating digital tools according to six main criteria showed a substantial positive impact on the educational process. First, the effectiveness of training increased, as the experimental group showed substantially better indicators of material assimilation and the ability to use knowledge in practice compared to the control group. This shows that digital tools improve the quality of education and contribute to the practical implementation of the acquired knowledge. Secondly, digital tools have helped reduce the time required to learn the material. Students in the experimental group spent less time completing training modules thanks to interactive and adaptive technologies that allowed them to learn new information faster and more easily. This increased the effectiveness of the learning process and made it possible to pay more attention to more complex aspects of learning. The third important indicator was student satisfaction. The use of interactive platforms allowed for an increase in the level of satisfaction among students of the experimental group. They appreciated the positive dynamics of the educational process due to the possibility of more active interaction with materials, receiving feedback, and participating in interactive tasks. The fourth criterion was the availability of digital tools. Mobile apps, online platforms, and other digital resources have proven to be very convenient and accessible for students. This made it easier to integrate technology into the learning process and allowed students to easily access learning materials at any time, making learning more flexible.

The interactivity of learning has also increased substantially. Students of the experimental group gained a better experience of interacting with the material and teachers, which increased their motivation to learn and contributed to more active participation in the educational process. This approach allowed students to engage in more dynamic and interesting learning. The last but no less important criterion was adaptability. New digital technologies have enabled the adaptation of educational processes to the individual needs of students (Shevchuk & Hunaza, 2025; Uludag, 2023). This is especially important for students with different learning styles or those who need additional opportunities to adapt. The personalised approach provided by digital tools allowed for improving the learning efficiency of each student individually.

Thus, the results of the experiment showed that the use of modern digital tools helps to improve the efficiency of the educational process, reduce the time for mastering the material, increase student satisfaction and engagement, and ensure the availability and adaptability of learning by the individual needs of each student.

4. Discussion

The results of the study showed that digital tools have a substantial impact on the educational process. It was determined that they have a positive effect on the involvement of applicants for education, the effectiveness of training, and the overall level of motivation. These

conclusions coincide with the results of other studies, confirming the effectiveness of interactive technologies in the educational process. Conlon et al. (2020) determined that one of the key aspects of optimising the educational environment is the involvement of students in the learning process. In this paper, it was established that the use of digital technologies, such as mobile applications, online platforms, and interactive games, substantially increases the level of student interest. The results of the study focused on an increase in activity during the educational process, an increase in the number of questions from students, and an overall improvement in test results. These data are consistent with the results of the study conducted by Pavlenko et al. (2023), where researchers argued that interactive technologies provide more efficient assimilation of educational material through visualisation and the ability to engage students in an active learning process. For example, interactive whiteboards and other digital platforms allow students to collaborate in real-time, which contributes to a better understanding of the topic. The same conclusions were drawn in a study by Vieilandie et al. (2024), where researchers found that digital tools improve communication between students and teachers, making the learning process more personalised.

The results of the study showed that another important aspect of using digital tools is the possibility of individualising learning. The use of technologies such as learning platforms with adaptive algorithms has allowed educational applicants to work at their own pace and focus on those aspects of the material that require additional attention. This is especially important in an inclusive education environment, where students with different levels of training can work together to receive personalised assignments and materials. The results of this study are consistent with the paper of Adler et al. (2023), Prochazka et al. (2021), who determined that digital tools allow creating individual learning trajectories for each student, which contributes to better assimilation of the material. Wang (2022), Sokol & Koc (2024) noted that the use of artificial intelligence technologies in the educational process allows for analysing the results of each student in real-time and offering additional materials or tasks to deepen knowledge. In this context, attention should also be paid to a paper by Himang et al. (2023) and Kozhukhova et al. (2021), which examined the impact of adaptive learning on student performance in higher education institutions. Their results showed that students who used platforms with adaptive capabilities achieved higher exam results and understood the material better compared to those who studied using traditional methods. The same results were obtained in this study.

Digital technologies contribute to the development of critical thinking among students (Efremov 2025a; 2025b). This study established that using technology for group discussions, debates, and project activities allows students to analyse information more deeply, find unconventional solutions, and argue their position. This reflects current trends in education, where more and more attention is paid not only to the accumulation of knowledge but also to the development of cognitive skills. The same results of this study are consistent with conclusions obtained by Aryabkina et al. (2021) and Salas Hernández et al. (2022), who argued that interactive technologies create an environment in which students can develop critical thinking skills through collaboration and active discussion. Lazar et al. (2020) examined distance learning experiences in schools and universities during the pandemic. Their results showed that students who actively used digital learning platforms showed greater independence and were better adapted to new learning environments. This opinion was supplemented by Boltsi et al. (2024), emphasising that digital technologies allowed teachers to quickly adapt curricula to new realities, which also had a positive impact on the quality of education.

Even though this study has confirmed the numerous advantages of digital technologies in education, the fact that both students and teachers face certain challenges is notable. It was determined that not all students have equal access to digital tools, which can create barriers to learning. Some teachers noted that to effectively use digital tools, they need additional training and advanced training. These results are consistent with the findings of Thongkoo et al. (2020), which pointed out that digital inequality remains one of the main problems in the introduction of technology in education. They noted that students with low technical skills or limited internet access may lag their peers, creating additional challenges for educational institutions. In addition, Ou & Xie (2024) and Zhang & Chen (2024) emphasised the need for continuous training of teachers so that they can effectively use the latest technologies in their work. Therefore, it is necessary to minimise digital inequality, and educational institutions should ensure that digital tools and resources are available to all students, regardless of their socio-economic status. This may include providing students with devices such as laptops or tablets and improving access to fast internet. Liu et al. (2022) confirm the information that educational institutions should implement training programmes for teachers that will help them master modern digital tools and technologies and apply them in the educational process.

It is important to consider the psychological aspects of using digital tools in the educational process (Ronzhes 2023; Yanovska 2022). Increased reliance on technology can have both positive and negative consequences. On the one hand, digital tools can improve learning efficiency by providing students with more opportunities for an individualised approach and cognitive skills development (Muthuraman 2021, Huang 2024). Therewith, excessive use of technology can lead to a decrease in the level of social interaction between students and teachers, which is an important element in the development of communication and social skills (Anamova et al. 2020). The lack of live communication can create barriers to the formation of social competencies that are important for future professional activities (Spytska 2023; Reva 2022).

The results of the study are consistent with the work of many researchers who emphasise the need to maintain a balance between online tools and traditional full-time learning. The use of mixed teaching methods helps to maintain a lively interaction between students, teachers, and peers, which, in turn, contributes to the formation of social skills. Digital technologies have the potential to substantially improve the educational process. Technologies help to adapt educational programmes to new conditions and the individual needs of students. However, several challenges remain, such as digital inequality and the need for additional training of teachers to use the latest technologies. This requires an integrated approach and support at the level of educational policy.

5. Conclusion

The study on the impact of digital technologies on the educational process covered students of various specialities. The results showed substantial advantages of modern digital tools in comparison with traditional teaching methods. The study participants were divided into control and experimental groups, where each of the groups had different approaches to learning: the control group used traditional methods, and the experimental group used digital tools. This experiment consisted of three stages and was aimed at assessing how the introduction of digital tools affects the educational process in higher education institutions. Key aspects included integrating technology with curricula, personalising educational content, using analytics to monitor progress, and providing feedback from students.

The findings of this study provide strong empirical evidence for the effectiveness of digital technologies in optimising the educational environment. The experimental group, which used a range of modern digital tools over one academic semester, demonstrated significant improvements across all key educational indicators compared to the control group. The average academic score in the experimental group rose from 75.3 to 89.7 out of 100, while the control group showed a smaller increase from 74.5 to 84.1. The number of students achieving top performance (90-100 points) in the experimental group increased by 15 individuals, indicating a higher concentration of academic excellence linked to the use of digital platforms.

Student engagement also increased substantially: the average attendance rate in the experimental group reached 92 out of 100 possible sessions, compared to 85 in the control group. The number of active contributions per student grew from 17 to 25 in the experimental group, reflecting a 47% rise in participatory behavior. Students in the experimental group demonstrated a 30% higher involvement in classroom discussions and presentations, while successful completion of group projects increased by 20%, underscoring the collaborative potential of digital platforms such as Zoom, Google Classroom, and Moodle. Survey data reinforced these quantitative results. After the experiment, 89% of students in the experimental group reported being satisfied with the learning process, compared to 72% in the control group. Positive assessments of the tools used were reported by 90% of students in the experimental group versus 65% in the control group. The perception of learning as interactive rose from 55% to 92%, while the share of students applying acquired knowledge in practice increased from 56% to 87%.

Digital tools also contributed to greater accessibility and adaptability of education. Applications such as Coursera and Duolingo allowed 50% of students to engage in self-directed learning, while the use of cloud platforms like Google Drive ensured constant access to study materials. Platforms were evaluated according to six criteria: academic performance, time efficiency, student satisfaction, availability, interactivity, and adaptability, and demonstrated clear advantages in all domains, particularly with Moodle, Quizizz, and Google Classroom, scoring high in interactivity and learner satisfaction.

A substantial achievement of this study was to increase the motivation of students in the experimental group. Interactive and adaptive technologies have made learning more interesting and dynamic. Accordingly, this affected students' involvement in the learning process and their interest in a deeper examination of the material. Students were also able to get instant feedback on their knowledge, which contributed to their progress and confidence in their academic achievements. Data analysis confirmed that the introduction of digital technologies not only improves the quality of the educational process but also optimises its duration. This is especially true in the context of modern education, where efficiency and effectiveness are key factors for successful learning. The integration of digital tools allows for a more individualised approach to learning, which contributes to better adaptation of students to educational requirements and their professional development.

Despite the successful results, the study also had limitations because it lasted relatively short, which did not allow for assessing the duration of the effect of implementing digital tools on the educational process. Further research should aim to expand the sample to include more universities and majors to draw more general conclusions. It is also promising to investigate the impact of certain types of digital tools on specific disciplines, which will allow for a deeper examination of their effectiveness and compliance with different areas of education.

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