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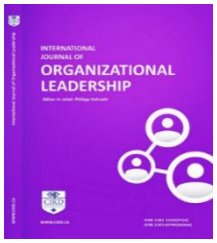

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Driving Organizational Leadership in Higher Education: Leveraging Innovative Teaching and IT-Communication Technologies for Digital Transformation

Alla Martyniuk[1]*, Nataliia Sushyk[2], Oksana Kovalchuk[3], Svitlana Lobanova[4], Volodymyr Kovalchuk[5], Liudmyla Dolozhevska[6]

[1,3,4,6]Department of Foreign and Ukrainian Philology, Faculty of Digital, Educational and Social Technologies, Lutsk National Technical University, Lutsk, Ukraine
[2]Department of Social Pedagogy and Pedagogy of Higher School, Lesya Ukrainka Volyn National University, Lutsk, Ukraine
[5]Department of Physical Education, Sports and Health, Faculty of Digital, Educational and Social Technologies, Lutsk National Technical University, Lutsk, Ukraine

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***Correspondence:**
a.martyniuk@lutsk-ntu.com.ua

ABSTRACT

The article explores the role of innovative teaching methods and the use of information and communication technologies in higher education in the context of digitalization. The main focus is on the fact that modern challenges in the educational sphere necessitate the adaptation of the educational process to the conditions of the digital environment. The study uses a descriptive method of analyzing literary sources for a more complete and accurate analysis of scientific literature. At the same time, the most effective innovative teaching methods that promote the use of the latest technologies are considered – contextual learning, simulation learning, problem-based learning, modular full knowledge acquisition and distance learning. At the same time, an analysis of the features of the use of blended learning, gamification and adaptive learning is carried out, which also contributes to increasing the efficiency of the educational process in higher education. Among the methods of innovative teaching in higher education, it is also necessary to indicate artificial intelligence, virtual and augmented reality, mobile learning, as a means of personalizing the educational process and activating the cognitive activity of students. It is important to note that information and communication technologies are tools that can ensure flexibility, accessibility and interactivity of higher education, contributing to enhanced knowledge acquisition in conditions of distance and blended learning. In addition, a number of problematic issues that arise in the field of digitalization of education have been identified, the main of which are the need to increase the digital literacy of teachers and students, the implementation of effective methods of assessing knowledge in the digital space, ensuring information security and protecting personal data. A number of recommendations have been proposed for improving digital educational technologies and integrating innovative teaching methods into the educational process, taking into account modern requirements in the labor market. The results obtained will contribute to the mastery of the systematic implementation of information and communication technologies in higher education, including adaptive teaching methods and the development of students' digital competencies. The importance of updating the content of educational programs and exploring the possibilities of integrating innovative teaching methods into the educational process of higher education has been identified. Further research should be aimed at assessing the effectiveness of digital technologies and developing mechanisms for their adaptation to the needs of modern education.

The development of higher education in Ukraine is aimed at integrating into the global educational process and harmonizing national and international standards. Today, the world requires specialists who are able to simultaneously solve a number of atypical tasks, find an optimal balance, and quickly master a particular field of activity. In this regard, the academic staff is subject to stricter requirements for the introduction of innovative teaching and learning methods based on the use of multimedia technologies, information programs and a modern knowledge transfer system. The teacher must create, and the students must accept, the conditions that suit them and under which the acquisition of knowledge will be most optimal. Such conditions are innovative teaching methods and the use of information and communication technologies with elements of digitalization, which are currently being actively implemented in the country's higher education institutions.

The modern digital transformation of higher education is an integral part of the development of innovative teaching methods aimed at improving the quality of the educational process. The most common technologies of innovative teaching methods are adaptive learning, artificial intelligence, virtual and augmented reality methods, as well as a number of online courses (MOOCs) that contribute to the personalization of the educational

process. In different countries, the introduction of innovative technologies in education is based on individual needs and capabilities. For example, in North America, the digitalization of education is a major trend. This is largely facilitated by investments in education and the development of new technologies. The European Union is also a leader in the pace of introducing innovative technologies into the education sector. The developed concepts are aimed at improving the level of education and are aimed at creating a single digital educational space that ensures accessibility, inclusiveness and high quality of education. In the Asia-Pacific region, the rapid introduction of innovative technologies in the educational space is driven by the high level of the digital economy, particularly in countries such as China, South Korea, and Singapore. Researcher Martin Armstrong notes that according to the Dentsu Aegis Network report, China is a leader in introducing innovative technologies and preparing people for a rapidly changing world. According to the survey, 68% of respondents noted the success of the introduction of innovative technologies and digital achievements, while in America, this figure was 39% (Armstrong, 2018).

It is worth noting that technology has become the main tool for ensuring student development and improving the quality of the educational process at universities, regardless of their rating, scale, or specialization. Since the rapid development of the digital era, which intensified after the Fourth Industrial Revolution, various models of digital transformation have been explored in higher education. These models reflect the integration of technology into the modern educational paradigm in order to adapt to global challenges and modernize the educational process. They are aimed at improving teaching and learning methods and optimizing administrative procedures in higher education institutions. Thus, digital transformation is not only a means of supporting educational processes, but also a tool for their systemic restructuring (Mualla & Mualla, 2024).

The development of the Internet, cloud computing, big data analysis technologies and other digital solutions significantly expands the ability of higher education institutions to store, process and analyze educational resources, providing wider and more convenient access to educational materials. The active introduction of online educational platforms, virtual laboratories, mobile learning systems, and digital tools for knowledge assessment contributes to the diversification of pedagogical approaches and the efficiency of the educational process (Qian et al., 2024).

The effectiveness of digital transformation mainly affects the competitiveness of graduates, as young professionals already have practical skills after graduation, which can only be improved further. However, in addition to its success, the introduction of innovative technologies has significant challenges, primarily related to the lack of digital competence of teachers, financial constraints, and problems in adapting traditional teaching methods to new technological realities. Innovative teaching methods based on digital technologies help to increase student motivation and create flexible educational trajectories. Successful digitalization requires the development of comprehensive strategies and active support at the state level. In general, the link between digital transformation and innovative teaching approaches is to create an adaptive, interactive, and student-centered learning environment. Thus, the future of higher education will be determined by the ability of the education system to integrate the latest technologies, taking into account the current challenges and needs of society.

The purpose of the article is to study and analyze the impact of innovative teaching methods and information and communication technologies on the process of digitalization of higher education, as well as their capabilities in improving the efficiency of learning and adapting educational processes to modern conditions. The tasks of the article include: the impact of innovative teaching methods and information and communication technologies on the digitalization of higher education; determining the role of interactive and innovative communication technologies in improving the efficiency of the educational process; harmonization of educational activities of higher education with modern requirements using innovative teaching.

Literature Review

Insufficient attention has been paid to the study of innovative teaching methods and information and communication technologies in the context of digitalization of higher education. The works of researchers do not fully reveal the peculiarities of the use of innovative teaching methods and information and communication technologies in the context of digitalization of higher education. The majority of scientific studies are dominated by works that address certain aspects of the digitalization of the educational process, such as the use of e-learning, blended learning, or adaptive technologies. Within this framework, a comprehensive approach to the integration of innovative teaching methods in higher education remains insufficiently covered. This aspect points to the need to systematize existing knowledge and form a scientifically based approach to the implementation of innovative teaching methods and information and communication technologies in higher education.

Verbivskyi (2023) defines the essence of the concept of **“**innovation” and conducts a comprehensive analysis of modern innovative educational technologies. The researcher outlines the problems of applying innovative technologies and their role in the modern educational process, highlights the classification of innovations, in particular modern educational and pedagogical technologies, emphasizing that innovation in education is an interconnected process consisting of new methods and approaches of the teacher, as well as scientific and cognitive activities of higher education students. Separately, his work explores the features of blockchain technology, which also belongs to innovative methods and is used in knowledge testing: tests, exams, defense of qualification papers, etc. (Verbivskyi, 2023).

Since digitalization is a paradigm shift that affects thinking, action, and communication, innovative technologies are more of a tool than a goal. It is worth noting that digitalization facilitates the educational process, making it more adaptive and flexible in accordance with modern realities, which, in turn, helps to form competitive specialists. In the field of education, digitalization is focused on ensuring life-long learning and individualization of the learning process through advanced learning technologies. Karpliuk (2019) emphasizes that digital technologies make it possible to create a favorable process of communication and cognition by automating a significant part of teaching activities, which allows teachers to devote more time to information search, communication, self-development and individual work with students. The author highlights the main areas of digitalization of higher education in Ukraine, including the creation of educational resources and platforms, the development of innovative teaching tools, and free access to the Internet.

Mialkovska et al. (2023a) focus on the issues of transformational change, focusing on the disclosure of modern models and methods of management in the education sector, including information technology, and emphasizing the assessment of domestic and international research as key factors for the success of education management in the context of modern challenges. The researcher points out the need for educational institutions to introduce information technology into the educational process, using modern management models and methods to achieve the goals of sustainable education (Mialkovska et al., 2023b).

Ovdiichuk (2021) tries to explain that the introduction of innovative technologies in the educational process is an objective necessity, as all spheres of public life, including education, are affected by the processes of informatization, technologization and digitalization. According to the author, the higher education system is being reformed at both the content and activity levels, which is reflected in updating educational and professional programs, curricula, the introduction of individual learning paths and the active use of modern educational technologies. The researcher focuses on the combination of traditional and interactive teaching methods, the use of innovative technologies in the process of studying literary disciplines (Ovdiichuk, 2021).

Chepik-Trehubenko (2024) analyzes the problems of introducing innovative methods of teaching lawyers. His article emphasizes that changes in the political, legal, economic, social, spiritual and cultural spheres of the modern constitutional order of Ukraine require the introduction of modern approaches to the upbringing and education of the future generation. The researchers establish that the current system of Ukrainian higher legal education in the context of new challenges requires significant changes and updating of the content at all levels, especially with regard to the specifics of education during martial law and in the post-war period. Of particular importance is the analysis of the role of academic staff in the process of modernizing the educational process, which contributes to the effective use of information and communication technologies and the improvement of the professional training of future lawyers (Chepik-Trehubenko, 2024).

Tolkunov (2023) investigates that modern training of highly qualified specialists requires the introduction of the latest innovative teaching methods and technologies, allowing students to be more competitive in the labor market. One of the ways to improve the educational process is to move to active learning methods that facilitate the rapid acquisition of the necessary knowledge and skills (Tolkunov, 2023).

Hai (2016) discusses in detail modern methods of teaching medical disciplines in higher education. The researcher says that modern effective methods of lecturing include elements of discussion, and the importance of involving teachers in the pedagogical arsenal of effective teaching methods to ensure high-quality training of future doctors, emphasizing the need to use modern educational methods, including computer technology (Hai, 2016).

Bearman et al. (2022) specify that the spread of artificial intelligence has enormous implications for higher education, as it enables students to prepare for the transformation of work in society. In general, AI is not only a subject of technological innovation, but also a fundamental change in the relationship between higher education and broader socioeconomic interests. As part of this, researchers propose to investigate the role and significance of artificial intelligence in the lives of higher education students (Bearman et al., 2022).

Crompton and Burke (2023) determine that the use of artificial intelligence in higher education has increased significantly over the past 5 years. It is actively used by both teachers and students in their daily activities. AI has proven to be an effective element in various subject disciplines, including language, engineering, mathematics, and medical education. Researchers emphasize that the modern definition of artificial intelligence is "computing systems capable of engaging in human-like processes such as learning, adapting, synthesizing, self-correcting, and using data for complex processing tasks (Crompton & Burke, 2023; Mialkovska et al., 2024).

Holmes et al. (2022) address the ethics of artificial intelligence in education. The researcher points out that although artificial intelligence research is driven by the desire to support student learning, ethical intentions alone are not enough. All members of the AI education community are motivated by ethical concerns, such as improving learning outcomes and enabling lifelong use of AI (Holmes et al., 2022).

Rof et al. (2022) propose to consider the impact of the sudden Covid-19 pandemic on the ongoing digital transformation process, as well as its impact on the value of learning for higher education institutions. The study is based on a case study of a digital university and focuses on the changes made to the value proposition of learning, in particular to the process of multi-mode learning. In addition, the researcher analyzes the relationship between multimodality and adapted and personalized learning, which depends on the use of digital educational technologies (Rof et al., 2022).

Method

The study uses a descriptive method of literature analysis, which allows us to identify and systematize the main concepts of innovative teaching methods and the use of information and communication technologies in the digitalization of higher education. A comprehensive review of scientific literature was conducted to accumulate the evidence base developed by leading researchers. For a more complete and accurate analysis of the literature, the content analysis method was used, which allows for a detailed examination of the content of scientific publications and identification of the main trends and concepts that determine the development of innovative teaching methods and digitalization of higher education. This approach provides a deep understanding of the structure and features of each source, allowing us to identify not only key ideas but also areas for future research. The use of content analysis contributed to a comparative analysis of different approaches to the digital transformation of education in the context of specific countries and regions, as well as to identify the most effective models for integrating digital technologies into the educational process.

Results

The current stage of development of the educational system is based on the introduction of innovative educational technologies aimed at improving the quality of the educational process. In view of this, in order to introduce innovative teaching methods and information and communication technologies into the educational process, it is necessary to modernize the approach to the higher education system, adapting and, in some cases, replacing traditional teaching methods in accordance with modern requirements. The development of digital technologies affects all spheres of public life. The educational sector has not been left without

attention. Rapid changes, fierce competition, and adaptability in the labor market are forcing higher education institutions to look for alternative ways to modernize the educational process. Such actions allow for personalized learning, optimizing it to develop critical thinking and practical skills in students. The digitalization of higher education not only expands the possibilities of traditional teaching methods, but also creates conditions for the development of competencies necessary for the successful integration of students into the digital society and the modern labor market. Through the use of innovative educational technologies, students get access to interactive content, digital platforms and virtual laboratories, which significantly improves the quality of education and helps it meet modern requirements.

In the process of modernizing education, the use of modern technologies makes learning more effective and focused on personal development. Innovative educational technologies open up opportunities for the use of special methods, software, and hardware to work with information. This changes the nature and dynamics of interaction between student and teacher: in networked learning environments, students can work at their own pace without constant contact with the teacher, who, instead of being just a source of knowledge, becomes a mentor and consultant. These changes significantly affect the choice of teaching methods, forms and technologies (Verbivskyi, 2023).

Innovative technologies should be developed for all specialties, including environmental education, as they help to integrate environmental principles into various curricula. This contributes to the development of students' environmental awareness, including cognitive, emotional and behavioral components. The introduction of such technologies not only increases the level of knowledge in the field of ecology, but also motivates students to apply this knowledge to solve practical environmental problems. As a result, future professionals acquire the necessary skills for sustainable natural resource management and environmental protection (Martyniuk et al., 2024).

As of the beginning of 2025, the digitalization of higher education is actively continuing on the basis of innovative teaching methods and information and communication technologies that are successfully transformed into the educational process. Table 1 shows the most popular innovative teaching methods in higher education institutions.

Table 1

Innovative Teaching Methods

Training method	Description of the method	Example of use
Gamification	Introducing game elements into the learning process increases student motivation and engagement.	Introducing educational games and game simulations to teach complex concepts.
Microlearning	Short, issue-focused modules that help you learn at your own pace.	Short 10-15-minute video tutorials that can be watched in a convenient mobile format.
The flipped learning method	The idea is that students study new material at home and actively discuss it in class.	Preparing for lectures using online materials.

Cooperative learning, simulation learning, and design thinking are becoming more and more common – approaches that create a “canvas” for the effective integration of digital technologies into the learning process (Becerra & Quiroz, 2022).

The modern system of innovations in higher education includes technological, pedagogical, organizational and economic innovations. Technological innovations include new teaching methods, educational programs, as well as teaching materials and student recruitment criteria. Pedagogical innovations focus on new teaching methods, interactive forms of learning, virtual reality technologies, and computer modeling. Organizational innovations involve changes in the structures of educational institutions, and economic innovations relate to new financial mechanisms, such as diversification of funding sources and new forms of payment for educational services (Burko, 2018).

Teaching and learning in modern higher education institutions are transformed not only by external challenges, time and space requirements, but also by the influence of people, such as teachers, students, and leaders, who are able to change educational institutions and improve the world. Digitalization processes in education are developing in two directions: external, under the influence of government agencies, and internal, which includes initiatives of the administration and active members of the academic staff. Internal initiatives can arise both from the bottom, through the enthusiasm of individuals, and from the top, when they are initiated by the administration. Both of these processes interact, contributing to the development and adaptation of educational institutions to new conditions (Semeniako et al., 2023).

The informatization of society as a whole is driven by the development of computer technologies, software, global networks, and multimedia technologies that are actively used in education. Information and Communication Technologies (ICTs) include hardware and software used to process and transmit information, turning them into pedagogical technology. The use of modern ICTs contributes to the development of the humanitarian potential of natural sciences, forming a scientific outlook, analytical and creative thinking. The digitalization of education should provide access to technology for students, teachers and administrators, as well as increase digital competencies and literacy (Zadorina et al., 2023).

It is worth noting that information and communication technologies in higher education institutions ensure effective learning and interaction between students and teachers, allowing the use of the latest technologies to create adaptive learning environments. These include the use of online courses, interactive platforms, video conferencing, and tools for automating educational processes. This makes education more accessible, improves its quality and efficiency, and reduces the workload of teaching staff. Table 2 contains a list of information and communication technologies in higher education institutions.

Table 2

Information and Communication Technologies in Higher Education Institutions

Technology	Description	Example of use
Virtual laboratories	Creation of digital models and simulation games for various scientific experiments and research.	Using software for modeling scientific research.
Online courses	Interactive platforms that allow a large audience to learn educational material and courses.	Coursera and edX offer courses from the world's leading universities.
Interactive platforms	These are tools for collaboration, knowledge and resource sharing for students and teachers.	Google Classroom, Microsoft Teams to organize the learning process.

In 2025, the integration of interactive technologies into higher education has become a necessity, not an additional advantage. Interactive panels, curricula, and remote learning services have become an integral part of the educational process in Ukraine and around the world. Research shows that students expect universities and colleges to offer more advanced and innovative technological experiences than their high schools. In this digital era, educational institutions should use technologies that support both academic activities and administrative processes (Promethean, 2024).

Misiejuk et al. (2023) presented an analysis of the changes made to the learning design of 102 courses in the LMS of a Norwegian university before, during, and after the COVID-19 pandemic. The results showed a positive trend of increasing the use of digital activities in the learning management system. The authors also emphasize the importance of supporting digital transformation by the university management.

Hagedorn et al. (2023) presented a game-based learning design that they used in several iterations of computer science courses in Germany. For each course on the basics of the Java programming language, they developed a continuous story like a game plot that accompanies students during their studies and helps them visualize key concepts. The authors share their approach to creating an ambient story in a MOOC and provide recommendations for educators to develop their own stories. Data and a long-term evaluation covering four Java courses from 2017 to 2021 showed students' openness to programming courses, and highlighted the elements that had the greatest impact. While only a few students did not like the story at all, most students utilized the additional story elements provided. According to the data, for 10-16% of students, history was the main motivation for the course. By conducting research in the context of surviving MOOCs, the authors improve game-based learning designs, promote student engagement and satisfaction with online courses, and help instructors facilitate knowledge transfer.

In 2024, the government of Ukraine allocated UAH 1.65 billion for the purchase of various interactive equipment for the subject **“**Defense of Ukraine.” The purpose of this purchase is to help students master practical skills. Previously, the training was conducted in the form of memorization of a large amount of information and overly academicized theory, but now the main focus is on practical skills using interactive technologies. It should be noted that the prestige of a higher education institution depends on the introduction of innovations in higher education. As part of this, various competitions are held among the top-rated universities, including those to determine their innovativeness. Thus, in 2024, Kyiv Aviation University

won the Best Innovative HEI 2024 nomination. The victory in the nomination proves that this university is the most innovative in Ukraine. The content of innovations is the development of startup systems based on the university, where each student can grow their own idea into a working startup. In August 2024, the first national cyber training ground was launched at the university, and in September, a modern Ajax electronics laboratory was opened. In early 2025, a Science Park aimed at monetizing research will be launched. In addition, the AxxonSoft and VD MAIS training laboratories, as well as the Huawei Excellence Center (NAU, 2024), are being prepared for launch.

The National University of Ostroh Academy is among the innovative higher education institutions in Ukraine that strive to keep up with the times. The university is opening new educational programs in robotics and artificial intelligence, taking into account global technological changes and the huge demand for specialists in these fields. The university provides students with not only theoretical but also practical skills to be competitive in the labor market in the future (Kostenkova, 2024).

The process of introducing innovative technologies includes the integration of digital tools and online platforms into all areas of educational and scientific life, as universities aim to empower students to learn more deeply, develop critical thinking, and train professionals who can compete in the international labor market.

Since the Industrial Revolution, Western science has become a powerful force that has shaped the lives of millions of people. Thomas Kuhn, in his work The Structure of Scientific Revolutions, proposed the concept of a paradigm shift, according to which scientific progress is not a gradual accumulation of knowledge, but occurs through revolutionary shifts when the old system cannot explain new phenomena. A paradigm defines the basic theoretical assumptions, methodological approaches, and way of thinking of the scientific community in a certain period, and its change means a radical reformatting of these foundations (Kuhn, 1996). In the context of digital education, we can talk about a paradigm shift from traditional learning to a digital and flexible learning environment. The traditional learning model, based on fixed curricula and hierarchical knowledge transfer, is gradually giving way to digital technologies that facilitate personalized and interactive learning. Key features of this transformation include:

- the transition to personalized learning – the development of online education, MOOCs (massive open online courses), micro-credentials and adaptive platforms is changing the role of the teacher, making learning more individualized;
- decentralization of knowledge – educational ecosystems such as Coursera, Udacity, GitHub, and Kaggle allow students to obtain knowledge from various sources, not just from traditional educational institutions;
- technological factors as a driver of change – artificial intelligence, virtual and augmented reality (VR/AR), big data analysis, and automated systems play a key role in shaping the new educational model.

Thus, modern digital education is an example of a paradigm shift, as it not only complements traditional approaches but also forms a new learning model that changes the role of teachers, students, and the educational process itself.

Recently, digital transformation has become an integral part of modern society's development, as it involves the transition from traditional ways of processing material to digital technologies to achieve greater productivity and improve results. Universities perform research and educational function, so it is important to undergo a complete digital transformation for the successful development and training of future professionals. The COVID-19 pandemic has accelerated this process, making digitalization a prerequisite for continuing the educational process. Higher education institutions must actively implement new technologies to attract the best students and improve the learning experience, teaching materials, and the overall education process. It also allows them to identify barriers to learning and reduce the dropout rate.

However, not everyone is ready to fully utilize the potential of digital technologies. The transition from traditional teaching methods to modern approaches is not limited to the use of digital tools and skills in their operation. It requires a user-centered approach and adaptation to the requirements of the modern educational environment, which requires a phased approach to technology implementation, taking into account the growing competition and needs of students (Nermend et al., 2022).

The unfavorable situation in the world caused by the pandemic has attracted the attention of the entire international community. As part of this, the world is forced to form a new learning paradigm. In general, the use of technology in the educational process is an important step towards its development and improvement. The integration of digital technologies significantly expands the possibilities of education and promotes its accessibility, which has become especially important in the context of the pandemic. Online classes and recorded lectures complement the traditional education system, increasing the level of quality control and expanding the reach of students. The transition to blended learning is a key trend in modern education, which involves the active use of artificial intelligence, virtual and augmented reality to overcome the limitations of synchronous learning. Educational technologies (EdTech) are focused on data analysis, immersive technologies and video content that enable personalization of the learning process. In the future, these approaches will help improve the efficiency of education and adapt it to the needs of students.

The concept of education is changing from the traditional acquisition of academic degrees within a certain time frame to a lifelong learning model. The educational process is becoming more flexible, allowing the acquisition of knowledge in blocks according to the needs of the individual, which promotes the integration of an interdisciplinary approach. Students will increasingly shape their own educational trajectories independently, which will change traditional ideas about the learning process. Self-directed learning will require students to take greater responsibility for their own development and to be able to set individual educational goals. As a result, the role of accountability and autonomy in the learning process will increase, which will contribute to more effective knowledge acquisition and the acquisition of key competencies (Paradigm Shift).

The new generation of higher education students is characterized by a shift away from the traditional linear learning model in favor of a flexible, multi-vector educational path. Their development is determined by the desire for self-realization, improvement of skills and expansion of knowledge in accordance with individual interests and ambitions. Despite the growing role of online education, effective ways to develop social capital during learning, as

well as opportunities for informal learning through platforms such as StackOverflow, GitHub, Kaggle, and social networks, are still under-researched. In addition, emerging technologies, such as geolocation, VR/AR, 5G, IoT, and artificial intelligence, have not yet been widely adopted in online courses and educational platforms. As a result, their potential to improve the learning process remains untapped. In the future, researchers should pay more attention to these aspects to create more effective and modern educational technologies (Gamage et al., 2023).

Universities at different stages of their development have always adapted to the needs of society and played a key role in scientific and technological progress. With the growing influence of Industry 4.0, there is a need for their transformation in accordance with the principles of the University 4.0 concept. The main factors behind the implementation of the University 4.0 principles are

- the rapid development of the high-tech industry and the growing need for new staff qualifications;
- development of information and communication technologies that open up new opportunities for education and science;
- the pandemic emphasized the importance of modern communication tools for the educational and professional environment.

Education and science shape innovations for industry, so timely and flexible adaptation of universities to modern requirements is a key factor in training specialists capable of innovative activities. The analysis of international experience plays an important role in understanding the transformation of universities. In general, a 4.0 university is an institution equipped with modern facilities and information and communication technologies that meet the requirements of Industry 4.0. The educational process there is built using these resources, focusing on the development of relevant skills and competencies in students (Kasych, 2022).

A group of researchers notes that universities have an important role to play in stimulating local innovation and socio-economic change (Gupta & Rosak-Szyrocka, 2024). They are active catalysts for transformation, facilitating the transfer of knowledge and developing the skills needed for the global digital economy. The concept of **“**University 4.0” is based on digital transformation as a key factor in enhancing innovation in various fields and envisages the following changes

- integration of lifelong learning into the education and training system;
- use of a personalized, flexible and adaptive approach to learning through modern technologies;
- focusing on the development of valuable human skills that go beyond traditional disciplines and are difficult to automate;
- formation of new interdisciplinary research areas at the intersection of technology, business and humanities to address the current challenges of the digital economy and society;
- introduction of cyber-physical technologies and new formats of cooperation between the public and private sectors to support education and research (Betts et al., 2024).

Education was constantly changing under the influence of industrial revolutions, adapting to new conditions. Education 1.0 was available only to a select few and was based on

memorization and informal methods. Education 2.0 expanded literacy through socio-economic progress and the advent of computers and the Internet. Education 3.0 has changed the format of learning by utilizing digital platforms and promoting knowledge generation. Education 4.0 has become flexible, learner-centered, with an emphasis on innovation and production. The main goal of the 4.0 concept is to use the opportunities of digitalization to increase the flexibility and competitiveness of companies. Changes in information and communication technologies affect the ways of thinking, living, learning and interacting, which in turn transforms the teaching and learning processes in higher education (Ülker & Otrar, 2024).

Thus, the digital transformation of education is an inevitable process that changes traditional approaches to learning, promoting its personalization and flexibility. The integration of modern technologies, including artificial intelligence, virtual reality, and adaptive platforms, opens up new opportunities to improve the efficiency of the educational process.

Discussion

Although the introduction of innovative teaching methods and information and communication technologies (ICT) into the modern educational process has become an integral part of higher education, contributing to the efficiency of learning, access to new knowledge and resources, and the development of key competencies of students, it also contributes to flexibility in the organization of the educational process. ICTs allow for the integration of various forms of learning, from traditional to online course formats, which allows for the satisfaction of diverse student needs, taking into account their individual characteristics and increasing motivation to learn.

Distance learning platforms, such as Moodle, allow students to access learning materials anytime and from anywhere. This is especially important in the context of globalization and student mobility. However, the introduction of ICT requires not only technical skills but also the ability to adapt traditional teaching methods to the new environment. The use of online tools such as video conferencing and interactive whiteboards requires teachers to be constantly engaged in professional development and ready for change.

The availability of artificial intelligence technologies facilitates their active implementation in the educational process. As the modern world is changing rapidly, scientists and the academic community cannot stand aside, as they need to adapt to new trends. This creates both new opportunities and challenges for education, particularly for teachers and students. The growing interest in the use of artificial intelligence in the academic environment opens up new perspectives, but at the same time, raises questions about adherence to the principles of academic integrity (Palamar & Naumenko, 2024).

Students need to develop digital literacy and the ability to use ICT effectively for independent learning. This includes skills in information search, critical analysis, and the use of a variety of digital resources. An important component is to ensure equal access to ICT for all students. Socio-economic factors that may affect students' ability to use digital technologies should be taken into account. Innovative teaching methods such as gamification and project-based learning are being actively implemented in higher education institutions. They help to increase student motivation and develop critical thinking. The main factor in the

development of information technology is qualified specialists who determine the success of all sectors of the national economy. In this regard, great attention should be paid to the quality of training of these specialists in higher education institutions. Graduates must have competencies that meet the current requirements of businesses and organizations. One way to solve this problem is to replace traditional teaching of academic disciplines with individualized e-courses. This approach is widely used in business education, and the term "customization" means adapting a product to the specific needs of the consumer by partially changing it or adding additional elements.

An e-learning course is a set of educational and methodological materials and services aimed at organizing both individual and group training using information and communication technologies. The main purpose of creating customized e-learning courses is to bring the learning process closer to the real needs of practice, taking into account the requirements of the organizations where future specialists will work. Customization of the course includes modular division of material, adaptive learning, creation of additional modules for successful students, master classes from practitioners, simulation methods of teaching, and the use of professional cases. Unlike a traditional course, a customized course consists of interconnected modules, where the mastery of each module depends on the previous one. This course structure allows us to identify students' weaknesses and provide them with targeted assistance in the learning process. This approach contributes to more effective learning and the development of practical skills.

The customization of courses is beneficial for higher education institutions as it allows them to increase the number of online courses created in cooperation with employers and expand their partner network, which increases the competitiveness of universities in the labor market. Customized courses allow students to reduce the time spent studying the basic material, as they can skip the repetition of topics they have already mastered and take a control exam. This reduces the workload on students, allowing them to focus on new material. The use of customized courses also reduces the number of classroom hours for instructors and the time required to check quizzes. Thus, customization of courses optimizes the learning process for both students and teachers (Bielikova et al., 2017).

In today's educational environment, tools such as Google Meet, Zoom, and Skype are gradually losing their relevance due to limitations in functionality, the need for integration with other platforms, and insufficient adaptation to modern requirements. They are being replaced by specialized and integrated platforms such as Microsoft Teams, Cisco Webex, and online learning platforms that combine video conferencing, collaboration, and learning management functions, such as Moodle or Blackboard. In addition, new technologies such as virtual and augmented reality (VR/AR), as well as platforms for creating interactive learning environments, such as Gather, are gaining popularity, offering new opportunities for real-time interaction and learning.

The role of artificial intelligence is also increasing, as it is not only easier but also more effective in teaching. AI is being actively implemented among students, reaching a wider audience and becoming an integral part of the educational process. Its main advantage lies in the ability to analyze specific issues and adapt educational programs to the characteristics of each student. The transformation of innovative AI-based tools contributes to the efficiency of education and provides a more flexible approach to learning in the digitalized world.

Researcher Hrytsenchuk (2024) notes that the use of AI systems in education contributes to the creation of adaptive learning materials, improved interaction and motivation of students, and improved learning outcomes. For teachers and administrators, these technologies allow for personalized learning, tracking student progress, assessment, and feedback. AI also helps to identify talented students and those who need additional support. The introduction of expert systems and immersive technologies in the digital learning environment can significantly improve the efficiency of the learning process.

Modern artificial intelligence technologies that are gradually being integrated into the educational process include expert systems, chatbots, intelligent tutors, personalized learning platforms, virtual learning environments, and machine learning technologies. The main areas of AI application in education are: personalization of learning, where AI analyzes data on students' performance and learning style to individualize educational programs; use of intelligent assistant systems, such as chatbots and virtual assistants, to support the learning process and help teachers prepare materials; learning analytics, which allows collecting and analyzing data to improve the educational process; automation of routine tasks, including scheduling and grading homework; and innovations in.

The use of AI systems can improve the learning process by providing individualized learning and support for students, including through personalized content, language capabilities, and digital skills development. For educators, AI can improve learning efficiency by helping to assess student progress, identify problems, and automate organizational processes such as checking work and assigning tasks. It also helps to ensure equal access to education and reduce the workload of teachers (Hrytsenchuk, 2024).

However, the benefits of AI are not so clear, although they are popular among students, as they can potentially not only improve the level of education but also potentially lead to a decrease in its quality. For example, the introduction of information and communication technologies can intensify the educational process, increasing the speed of perception and understanding of the material. On the other hand, excessive use of technology can lead to computer dependence and negatively affect students' mental health. As part of this, it is important to ensure a balanced approach to the integration of technology into the educational process in order to maximize its benefits and minimize potential risks. The integration of insufficiently researched technologies carries significant risks that can threaten people's conscious thinking and critical skills.

Currently, most innovation platforms are AI-powered. Artificial intelligence is rapidly spreading in the education space, contributing to the development of new revenue strategies, such as the sale of textbooks and books created by chatbots and AI-generated images. Its main advantage is the rapid search and organization of information, which allows users to quickly receive answers to queries.

Bearman et al. (2022) emphasize that the Covid-19 pandemic has accelerated the adoption of online technologies in higher education, facilitating machine-to-student interaction through AI. Artificial intelligence is used in learning management systems and commercial educational technologies, such as language learning applications. Computerization is facilitating the transition from routine tasks to analytical and interactive ones, which is affecting labor markets and education. AI is not only a technological innovation, but also changes the relationship between higher education and society. Universities should develop

clear policies and research programs on AI, taking into account its ethical aspects (Bearman et al., 2022).

Over the past five years, the use of artificial intelligence in higher education has increased significantly due to the emergence of new available tools. Researchers note that AI opens up opportunities for both teachers and students, contributing to the personalization of learning. Its benefits include adapting the educational process to the needs of different students, providing individual feedback, improving assessment, and predicting academic performance. Such research helps teachers to integrate artificial intelligence into the learning process more effectively (Crompton & Burke, 2023).

Holmes et al. (2022) emphasize that AI research in education is aimed at supporting the learning process of students. At the same time, the experience of other areas where AI is actively used indicates that good intentions are not enough to ensure the ethical use of technology. Increasingly, scientists are focusing on the ethical aspects of introducing artificial intelligence technologies into various spheres of human life, including education. As an innovative technology, AI has the potential to change the educational process, but at the same time, it raises the question of possible ethical challenges and risks. In particular, it is about protecting students' personal data, ensuring fairness in the use of algorithms, and avoiding possible biases in educational systems. Therefore, it is important to develop ethical standards for integrating AI into educational processes to maximize the benefits and minimize the negative consequences for all participants in education (Holmes et al., 2022).

Rof et al. (2022) note that although the sudden pandemic has accelerated the process of digital transformation, forcing higher education institutions to quickly adapt to new realities, and the transition to online learning and the introduction of digital technologies have expanded access to education, but despite this, universities have faced new challenges related to the quality of teaching and interaction between students and teachers. That is why universities must now reconsider their development strategies to ensure not only technological progress but also the preservation of the value of learning and educational traditions (Rof et al., 2022).

Conclusion

The study suggests that innovative teaching methods and information and communication technologies play a key role in the digitalization of higher education. Their application contributes to improving the efficiency of the educational process, expanding opportunities for interactive learning and improving the adaptation of educational programs to modern requirements.

The analyzed impact of digital technologies on educational activities, in particular their ability to improve communication between teachers and students, personalize learning, and integrate modern tools to increase student motivation and engagement, gives grounds to establish that the use of interactive platforms, distance learning, adaptive learning environments, and blended learning allows for more effective implementation of innovative approaches in the educational process. The paradigm shift in higher education, in particular through the integration of the latest technologies and innovative teaching approaches, creates new opportunities for the development of both students and teachers (Gandhi, 2025). The shift from traditional methods to more flexible, personalized, and technologically supported

learning models contributes to the efficiency of the educational process. However, this process also poses a number of challenges to education, including the need to adapt to changing conditions and ensure academic integrity in the context of digitalization and technological innovation. The need to further adapt higher education to digital realities by modernizing curricula, increasing the level of digital competence of teachers and students, and providing technical and methodological support in the implementation of the latest technologies has been established. Thus, the digitalization of higher education is not only a requirement of the times but also a strategic direction for the development of the modern educational system.

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