Impact of digital technologies on the quality of higher education

Impacto de las tecnologías digitales en la calidad de la educación superior

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Abstract

The content of the concept of "digital technologies" is presented. Their classification is proposed, which is effective in the formation of students' professional competencies and indicates the importance of digital technologies in the training of students, contributes to the ability to solve educational tasks independently, and creates the possibility of active individual activity in the modern digital world. The impact of digital technologies

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on the quality of higher education is shown. The tasks of digitalization set for a higher education institution are analyzed; the principles and conditions for the formation of a digital environment of a higher school that affect the quality of higher education and the general strategic goals of the development of the educational system are revealed. The general strategic goals of the development of the educational system are taken into account when solving the problem of using digital technologies for high-quality higher education. The importance of virtual reality technology is shown, and virtual modeling and electronic immersive learning technologies for high-quality higher education in the educational space are revealed. The importance of the digital university is shown as a requirement of an innovative modern digital educational space. A system for forming a specialist's digital competence is proposed. Analysis of data obtained during the sections of the formative stage of work recorded the dynamics.

Keywords: digital technologies, quality of higher education, virtual reality technologies, virtual modeling, digital university.

Resumen

Se presenta el contenido del concepto de "tecnologías digitales" y se propone su clasificación, que es efectiva en la formación de competencias profesionales de los estudiantes e indica la importancia de las tecnologías digitales en la preparación de los estudiantes, promueve la capacidad de resolver de forma independiente tareas educativas, crea la posibilidad de una actividad personal activa en el mundo digital moderno. Se muestra la influencia de las tecnologías digitales en la calidad de la educación superior. Se analizaron las tareas de digitalización que tiene ante sí la institución de educación superior; Se revelan los principios y condiciones de la formación del entorno digital de la escuela superior, que inciden en la calidad de la educación superior y los objetivos estratégicos generales del desarrollo del sistema educativo. Los objetivos estratégicos generales del desarrollo del sistema educativo se tienen en cuenta al resolver el problema del uso de tecnologías digitales para la educación superior de alta calidad. Se muestra la importancia de la tecnología de realidad virtual, se revela la simulación virtual, las tecnologías de aprendizaje por inmersión electrónica para una educación superior de alta calidad en el espacio educativo. Se muestra la importancia de una universidad digital como requisito de un espacio educativo digital moderno e innovador. Se propone un sistema de formación de la competencia digital de un especialista. El análisis de los datos obtenidos durante los tramos de la etapa formativa del trabajo registró la dinámica.

Palabras clave: tecnologías digitales, calidad de la educación superior, tecnologías de realidad virtual, simulación virtual, universidad digital.

Introduction

Global trends in the development of both education and management of educational institutions are aimed at transitioning to digital transformation. This means that all educational, scientific, administrative, and other processes of a higher education institution must completely transition to a digital environment. Without digital transformation, a higher education institution cannot effectively organize high-quality educational processes and remote work of its departments with documents and cannot function normally in competitive conditions, which negatively affects students, teachers, and employees (Koval-Mazyuta et al., 2023).

Traditional approaches to automating the activities of a higher education institution have lost their effectiveness and can no longer meet modern requirements. Automated systems of learning, management, and accounting not only do not solve all the tasks of a higher education institution, but they also divide the information space by those functional tasks for the solution of which this or that information is required. Usually, these are separate tools that are not combined into a single system for solving the functional tasks of a higher education institution. And, of course, such an approach does not allow for the effective implementation of digitalization projects and does not allow for the creation of a single system for building digital universities. New approaches and new concepts of digital transformation of higher education institutions are needed. Approaches that will allow for the unification of all processes of creating and using software and information tools for the construction of digital universities (Kovalskyi & Kyslenko, 2024).

Therefore, an urgent scientific task arises, which is to develop methods and models of digitalization of higher education institutions based on the unification of all functions, procedures, and information bases into a single concentric information technology for the digital transformation of educational activities of a higher education institution (Karpliuk, 2017).

The development of digital technologies in the high-quality training of future specialists is currently a relevant issue of the theory and methodology of teaching in the educational process. Based on this, we considered the following issues in the article:'

‒ The content of the concept of "digital technologies" and their classification.
‒ The impact of digital technologies on the quality of higher education.
‒ Digitalization tasks are set for higher education institutions.
‒ Principles and conditions for the formation of a digital environment of a higher education institution that affects the quality of higher education and the general strategic goals of the development of the educational system.
‒ Taking into account the general strategic goals of the development of the educational system when solving the problem of using digital technologies for high-quality higher education.
‒ Virtual reality technologies and virtual modeling, electronic immersive learning technologies for high-quality higher education in the educational space.
‒ A digital university is a requirement of an innovative, modern digital educational space.

Therefore, the relevance and insufficient development of the issues of the theory and practice of the impact of digital technologies on the quality of higher education determined the choice of the topic of the article.

Literature Review

In the global scientific debate, scientists have made several positive changes in the development of digital technologies and the digital competence of specialists, but the process of influencing digital technologies on the quality of higher education requires improvement and optimization.

The analysis of scientific publications and research, the identification of the main trends in the development of digital education, and the study of existing practices in this area were analyzed by A. Gedzyk (2024). The results of the study include an analysis of massive open online courses, a review of the evolution of distance learning, an identification of the advantages of such technologies and the challenges of their use, and examples of successful implementation in higher education are also provided.

In connection with the integration of digital technologies into all modern fields of science, technology, and professional human activity, V. Kovalsky & D. Kyslenko (2024) analyzed the pedagogical aspects of the use of digital technologies in higher education; key terms were defined, changes occurring in pedagogical practice were considered; drew attention to the analysis of the role of adaptability of digital resources and mobility, which contributes to the involvement of students in innovative activities and greater flexibility of teaching methods in the educational process.

Thus, the authors' works highlight the resources used in teaching: multimedia platforms, social networks, learning management systems (Google Classroom, Moodle), artificial intelligence algorithms that allow adjusting educational content according to the individual needs of each student, the use of game elements in teaching, which stimulates the active participation of students in the educational process.

The features of virtual reality are considered by A. Ulishchenko & V. Ulishchenko (2022), which is the basis for teaching students of higher educational institutions to use and develop IVR technologies. An overview of several VR platforms is offered, and attention is also focused on various aspects of organizing online teaching. It has been proven that the use of 360° visualization offered on various Internet resources allows you to create an immersion effect in the communicative environment when learning a language and contributes to the improvement and acquisition of practical communication skills. Continuing the authors'

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opinion, O. Tovkanets (2018) considers the main strategic aspects of the development of digital technologies in European higher education. Documents on the problems of the Council of Europe strategy are analyzed. To ensure the competitiveness of future specialists, competencies, and professional knowledge to contribute to innovation for successful entry into the European labor market, ways of implementing digital technologies at the international and national levels have been identified. An attempt to analyze the modern definition of "digitization" of the information society was made by S. Karplyuk (2019). Thus, several authors' data reveal the process of digitalization and informatization of modern spheres of human activity. The main directions and results of the digital revolution are outlined. It is proven that the digitalization of education directly depends on the degree of mastery of digital technologies of higher education teachers and the level of digital literacy of students. The main tasks of each higher education institution regarding the digitalization of its activities are determined.

Having analyzed the works of the authors, we note that the researchers paid attention to the analysis of the role of adaptability of digital resources and mobility, which contributes to the involvement of students in innovative activities and greater flexibility of teaching methods in the educational process. The tools used in teaching were considered: multimedia platforms, social networks, learning management systems (Google Classroom, Moodle), and artificial intelligence algorithms, which allow adjusting educational content to the individual needs of each student. It is proven that the digitalization of education directly depends on the degree of mastery of digital technologies of higher education teachers and the level of digital literacy of students.

According to the results of studying the works of scientists, it was found that the problem of the impact of digital technologies on the quality of higher education was not the subject of separate special studies. The need to study and solve the specified problem and its relevance is due to the existing contradictions between:

– Modern requirements for the organization of the educational process of students, and insufficient justification of the conceptual, didactic, and methodological foundations of the formation of digital competence of education seekers;
– The needs of society in future specialists with a high level of formation of digital competence and the real state of students' training;
– The didactic potential of modern education in the formation of digital competence of students in the educational environment and the lack of certain substantiated didactic conditions, the creation of which will contribute to the effectiveness of the implementation of this process.

Therefore, a conceptual study of this problem will allow designing digital technologies in higher education institutions that will contribute to ensuring high-quality training of specialists in the conditions of a digital society.

The purpose of the article is to show the influence of digital technologies on the quality of higher education to analyze the pedagogical aspects of the use of digital technologies in higher education.

Methodology

Research methods are based on general scientific and systemic approaches that are focused on studying terminology, specifics of functioning, and cognitive perspectives of the problem.

The study uses theoretical research methods (generalization of publications, analysis of the source base, software options) and empirical research methods (observation of the educational process in higher education, student audience, questionnaires, surveys); methods of statistical and mathematical data processing to clarify the reliability of the quantitative and qualitative analysis of the results of the experiment (Fisher's angular transformation).

In our case, the state of the subjects at the beginning and the end of the experiment was considered. A comparison was made according to the frequency of the studied indicators (generalized indicators; the level of formation of each of the components). The conversion into the values of the central angle of the percentages, given in radians, is the Fisher angular transformation φ. A larger percentage corresponds to a larger angle $\varphi1$ and a smaller angle $\varphi2$ to a smaller one. It should be noted that the relationship between these values is nonlinear: $\varphi = 2arcc\ddot{\imath}n\sqrt{P}$, (1), where P is the percentage expressed in fractions of a unit. The values of the criterion increase with an increase in the number of samples or an increase in the angles of divergence. The existing differences between the samples are non-random, the more likely, the larger the value of φ.

The study had the following statistical hypotheses:

− H0: the level of formation at the end of the experiment of the corresponding indicator is not higher than at the beginning of the experiment;
− H1: the level of formation at the end of the experiment of the corresponding indicator is higher than at the beginning of our experiment.

As a result of our work, a pedagogical experiment was conducted, which took place within the framework of the annual program.

To determine the level of formation of a specialist's digital competence, surveys were conducted among students divided into CG and EG regarding the formed skills of working with digital tools and existing knowledge that emphasize digital competence.

The summarized results of the initial levels of formation of digital competence of specialists of EG and CG at the ascertaining stage of the study indicate the need to develop a system for the formation of a specialist's digital competence, introduce changes, implement and search for effective methods, forms, and means of forming the digital competence of a future specialist.

Therefore, the implementation of the system for the formation of a specialist's digital competence involved conducting a formative stage of the experiment.

Based on the research, we developed a system for the digital competence of a specialist.

We took into account the fact that the answers to the questions reflect the most accurate picture of the specialist's digital competence, and it is the answers to the questions that are required of users and are based on the results of performing innovative tasks, we formed levels based on the results, not through self-assessment.

To conduct a statistical analysis at the beginning of the experiment and at the time of its completion, we compared the state of the group. Fisher's angular transformation φ was used. The effectiveness of the developed system for forming a specialist's digital competence is evidenced by the obtained indicators. The effectiveness and efficiency of training were checked using the consumer loyalty index – NPS and key performance indicators – business indicators KPI, which are universal.

To assess the quality of the training organization, we used the NPS (Net Promoter Score) consumer loyalty index. Respondents were classified by their degree of readiness to recommend the digital competence formation system (training, methodology) to other people using questions.

When receiving the NPS index, we made the following conclusions:

− An index of more than 50% indicates high results, where the respondent is noted as a leader in the labor market with a high level of digital competence formation using the system for the formation of a specialist's digital competence;

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- From 30% to 50%, the index indicates a good result of the formation of the level of digital competence using the system for the formation of a specialist's digital competence. However, we took into account that a series of errors or a negative incident can affect the reputation of the organizer of the system for the formation of a specialist's digital competence;
- Up to 30%, the index indicates the presence of minor problems in the formation of the level of digital competence using the system for the formation of a specialist's digital competence, which requires attention to all structural divisions that conduct direct training;
- Less than 0% – a negative index, which indicates that the number of respondents dissatisfied with the system for forming the digital competence of a specialist significantly exceeds the number of satisfied respondents and is a systemic problem.

The NPS index we obtained = 48, which indicates a high-quality organization of training in general and indicates a high-quality experiment, a correctly chosen tactic, and a strategy for building a training system, which is based on the effective formation of digital competence of respondents using the developed system. Since the respondents who are studying will be competitors in the services market, we assessed the results of the experimental work using the Key Performance Indicators (KPI) indicator.

Key performance indicators are KPIs used to assess the achievement of goals and their clear reflection or optimality of the process and are measured in numbers, as well as achieving efficiency and effectiveness of the process. An important management tool is key performance indicators, which allow you to evaluate and control the work of departments, working groups, individual specialists, and companies. KPI analysis contributed to the assessment of the implementation of the selected strategy for forming the digital competence of a specialist. In our study, the indicators were:

- KPI – the ratio of respondents who successfully completed their training and the formation of their digital competence corresponds to a high level;
- KPI-2/1, KPI-3/1, KPI-3/2 – the ratio of respondents who joined the number of participants of the previous level – to the next level. During the basic level of the training course, an experiment was conducted in which we analyzed the dynamics of the results obtained in the context of each of the levels;
- More than 75% of students successfully completed the basic level of training, which for a mass course is a very high indicator of the formation of their digital competence (the indicator fluctuates within 10-25%);
- 82% of respondents passed the average level of training;
- 72% of respondents passed the advanced level of the course (data according to the KPI indicator).

Other indicators (KPI-2/1, KPI-3/2, KPI-3/1) indicate that after completing the training on the developed system for the formation of digital competence of specialists of the full-fledged basic level course, we managed to keep the attention of respondents who joined the advanced level of the course and the intermediate level of the course. More than 20% of respondents successfully completed the three levels of training on the developed system for the formation of digital competence of specialists.

We note that there were no requirements for mandatory training at all levels because the material of the basic course already allowed respondents to effectively use the proposed digital tools in their professional activities, which was provided to them by the developed system for the formation of digital competence of specialists.

The analysis of data obtained during the sections of the formative stage of work recorded the dynamics.

The implementation of the pedagogical experiment was carried out in three periods: preparatory, main, and final.

At the preparatory stage, the purpose and objectives of the study were determined, an experimental plan was created, methods of measurement and processing of results were indicated, control and experimental groups were selected, and their homogeneity was checked.

At the main stage, the experiment was conducted.

At the third, final stage, the results of the experiment were analyzed, their reliability was confirmed, and conclusions were drawn about the pedagogical effect of the experiment.

The reliability and validity of the results obtained and the objectivity of their assessment were ensured by the methodological soundness of the initial positions and the qualimetric mechanism for assessing the quality under study, the use of a complex of complementary research methods, and the involvement of a group of respondents from a higher educational institution in the analysis of its results.

The study largely depends on the accuracy and reliability of the data. In research, the quality of data collection and analysis not only adds weight to the research but also contributes to the formation of sound conclusions, which is key to academic success.

The following digital tools for data collection were useful in the study: Microsoft Excel or Google Sheets - spreadsheets are useful for organizing and analyzing collected data when working with quantitative data. The total sample size was 86 subjects. The sample was formed by random selection using the technical procedure of calculating the selection step.

The results of the experimental study confirmed the applicability, optimality, and effectiveness of the proposed ways of the impact of digital technologies on the quality of higher education.

Results and Discussion

The content of the concept of "digital technologies" and their classification.

The educational environment in which learning takes place is significantly affected by the adaptability of digital technologies and mobility. It is such an educational environment that acts as a tool for adaptation and personal flexibility to changed forms of educational interaction of the individual, characterized by the absence of temporal, geographical, and territorial restrictions and high dynamism of the educational process. The development of the educational environment is closely related to the use of modern digital innovative technologies.

The wide application of the concept of "digital technologies" in the process of analyzing international regulatory legal acts at the world level has been revealed. M. Zhurba (2013) describes digital technologies as technologies where information is encoded into discrete signal pulses. O. Bernazyuk (2017) refers to the concept of "digital technologies" as technologies that use digital signals to transmit information.

Scientific research proves that it is important for education that publishing and technology companies, together with professional associations, actively stimulate and support the efforts of higher education teachers in implementing digital technologies for continuous innovative improvement of the educational process (Mytnyk et al., 2024). This approach contributes to the success of an individual on his educational path and the demand for such a person in society in general and in the labor market in particular. When higher education teachers use the latest digital resources available on the market, these efforts become even more effective in increasing student engagement and interactivity. As the monitoring of online resources has shown, there are digital tools that create conditions for innovative activity of teachers and active educational activity of higher education students in the electronic educational environment (Yuriy et al., 2022).

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Digital technologies are classified into several areas. Let's consider them:

- Learning Management Systems, such as Google Classroom, Moodle, WebCT, Canvas, and Blackboard, which at various levels contribute to the implementation of educational processes and support the implementation of online courses;
- Social networks, such as Facebook, Twitter, Instagram, Clubhouse, Ning, LinkedIn, and Academia.edu, play an important role in the exchange of experience between scientists and students and the establishment of professional contacts;
- Tools for interaction, publication, and sharing (podcasts, YouTube, video lectures, e-books, Google documents, Mind Maps, social bookmarks, Blogs, and Wikis, which facilitate knowledge exchange and collaboration;
- Virtual reality, real-time programs, online games, and virtual laboratories, which allow for experimentation and reproduce real conditions in controlled conditions;
- Mobile applications (apps), software for tablets, smartphones, and other mobile devices, which facilitate learning anywhere and at any time;
- Interpersonal communication tools, including e-mail, Viber, Telegram, ZOOM, WhatsApp, Telegram, Discord, Skype, forums, online projects, and webinars, which provide communication between participants in the educational process;
- Content aggregation tools, such as Google Reader, NetVibes, and RSS feeds, which help to quickly organize and collect text data;
- Feedback and assessment systems, such as electronic testing via Moodle and Google Forms, as well as electronic note-taking and reflection systems such as Evernote, Pages, and Trello.

The proposed classification is effective in forming students' professional competencies, indicates the importance of digital technologies in the training of students, contributes to the ability to independently solve educational tasks, and creates the possibility of active individual activity in the modern digital world.

The impact of digital technologies on the quality of higher education.

To form the digital competence of specialists and develop a system for forming the digital competence of students, to introduce changes, implement, and search for effective methods, forms, and means of forming the digital competence of a future specialist, we analyzed the impact of digital technologies on the quality of higher education.

The ability to expand and enrich traditional forms of education is one of the key aspects of the use of digital technologies.

Deeper involvement in the educational process of higher education applicants is facilitated by the interactivity provided by digital resources.

Digital tools and multimedia materials, such as virtual laboratories and simulations, bring diversity to teaching methods, which helps future specialists better develop practical skills in a controlled and safe environment and master complex concepts.

It can make learning more accessible and flexible – the use of open educational resources and online courses allows students to study the material at any convenient time and at the pace that is optimal for them. Each student can choose an individual approach to learning, taking into account their own educational goals and needs, which contributes to creating conditions for independent learning for each individual, which was taken into account in the experimental work when developing a system for forming students' digital competence.

Pedagogical opportunities in higher education are significantly expanded by digital technologies, in particular through the personalization of the educational process and increased accessibility.

With the help of digital technologies, the democratization of access to education opens up the opportunity for students from all over the world to receive high-quality knowledge without geographical restrictions.

Through the personalization of the educational process, the digitalization of education brings innovations. Artificial intelligence algorithms and intelligent educational systems allow you to customize educational content, taking into account the individual needs of each student and their characteristics.

This approach significantly increases students' motivation to learn and not only helps optimize the learning process since the material is presented in a clear, convenient way, adapted to the individual pace of the student for high-quality assimilation of information (Kovalskyi & Kyslenko, 2024).

There is a need to implement a digital revolution in the educational sector, given such rapid and significant rates of scientific and technological progress, since the modern information society requires fundamentally new approaches to obtaining a quality education, starting from the preschool age. With such an approach, it is worth looking for new ways, methods, and means of training highly qualified specialists who will be able to develop, disseminate, and implement digital education and who will have the basics of digital literacy. This task can be achieved within the walls of higher education through a qualitatively adjusted educational process (Karpliuk, 2019).

Digitalization in education, i.e., life-long learning, as well as its individualization based on advanced learning technologies, is aimed at ensuring the continuity of the learning process (lifelong learning). The content of digital technologies by individual students when studying certain disciplines includes the use of significant data in education about the process of professional growth, automatic adaptation of the educational process, the use of augmented reality, virtualization, cloud computing, and many other technologies (Karpliuk, 2019).

The impact of digital technologies on the quality of higher education depends directly on the level of mastery of digital technologies by the teacher to use them productively in educational activities. Today, there is a need to develop in teachers the ability to navigate the flow of digital information, process it, work with it, and integrate it into new pedagogical technology. The information format is based on the digital presentation of information. The digital format, unlike the electronic format, represents information more accurately, ensuring placement, processing, free circulation, and use in computer networks. The digital education system includes a management system, telecommunications, and information resources (Vasylyk & Kushnir, 2018). To form the digital competence of specialists and develop a system for forming the digital competence of students, to introduce changes, implement and search for effective methods, forms, and means of forming the digital competence of a future specialist, we used digital technologies in the educational process of higher education.

Recently, the process of using and creating open online resources has been actively implemented, ranging from tests and individual tasks to modules and full-scale courses to form the necessary competencies of a specialist. The growth in the availability of online courses demonstrates the dynamics of the development of online learning.

The practice of blended learning and online courses creates a field of unlimited educational opportunities that orient each person by their interests and capabilities to the quality of education, regardless of their skills and place of residence (Knysh et al., 2024).

The following changes require a teacher to be fluent in the digital educational environment. Therefore, a promising task for all higher education institutions is to improve digital literacy and teacher qualifications, focused on the use of the digital environment in the educational process, which requires teachers to have a different picture of the world, mentality, and perfect forms and methods of working with students (Marrero-Sánchez & Vergara-Romero, 2023).

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Digitalization tasks are set for higher education institutions.

The higher education institution set the tasks of digitalization to form the digital competence of specialists and develop a system for forming the digital competence of students. The content of digital technologies and digital literacy of the individual comes down to understanding: if there is clarity in the structure and content of digital reality, then there will be clarity in interaction with digital technologies and in the control of knowledge and skills (Sulym et al., 2023).

Let's formulate the digitalization tasks that must be set for higher education institutions to form the digital competence of specialists and develop a system for forming the digital competence of students:

– Implementation of digital technologies in the educational process;
– Improving the qualifications and ensuring innovative training of higher education teaching staff on the use of digital technologies in educational activities;
– Providing the opportunity for free access to digital resources in cloud services and their collective use;
– Providing consulting and information services on the use of cloud and digital technologies with unlimited resources;
– Through the introduction of digital technologies – creating innovative conditions for development;
– Dissemination, systematization, and accumulation of information by a higher education institution on the use of cloud and digital technologies.
– Ensuring that teachers and students increase the level of motivation to use and professional improvement by introducing digital technologies into professional activities.

Having completed these tasks, the education system will be able to ensure a confident transition to the digital era of society, focused on virtual and augmented reality, building individual learning routes, increasing the productivity of the educational process, managing one's own learning outcomes, etc. (Karpliuk, 2019).

Principles and conditions for the formation of a digital environment of a higher education institution that affects the quality of higher education and the general strategic goals of the development of the educational system.

The formation of a digital environment for obtaining higher education should be based on innovative principles, which are necessary for the formation of the digital competence of specialists and the development of a system for the formation of the digital competence of students to introduce changes, implement and search for effective methods, forms, and means of forming digital competence of a future specialist:

– Compliance with the trends in the development of electronic learning (e-learning), world standards, and learning management;
– Integration into a networked multilayer world information space;
– Unification of navigation tools, which provides users with the opportunity to access all information resources conveniently and quickly;
– The presence of an information-network internal open structure that ensures the integration of administrative, scientific, and educational divisions of a higher education institution;
– Compliance with copyright and ensuring information security requirements.

The main goal of the digital environment of a higher education institution should be in an authorized mode, focused on different groups of users, in ensuring the possibility of interactive remote access to all innovative information educational resources.

When developing a system for forming students' digital competence, we considered the advantages of the digital environment of higher education to be: the possibility of using various multimedia components of educational materials, numerous open information resources, the presence of an e-portfolio that integrates learning outcomes, interactive communication in a subject context with other students and the teacher; flexibility of time parameters and learning trajectory. Such a digital environment of higher education provides the teacher with the opportunity to promptly update educational resources, adjust the educational process, carry out automatic monitoring of educational activities according to the needs of each student, control in detail, and organize the independent work of higher education applicants.

Today, in higher education, due to the impact of digital technologies on the quality of higher education, a new paradigm of equal access based on modern ICT to quality education is being formed.

An open process of the impact of digital technologies on the quality of higher education was carried out in the formation of digital competence of specialists and the development of a system for the formation of digital competence of students under such conditions in higher education:

− Development and formation in higher education institutions of a safe, educational environment and a pedagogically balanced environment;
− Introduction into educational practice of innovative digital technologies and methodological training systems, information and analytical systems for managing education and science and supporting scientific research;
− Ensuring access to digital technologies for all participants in the educational process of higher education, creating high-quality electronic educational resources;
− Ensuring timely updating of the composition and functioning of digital technologies;
− Conducting retraining, continuous training, and advanced training of personnel in the direction of creative and active use of digital technologies in professional activities;
− Ensuring the functioning and creation of units and institutions that support digital technologies and coordinate at all organizational levels the processes of informatization of the institution by the prospective and current tasks of the educational industry and society (Romanova et al., 2022).

Taking into account the general strategic goals of the development of the educational system when solving the problem of using digital technologies for high-quality higher education.

When solving the problem of using digital technologies for high-quality higher education, it is necessary to take into account (including innovative aspects) the general strategic goals of the system development and formation of digital competence of students to introduce changes, implement and search for effective methods, forms, and means of forming digital competence of a future specialist:

− Creation of virtual groups and formation of network communities for information exchange at the international and national levels;
− Creation of special services to help teachers based on publicly available resource centers;
− Improvement of skills in mastering digital technologies for high-quality higher education will allow teachers to use not only new programs in teaching but also to develop their own methods in the educational digital environment;
− Use of digital technologies in administrative work, and not only in educational activities, will ensure productive, more precise work with personnel and will allow more time and resources to be allocated to solving problems related to education;
− Systematic monitoring of the use of digital technologies for high-quality higher education.

Therefore, the use of digital technologies for high-quality higher education at the beginning of the 21st century is a strategic priority of socio-economic development and the educational policy of society (Tovkanets, 2018).

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Virtual reality technologies and virtual modeling, electronic immersive learning technologies for high-quality higher education in the educational space.

To form digital competence in specialists and develop an original system for forming digital competence of students, we used virtual reality technologies and virtual modeling, electronic immersive learning technologies for high-quality higher education in the educational space. Virtual reality technologies and virtual modeling open up broad prospects for using the latest achievements of computer technologies in the educational space for high-quality higher education, provide teachers and students with convenient tools for teaching and learning, for the formation of practical professional skills, and contribute to the transfer of skills and knowledge to non-standard, new situations when learning organized in one context affects performance in another context (Kuchai et al., 2022). IVR technology significantly helps in such transfer of acquired experience to real situations. In the context of learned algorithms of actions and specific activities, it is virtual modeling that contributes to the actualization of knowledge (a virtual "tour" of the human brain using IVR aids in the productive assimilation of brain anatomy). (Shuliak et al., 2022).

In recent years, the ecosystem approach has been analyzed and discussed quite actively, which is relevant for all spheres of society, including the educational sector (Hrynevych et al., 2021). We used the ecosystem approach in forming digital competence in specialists and developing an author's system for forming digital competence in students in higher education as one of the solutions to the problem of forming practical skills that were acquired according to the traditional model.

The ecosystem approach is related to lifelong learning and means harmonious relationships between all components of the education system, teachers, and students. The ecosystem approach creates favorable conditions for thinking and developing new ways of learning, teaches to cooperate and live in a new way, and opens up space for the development and improvement of network learning models (network courses, virtual laboratories, and schools).

Effective modern electronic immersive learning platforms make it possible to display a different image for each eye, creating visual signals for the perception of image depth, tracking changes in head position, and, as a result, significantly increasing the size of the field of view compared to a conventional monitor. These factors are very important for creating innovative educational projects for developing meaningful and interesting content for higher education. That is why it was used in the formation of digital competence in specialists and the development of an author's system for the formation of digital competence in students in higher education.

Compared to traditional multimedia means, the determining factor of learning is the use of IVR – video, PowerPoint, a high level of interactive interaction, since instant feedback between real movements and the corresponding visual effect is a technical feature of the IVR educational environment, the ability to control the process of higher education, directing professional training in the desired direction (Knysh et al., 2023). As a mosaic of technologies, IVR can be considered to support the creation of spatial, highly interactive, synthetic, three-dimensional (3D) environments that simulate unreal situations or real ones. In the field of information technology, thanks to rapid progress and the spread of free and paid programs, today, you can get an exciting experience of immersion in virtual reality. Such opportunities associated with the introduction of technological approaches and methods that meet the needs of modern society open up new prospects for education. As a component of the educational ecosystem, digital learning platforms provide teaching online courses using audio-video communication, digital collaboration between teachers and students, general management of online teaching, creation of digital content and publication of courses; support the creation of video content, facilitate the exchange of information between the teacher and students, which forms digital ecosystems for work. And since many platforms are intuitively quite understandable, only basic knowledge of digital technology is required (Ulishchenko & Ulishchenko, 2022).

A digital university is a requirement of an innovative, modern digital educational space.

To develop effective teaching methods, it is important to understand the pedagogical aspects of using digital technologies in higher education that meet the requirements of an innovative modern educational space.

In recent years, the digitalization of the educational process of higher education has been recognized as a significant factor in the development of economic, political, cultural, and social relations in society. The concept of a "digital university" is revealed when it comes to the modernization of higher education and its main trends. During the transition of higher education institutions to distance and blended learning during the pandemic, even more, attention began to be paid to the issues of digitalization of higher education. The transition to a digital university from a traditional one involves a change in priorities, goals, organizational approaches, principles, corporate ideology, the structure of the institution, etc., and not just the quantitative accumulation of technical means. In the network, it is possible to combine digital individual universities for which there are no geographical restrictions and political boundaries, although the emergence of such higher education institutions requires a certain unification of requirements and rules for the participants of the association. The transition of higher education institutions to a digital innovative structure involves a set of measures in the following areas: economic, organizational, regulatory, ideological, and social (Reshetylov et al., 2022).

Modern universities have faced several challenges in creating an innovative modern digital educational space, namely:

- The need to form an optimal structure in a higher education institution and combine the components of this structure into an effective system (a digital university is formed precisely based on such a structure);
- Searching for a model of digitalization within the limits of the autonomy determined by each higher education institution;
- Determining the types of activities, tasks, and roles for teachers of such a university;
- Searching for methods and methods of distance learning corresponding to educational tasks;
- Combining effective network tools, technical means of learning, and elements of digital technologies, which are in each university, into a system based on which the digital university is formed;
- Replacing the virtual network, classroom (traditional) educational space with a virtual one;
- Establishing effective communication in the network environment of all participants in the educational process of higher education.

In response to significant changes in society, universities develop their own digital strategies through the use of new digital technologies while not having the ability, determination, and vision to effectively implement them.

Each digital university must maintain structural, organizational, content, and personnel originality in the conditions of functioning of open educational systems within the autonomy of the institution (legislated) and single educational legislation of the legal field.

The search for the optimal combination of the activities of a digital university and the regulatory unification of basic procedures and processes of organizational identity is the main challenge for implementers of ideas for the digitalization of higher education.

In the context of a digital university, distance learning is a coordinated time and space, purposefully organized process of educational interaction between teachers and students based on appropriate information technologies and technical means (Areshonkov, 2020).

Therefore, to form digital competence in specialists and develop an original system for forming digital competence in students, we tried to create a system of the educational process of a digital university in

higher education, which is a requirement of an innovative modern digital educational space and a necessity for developing effective teaching methods, understanding the pedagogical aspects of using digital technologies in higher education, which meet the requirements of an innovative modern educational space and are necessary for the further professional activities of each person.

The experiment

As a result of our work, a pedagogical experiment was conducted, which took place within the framework of the annual program.

In the current educational process, experimental work was carried out without violating the content of the curriculum and the structure of classes.

The experimental study was conducted during 2022–2024. It included interrelated stages of the experiment: analytical (2022), ascertaining (2023), formative (2024)

The program set the tasks of digitalization for the higher education institution to form the digital competence of specialists and develop a system for forming the digital competence of students. The formation of the digital environment for obtaining higher education should be based on innovative principles that are necessary for the formation of the digital competence of specialists and the development of a system for forming the digital competence of students to introduce changes, implement and search for effective methods, forms, and means of forming the digital competence of a future specialist. When solving the problem of using digital technologies for high-quality higher education, we took into account (including innovative aspects) the general strategic goals of developing the system for forming the digital competence of students. To form the digital competence of specialists and develop an original system for forming the digital competence of students, we used virtual reality technologies and virtual modeling, electronic immersive learning technologies for high-quality higher education in the educational space.

To form digital competence in specialists and develop an author's system for forming digital competence in students, we at the higher school tried to create a system of the educational process of a digital university, which is a requirement of the innovative modern digital educational space and a necessity for developing effective teaching methods, understanding the pedagogical aspects of using digital technologies in higher education, which meet the requirements of the innovative modern educational space and are important in the further professional activities of specialists.

To determine the level of formation of a specialist's digital competence, we conducted surveys of students divided into CG and EG regarding the formed skills of working with digital tools and existing knowledge that emphasize digital competence. The CG and EG groups consisted of graduating students of socio-economic specialties.

The summarized results of the initial levels of formation of digital competence of specialists EG and CG at the ascertaining stage of the study indicate the need to develop a system for the formation of a specialist's digital competence, introduce changes, implement and search for effective methods, forms, and means of forming the digital competence of a future specialist.

Therefore, the implementation of the system for the formation of a specialist's digital competence involved conducting a formative stage of the experiment.

Based on the research described above, we developed a system for the digital competence of a specialist: We identified the prerequisites for the formation of a specialist's digital competence:

– Taking into account virtual reality, information reality, and the features of the information society;
– Substantiation of the digital competence of a specialist;

- Interpretation of the interdependence of the digital competence of a specialist and his competence;
- The soundness of the teacher's digital competence based on the systematic consideration of laws, categories, and methods;
- Improving the level of formation of digital competence.

The main principles of the formation of the digital competence of a specialist were the priority of the human factor, integrity and comfort of the educational environment, adaptability, systematicity, reproducibility, cooperation, conformity to nature, variability, and unity of forms of self-education and training.

For the formation of the digital competence of a specialist, the following important approaches were identified: a synergistic approach, an integrative approach, a systemic approach, an axiological approach, an andragogical approach, and a competency-based approach.

Indicators were formed to determine the effective content and methodological support of the system for the formation of the digital competence of a specialist:

- A set of practical tools and methods of the educational process;
- Open educational digital resources;
- Curricula and courses for the professional training of specialists;
- Materials for the student's independent study.

We took into account the fact that the answers to the questions reflect the most accurate picture of the digital competence of a specialist, and it is the answers to the questions that are required from users and are based on the results of performing innovative tasks, we formed the levels based on the results, not through self-assessment.

As the results of the ascertaining stage of the experiment showed, the majority of respondents were at the following levels (Fig. 1):

- High level (professional) – 20%;
- Medium level (user) – 41%;
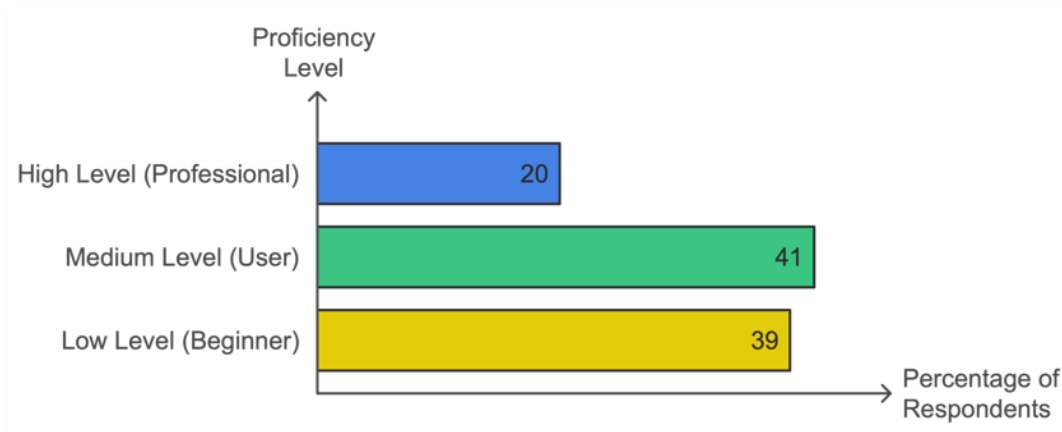- Low level (beginner) – 39%.

Figure 1. Proficiency Levels of Respondents.

After the formative stage of the experiment, diagnostics of the level of formation of the digital competence of the future specialist were carried out twice.

Positive dynamics were observed at each level (Fig. 2):

- At the beginner level – the percentage of respondents decreased to 13% from 39%;
- At the user level – the percentage of respondents decreased to 11% from 41%;
- At the professional level – the percentage of respondents increased to 76% from 20%.

The participants of the experiment stated that the most relevant form of digital competence formation is:

- Offline training accompanied by a trainer – 23.3%;
- A combination of online and offline methods – 27.7%;
- Online training – 44.8%.

To conduct a statistical analysis at the beginning of the experiment and at the time of its completion, we compared the state of the group. In this case, Fisher's angular transformation was used.

In our case, the state of the subjects at the beginning and the end of the experiment was considered. A comparison was made according to the frequency of the studied indicators (generalized indicators; the level of formation of each of the components). The conversion into the values of the central angle of the percentages, given in radians, is the Fisher angular transformation φ. A larger percentage corresponds to a larger angle φ_1 and a smaller angle φ_2 to a smaller one. It should be noted that the relationship between these values is nonlinear: $\varphi = 2arcc\bar{\imath}n\sqrt{P}$, (1), where P is the percentage expressed in fractions of a unit. The values of the criterion increase with an increase in the number of samples or an increase in the angles of divergence. The existing differences between the samples are non-random, the more likely, the larger the value of φ.

At the final stage of the formative experiment, as a result of the statistical verification of the results, it was found that under the proposed system for the formation of a specialist's digital competence, the levels of each of the components and their generalized indicators increased significantly, which was confirmed by the Fisher angular transformation.

Table 1.
Calculation of the Fisher criterion for the final stage

Indicator	Stage		Accepting the hypothesis
	Beginning	Terminal	
Environmental component			
Proportion value when "There is an effect", %	12,37	73,10	We accept hypothesis H1
Angular transformation	0,7188	2,0510	
Empirical value of the criterion	82,11		
Criterion significance level	0,01		
Content component			
Proportion value when "There is an effect", %	22,18	75,48	We accept hypothesis H1
Angular transformation	0,9807	2,1055	
Empirical value of the criterion	69,33		
Criterion significance level	0,01		
Communicative component			
Proportion value when "There is an effect", %	0,0853	0,7810	We accept hypothesis H1
Angular transformation	0,5927	2,1676	

Empirical value of the criterion	2,1676		
Criterion significance level	0,01		
Generalized indicator			
Proportion value when "There is an effect", %	14,36	75,56	We accept hypothesis H1
Angular transformation	0,7773	2,1074	
Empirical value of the criterion	81,98		
Criterion significance level	0,01		

Thus, the effectiveness of the implementation of the system for forming a specialist's digital competence was analyzed, a quantitative and qualitative analysis of the results obtained was conducted, and the corresponding conclusions were drawn: a cross-sectional analysis and interpretation of the research results showed that under the proposed system for forming a specialist's digital competence, the levels of each of the components and their generalized indicators increased significantly, which was confirmed by the Fisher angular transformation.

The study had the following statistical hypotheses:

- H0: the level of formation at the end of the experiment of the corresponding indicator is not higher than at the beginning of the experiment;
- H1: the level of formation at the end of the experiment of the corresponding indicator is higher than at the beginning of our experiment.
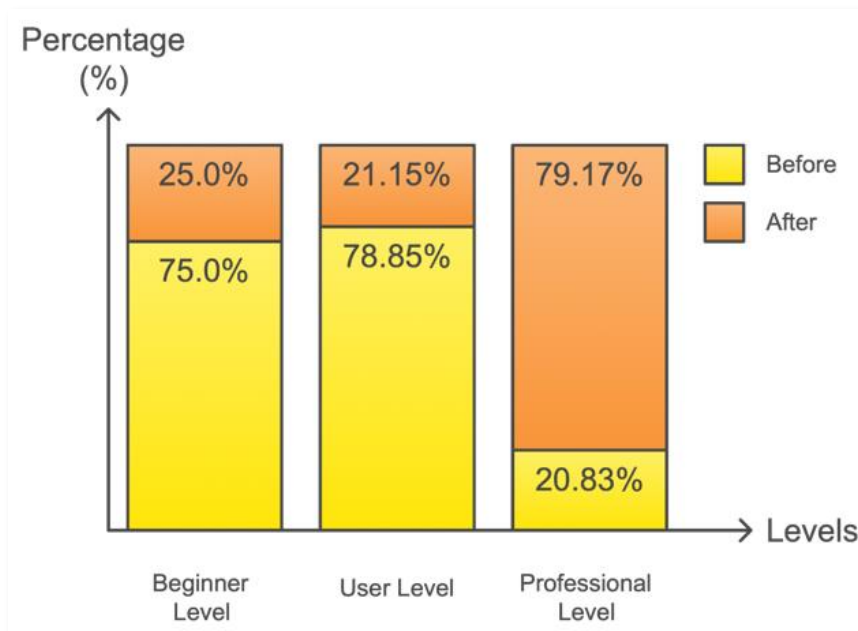

Figure 2. Respondent Percentage Changes by Level.

To conduct a statistical analysis at the beginning of the experiment and at the time of its completion, we compared the state of the group. Fisher's angular transformation was used. The effectiveness of the developed system for forming a specialist's digital competence is evidenced by the obtained indicators.

The effectiveness and efficiency of training were checked using the consumer loyalty index – NPS and key performance indicators – business indicators KPI, which are universal.

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To assess the quality of the training organization, we used the NPS (Net Promoter Score) consumer loyalty index. Respondents were classified by their degree of readiness to recommend the digital competence formation system (training, methodology) to other people using questions.

When receiving the NPS index, we made the following conclusions:

- An index of more than 50% indicates high results, where the respondent is noted as a leader in the labor market with a high level of digital competence formation using the system for the formation of a specialist's digital competence;
- From 30% to 50%, the index indicates a good result of the formation of the level of digital competence using the system for the formation of a specialist's digital competence. However, we took into account that a series of errors or a negative incident can affect the reputation of the organizer of the system for the formation of a specialist's digital competence;
- Up to 30%, the index indicates the presence of minor problems in the formation of the level of digital competence using the system for the formation of a specialist's digital competence, which requires attention to all structural divisions that conduct direct training;
- Less than 0% – a negative index, which indicates that the number of respondents dissatisfied with the system for forming the digital competence of a specialist significantly exceeds the number of satisfied respondents and is a systemic problem.

The calculation of the NPS indicator of the experimental course is given in Table 2.

Table 2.
Calculation of the NPS indicator

Level	Indicator	Value
Intermediate level	Vd, detractors - percentage	11
	Vp, promoters – percentage	59
	NPS= Vp-Vd	48

The NPS index we obtained = 48, which indicates a high-quality organization of training in general and indicates a high-quality experiment, a correctly chosen tactic, and a strategy for building a training system, which is based on the effective formation of digital competence of respondents using the developed system. Since the respondents who are studying will be competitors in the services market, we assessed the results of the experimental work using the Key Performance Indicators (KPI) indicator.

Key performance indicators are KPIs used to assess the achievement of goals and their clear reflection or optimality of the process and are measured in numbers, as well as achieving efficiency and effectiveness of the process. An important management tool is key performance indicators, which allow you to evaluate and control the work of departments, working groups, individual specialists, and companies. KPI analysis contributed to the assessment of the implementation of the selected strategy for forming the digital competence of a specialist. In our study, the indicators were:

- KPI – the ratio of respondents who successfully completed their training and the formation of their digital competence corresponds to a high level;
- KPI-2/1, KPI-3/1, KPI-3/2 – the ratio of respondents who joined the number of participants of the previous level – to the next level. During the basic level of the training course, an experiment was conducted in which we analyzed the dynamics of the results obtained in the context of each of the levels.
- More than 75% of students successfully completed the basic level of training, which for a mass course is a very high indicator of the formation of their digital competence (the indicator fluctuates within 10-25%);
- 82% of respondents passed the average level of training;

−   72% of respondents passed the advanced level of the course (data according to the KPI indicator).

Other indicators (KPI-2/1, KPI-3/2, KPI-3/1) indicate that after completing training on the developed system for the formation of digital competence of specialists of the full-fledged basic level course, we managed to keep the attention of respondents who joined the advanced level of the course and the intermediate level of the course. More than 20% of respondents successfully completed three levels of training on the developed system for the formation of digital competence of specialists.

We note that there were no requirements for mandatory training at all levels because the material of the basic course already allowed respondents to effectively use the proposed digital tools in their professional activities, which was provided to them by the developed system for the formation of digital competence of specialists.

The analysis of data obtained during the sections of the formative stage of work recorded positive dynamics in the EG.

Therefore, the results of the study correlate with the goals of the study regarding the formation of students' skills in working with digital tools and obtaining existing knowledge that emphasizes the digital competence of future specialists, which can be achieved thanks to the developed system for forming the digital competence of a specialist, by introducing changes, implementing and searching for effective methods, forms, and means of forming the digital competence of a future specialist.

Conclusions

The content of the concept of "digital technologies" is presented, and their classification is proposed, which is effective in the formation of students' professional competencies and indicates the importance of digital technologies in the training of students, promotes the ability to independently solve educational tasks, creates the possibility of active individual activity in the modern digital world.

The impact of digital technologies on the quality of higher education is shown. The tasks of digitalization set before the higher education institution are analyzed; the principles and conditions for the formation of the digital environment of higher school are revealed, which affect the quality of higher education and the general strategic goals of the development of the educational system.

The general strategic goals of the development of the educational system are taken into account when solving the problem of using digital technologies for high-quality higher education.

The importance of virtual reality technology is shown, and virtual modeling electronic immersive learning technologies for high-quality higher education in the educational space are revealed. The importance of the Digital University is demonstrated as the requirements of an innovative modern digital educational space.

A pedagogical experiment was conducted within the framework of the annual program.

The summarized results of the initial levels of formation of digital competence of EG and CG specialists at the ascertaining stage of the study indicate the need to develop a system for the formation of digital competence of a specialist, introduce changes, implement and search for effective methods, forms, and means of forming digital competence of a future specialist.

Therefore, the implementation of the proposed system for the formation of digital competence of a specialist involved the conduct of the formative stage of the experiment.

The prerequisites for the formation of digital competence of a specialist were identified.

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The main principles for the formation of the digital competence of a specialist were the priority of the human factor, integrity and comfort of the educational environment, adaptability, systematicity, reproducibility, cooperation, nature-relatedness, variability, unity of forms of self-education, and training.

For the formation of the digital competence of a specialist, the following important approaches were identified: synergistic approach, integrative approach, systemic approach, axiological approach, andragogical approach, and competency approach.

Indicators have been formed to determine the effective content and methodological support of the system for forming a specialist's digital competence.

The effectiveness of the implementation of the system for forming a specialist's digital competence was analyzed, a quantitative and qualitative analysis of the results obtained was conducted, and the corresponding conclusions were drawn: a cross-sectional analysis and interpretation of the research results showed that under the proposed system for forming a specialist's digital competence, the levels of each of the components and their generalized indicators increased significantly, which was confirmed by the Fisher angular transformation.

Analysis of data obtained during the sections of the formative stage of work recorded the dynamics.

The results of the study correlate with the goals of the study regarding the formation of students' skills in working with digital tools and obtaining existing knowledge that emphasizes the digital competence of future specialists, which can be achieved thanks to the developed system for forming the digital competence of a specialist, by introducing changes, implementing and searching for effective methods, forms, and means of forming the digital competence of a future specialist.

Prospects for further scientific exploration are the study of the role of digital learning in European countries in the system of professional training of future specialists and the possibility of effective implementation of best practices in their educational activities.

Bibliographic references

Areshonkov, V. (2020). Digitalization of higher education: challenges and answers. *Herald of the National Academy of Educational Sciences of Ukraine, 2*(2), 1-6. https://doi.org/10.37472/2707-305X-2020-2-2-13-2

Bernazyuk, O. O. (2017). The problem of scientific definition of the concept of digital technologies in management. Scientific Bulletin of Uzhgorod National University. *Law Series, 47*(2), 83-86. https://dspace.uzhnu.edu.ua/jspui/handle/lib/33965

Hedzyk, A. (2024). Current trends in the use of network digital technologies in higher education: distance learning and massive open online courses (MOOCs). *Pedagogical Academy: Scientific Notes, (6).* https://doi.org/10.57125/pedacademy.2024.05.29.03

Hrynevych, L. M., Morze, N. V., Vember, V. P., & Boiko, M. A. (2021). The role of digital technologies in the development of the STEM education ecosystem. *Information Technologies and Learning Tools, 83*(3), 1-25. https://doi.org/10.33407/itlt.v83i3.4461

Karpliuk, S. O. (2017). Information and pedagogical management of higher education: current state and development prospects. *Scientific Bulletin of Uzhgorod University. Series: Pedagogy. Social Work, (2),* 122-125. http://nbuv.gov.ua/UJRN/Nvuuped_2017_2_31

Karpliuk, S. O. (2019). Features of digitalization of the educational process in higher education. In *Information and digital educational space of Ukraine: transformation processes and development prospects* (pp. 188–197). Materials of the methodological seminar of the National Academy of Sciences of Ukraine, 188-197. http://eprints.zu.edu.ua/29742/1/Карплюк%20С._стаття%20в%20НАПН_1.03-перетворено_copy.pdf

Knysh, I., Budanova, O., Vakulenko, S., Syrotina, O., & Popychenko, S. (2023). Innovative educational technologies as a way of higher education enhancement. *Amazonia Investiga, 12*(68), 21–32. https://doi.org/10.34069/AI/2023.68.08.2

Knysh, I., Drobin, A., Filimonova, T., Koycheva, T., Kushnir, A., & Kuchai, O. (2024). The use of information technologies in the educational space of Ukraine (on the example of STEAM technologies). *Revista Conrado, 20*(100), 437–448. https://conrado.ucf.edu.cu/index.php/conrado/article/view/3979

Koval-Mazyuta, M., Bakhmat, N., Sonechko, O., Fedotov, V., & Kustovska, O. (2023). Information and communication and digital technology in education: Some aspects of SMART technology application. *Amazonia Investiga, 12*(62), 336–344. https://doi.org/10.34069/AI/2023.62.02.34

Kovalskyi, V. O., & Kyslenko, D. P. (2024). Pedagogical aspects of the use of digital technologies in higher education. *Academic Visions, (30).* https://doi.org/10.5281/zenodo.13294205

Kuchai, O., Hrechanyk, N., Pluhina, A., Chychuk, A., Biriuk, L., & Shevchuk I. (2022). World Experience in the Use of Multimedia Technologies and the Formation of Information Culture of the Future Primary School Teacher. *International Journal of Computer Science and Network Security, 22*(3), 760-768. https://doi.org/10.22937/IJCSNS.2022.22.3.100

Marrero-Sánchez, O., & Vergara-Romero, A. (2023). Digital competence of the university student. A systematic and bibliographic update. *Amazonia Investiga, 12*(67), 9–18. https://doi.org/10.34069/AI/2023.67.07.1

Mytnyk, A., Uninets, I., Ivashkevych, E., Rashkovska, I., Ivashkevych, E., & Kuchai, O. (2024). Formation of professional competence in future psychologists using innovative technologies. *Revista Conrado, 20*(100), 293–304. https://conrado.ucf.edu.cu/index.php/conrado/article/view/3963

Reshetylov, K., Rajab Aljad, R., Panchenko, H., Bukliv, R., & Vynograd, O. (2022). Digital transformation of education and science: responses to modern challenges. *Amazonia Investiga, 11*(58), 202–211. https://doi.org/10.34069/AI/2022.58.10.22

Romanova, I., Kudin, S., Rybak, O., Zavalevskyi, Y., & Pushkarova, T. (2022). Influence of digital technologies of distance education on the mental health of a child in the conditions of wartime realities. *Amazonia Investiga, 11*(56), 224–231. https://doi.org/10.34069/AI/2022.56.08.22

Shuliak, A., Hedzyk, A., Tverezovska, N., Fenchak, L., Lalak, N., Ratsul, A., & Kuchai, O. (2022). Organization of Educational Space Using Cloud Computing in the Professional Training of Specialists. *International Journal of Computer Science and Network Security, 22*(9), 447-454. https://doi.org/10.22937/IJCSNS.2022.22.9.58

Sulym, V., Melnykov, A., Popov, M., Vechirko, O., & Malets, D. (2023). Improving education through implementation of information technologies into the educational process. *Amazonia Investiga, 12*(68), 281–293. https://doi.org/10.34069/AI/2023.68.08.26

Tovkanets, O. S. (2018). Strategic directions of development of information and communication technologies in higher European school at the beginning of the 21st century. *Information Technologies and Learning Tools, 66*(4), 14–23. https://dspace.uzhnu.edu.ua/jspui/handle/lib/39232

Ulishchenko, A., & Ulishchenko, V. (2022). Peculiarities of immersion educational technologies in higher school. *Current Issues of the Humanities: Interuniversity Collection of Scientific Works of Young Scientists of the Ivan Franko Drohobych State Pedagogical University*, *(51)*, 702–709. https://doi.org/10.24919/2308-4863/51-108

Vasylyk, A. V., & Kushnir, A. I. (2018). Competences of HR-specialist in the digital technologies era. *Scientific Bulletin of Kherson State University*, *(9)*, 119-127. https://ej.journal.kspu.edu/index.php/ej/article/view/48

Yuriy, R., Huzchenko, S., Lobach, N., Karbovanets, O., Bokova, S., & Isychko, L. (2022). Modern digital learning and simulation technologies in higher medical education: definitions, innovative potential. *Amazonia Investiga, 11(*60), 53–61. https://doi.org/10.34069/AI/2022.60.12.6

Zhurba, M. A. (2013). Digitalization of culture and media risks: metaphysical aspect. *Bulletin of Dnipropetrovsk University. Series: Philosophy. Sociology. Political Science, 21*(23(2)), 114-120. http://nbuv.gov.ua/UJRN/vdufsp_2013_21_23(2)__23

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