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Development of information and digital technologies in higher education institutions

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■ **Abstract.** The relevance of the study was due to the need to implement and develop digital tools and systems for any specialties, in particular the transport industry and logistics, professional education in labour protection, and technological education. The purpose of the article was to substantiate the planning of the development of information and digital technologies in higher education institutions. In the research process, general scientific and pedagogical research methods were used: theoretical analysis (comparative, systemic, analytical-synthetic, inductive, deductive) to substantiate the strategic plan for the development of information and digital technologies in higher education institutions; synthesis (general scientific, intersectoral, interdisciplinary) to substantiate the unity of interconnected tools and systems in higher education institutions, formulation of a conclusion; classification, systematisation, generalisation with the aim of generalising methods, electronic resources, interactive tools, platforms, etc. The article was devoted to the problem of development of information and digital technologies in higher education institutions. The relevance and necessity of developing information and digital technologies were substantiated to determine: planning, implementation and development of digital tools and systems; steps to modernise curricula; training teachers in digital skills; creation of electronic resources for learning. A graph of the development of information and digital technologies in higher education institutions was developed. The specific directions of its development were substantiated: needs analysis, improving the level of qualification of scientific and pedagogical staff, modernisation of curricula, creation of electronic resources, implementation of analytics systems, ensuring access, security and confidentiality, support and development, evaluation and optimisation. The elements of the development of information and digital technologies were substantiated. The practical significance of this work is to determine the planning of the development of information and digital technologies in higher education institutions in the relevant areas, which allowed to predict the increase in the professional development of scientific and pedagogical workers, to provide high-quality education to students and trainees in difficult conditions

■ **Keywords:** graph; innovative technologies; technological education; occupational safety; transport; logistics

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■ Introduction

The problem of the development of information and digital technologies (IDT) in institutions of higher education encompasses many topical issues characteristic of the modernisation of the higher education system in Ukraine, particularly in the context of martial law and post-war times in the future. The problem of the development of IDT in higher education is a priority all over the world. The current state of these technologies and their development determine the future of higher education. The relevance of the research lies in the urgent need to develop digital technologies for any field of education, particularly the transportation and logistics industries, as well as vocational and technical education. The process of integration of Ukrainian education into the global educational space necessitates critical thinking and substantiation of information and digital technologies into a single system. Scientists rightly point to the improvement of teachers' qualifications aimed at the development of general ideas about the ways and prospects of education informatisation; application of information digital technologies, etc.

L. Khoruzh *et al.* (2020) figured out that the teacher's ability to perceive the new, use information and communications technologies (ICT) in the educational process, improves the quality of learning activities. In their study, authors rightly concluded that ICT used by teachers during teaching significantly improve the learning process, motivate and increase students' interest and learning effectiveness. As noted by O. Myroshnychenko (2020), the formation of digital competence among higher education graduates is a pressing problem because it requires rapid adaptation to the conditions of the information environment. N. Manoylenko *et al.* (2021) concluded that digitalisation of education is considered a leading direction in improving the efficiency of learning and the quality of the educational process. It is worth noting the conclusion of Ukrainian scientists V. Kornyat *et al.* (2022) that the digitalisation of the educational process is due to the emergence of new requirements for the formation of key competencies of specialists in connection with the new digital generation. The authors rightly pointed out that the issue of digitalisation also becomes relevant during distance and blended learning as a result of the war with the Russian Federation.

As A. Lazko & I. Tomashevska (2023) rightly emphasised in their study, the spread of digital technologies will make citizens' digital skills dominant among other skills of the 21st century. Like other researchers of these technologies, the authors emphasise the extreme importance of timely digitalisation for modern production. This involves full automation of production, design and product maintenance. As for the reform of the digitalisation of education, the authors rightly point out the need to improve software quality. This will allow to use educational resources, developments, scientific researches,

electronic scientific libraries, etc. As noted by Ukrainian scholars N. Seiko & M.O. Ershov (2021), information technologies in education provide for: constant continuous improvement of the content of educational programs; functioning of educational IT centres; development of distance and virtual learning, etc. Ukrainian scientists L. Kononenko *et al.* (2022) convincingly concluded that it is advisable for teachers need to improve their level of training in the use of digital technologies, and blended learning using various forms of learning is the most optimal way to improve the quality of education. In their research, scientists came to the conclusion that improving the quality of education is impossible without information resources of high school, an information environment in the global information space. Despite the large number of studies by Ukrainian scientists in the field of using computer technologies in higher education, the problem of developing information and digital technologies in higher education remains insufficiently studied. The aim of this article was to justify the advancement of innovative digital technologies within higher education institutions.

■ Materials and Methods

During the study, well-known pedagogical and scientific methods were used, in particular – when teaching the disciplines of the transport industry and occupational safety of vocational education, to substantiate the unity of interconnected tools and systems in higher education institutions using the example of these specialties, formulating a conclusion; analysis of the educational and work programs of the various degrees of higher education (Transport, Occupational Safety) to clarify the state of training of pedagogical specialists in the transport industry and occupational safety; method of surveying teachers, students and administration of the above-mentioned industries to identify problems related to the development of information and digital technologies; modelling method – to create a graph of the development of information and digital technologies in higher education institutions. When using the theoretical research method, pedagogical scientific works among Ukrainian scientists and scientists from other countries were analysed. The analysis was focused on the difficulties and advantages of the educational process when using information and digital technologies. Using a systematic approach in scientific research, the constituent elements of the development of information and digital technologies in higher education institutions were systematised and a graph with these relevant elements was developed based on the modelling method.

The survey was attended by 178 respondents from the Faculty of Technological and Mathematical Education, specialty 015 Vocational Education (Occupational Safety) at the Hryhorii Skovoroda University in

Pereiaslav and students from the transport sector of the educational and scientific centre of the National Centre of Vocational and Technical Education and Vocational Education of the National Academy of Sciences of Ukraine, as well as the administration of the relevant institutions. All survey participants were informed about its purpose and content, and they gave their consent to participate while guaranteeing the confidentiality and anonymity of their responses. According to the American Sociological Association Code of Ethics (1997), the collected data were used exclusively for scientific purposes and were not disclosed to anyone. A survey was conducted in the form of a questionnaire, in which respondents were asked the following questions: are you satisfied with the state of use (implementation) of IDT in the institution, how often do you use information and digital technologies per week, what, in your opinion, should be the software during the educational process, what is the use of IDT, what should be the training of specialists in IDT, what are the problems and the path of development of information and digital technologies in higher education, how do you see increasing your competence in information and digital technologies, what skills and abilities in working with information and digital technologies need to be improved by Ukrainian teachers so that student education is more productive and high-quality, what is the provision of access, security and confidentiality when using information and digital technologies, what are the specific directions of development of IDT in higher education institutions, what needs to be modernised in educational institutions, programs, which technologies (disciplines, practical or laboratory) need to be introduced. This survey helped to reveal a number of shortcomings in the organisation of the development of IDT.

■ Results and Discussion

The main objective of the survey was to determine how ICT should be developed in higher education institutions. The questionnaires sent to respondents from the transport sector and occupational health and safety of vocational education (future teachers among students and teachers and administration) were aimed at finding out what difficulties arise when using and implementing information and digital technologies. The question "Are you satisfied with the state of use (implementation) of information and digital technologies in the institution?" offered the following answer options: "yes", "no", "insufficient", "rather yes". The answers of the majority of respondents showed dissatisfaction with the state of implementation and use of these technologies.

The answers also allowed to analyse the frequency of ICT use and move on to the next question: "How often do you use ICT per week?". Considering the results, it turned out that 28% of respondents (50 students) regularly use ICT during the week, 25% (45 students) several times a week when performing educational tasks

of the educational process (searching for information on the Internet, preparing term papers and self-study works, essays, research papers, etc.). 32% (56 students) rarely used it, 1.8% (3 students) – never. When asked "what software should be used during the educational process in your opinion", 75% (134 students) of respondents noted that the use of such educational platforms as Moodle, Google Classroom and Teams makes it possible to organise blended and distance learning, which is a necessary condition of the war that the Russian Federation unleashed against Ukraine. When asked "what skills and abilities in working with information and digital technologies do Ukrainian teachers need to improve in order to make student learning more productive and high-quality?" 10% of respondents (18 students) noted the introduction of cloud technologies, in particular Microsoft 365 to implement data storage security during work, as well as video courses for students for the convenience of learning.

Among the specific areas of development of information and digital technologies in higher education institutions, 23% of respondents (41 students) identified the modernisation of educational programs with their adaptation to the requirements of the information and digital era. It should be noted that the information educational environment, which includes information and digital technologies, during teaching at such departments: theory and methods of vocational training of the Hryhorii Skovoroda University in Pereiaslav, as well as on the basis of the National Centre for Vocational Training, provided: communication between scientific and pedagogical workers (NPT), administration, students; effectively plans teaching in the institution; quickly provides information on the organisation and monitoring of the educational process; the content of educational complexes for the study of disciplines and practices; safe organisation of the educational process, in particular during a pandemic or martial law. The graph the problem studied in this article, shown in Figure 1, aims to plan the optimisation of the educational process using modern technologies.

According to the authors of this article, the problem under consideration is one of the current issues in higher education in Ukraine. Due to modern ICT, it is possible to reach a more modern level of education. The needs analysis for the assessment of the institution of higher education in digital solutions (AN) takes into account the following aspects: surveying students, teachers and administration to determine their needs and expectations from digital solutions; market analysis to examine education and digital trends, competitive landscape and potential opportunities for improvement; evaluation of existing digital solutions in the educational institution and their compliance with educational tasks and the needs of the modern market; involvement of experts in the field of education to receive advice and recommendations on improving digital solutions.

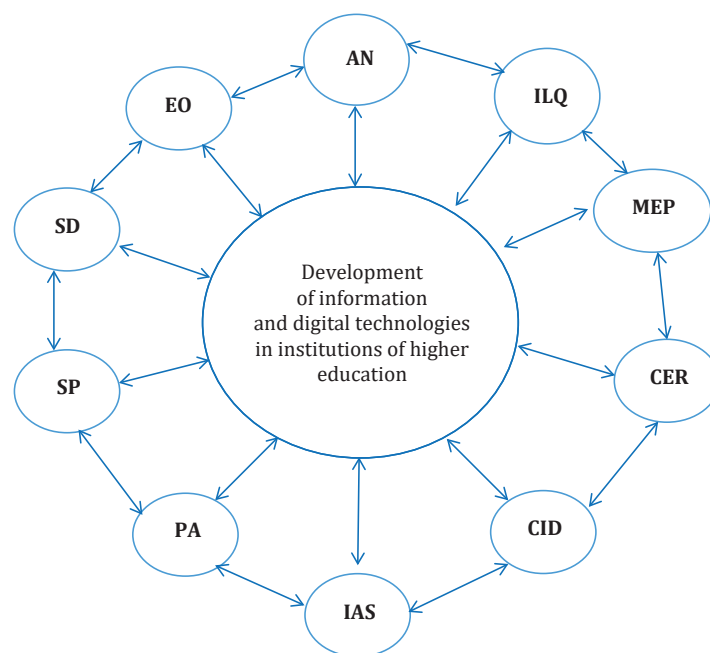


Figure 1. Graph of the development of information and digital technologies in institutions of higher education

Note: **AN** – analysis of needs; **ILQ** – increasing the level of qualification; **MEP** – modernisation of educational programs; **CER** – creation of electronic resources; **CID** – creation of information and digital platforms; **IAS** – implementation of analytics systems; **PA** – provision of access; **SP** – security and privacy; **SD** – support and development; **EO** – evaluation and optimisation

Source: developed by the authors

Increasing the level of qualifications (**ILQ**) may include the following stages and measures: studying the current level of training of teachers in the use of computer technologies during teaching and educational work; development of educational programs and courses taking into account the individual needs of employees; conducting trainings, master classes, advanced training courses and other forms of training; carrying out an assessment of the effectiveness of educational activities, as well as tracking changes in the employee performance after the completion of training; creation of a support and motivation system for employees involved in professional development, for example, providing access to resources for self-study, awarding for achievements, etc. These measures will help to ensure the effective promotion of scientific research and teachers improve the quality of teaching.

The modernisation of educational programs (**MEP**) is manifested through the introduction of modern technologies, the updating of the content of mandatory and optional subjects, as well as educational, production, technological and pedagogical practices. The modernisation of educational programs has the following aspects: the inclusion of modern topics that reflect modern technological and social trends, including artificial intelligence, cybersecurity, data processing, media education, etc.; use of interactive platforms, online resources, video lectures, virtual reality and other digital tools to improve the learning process; focusing on

the development of digital competencies, taking into account critical thinking, problem solving, online communication, etc.; using innovative assessment methods (projects based on real tasks, skills development portfolios, as well as the use of digital tools for data collection and analysis; providing teachers with access to professional development so that they can effectively use new technologies and approaches in their practice. The creation of electronic resources (**CER**) includes the development and implementation of educational materials, online courses and other information and digital resources for students.

The creation of information and digital platforms (**CID**) for online education of students allows: to ensure the opportunity to use various resources during training, remote communication, the possibility of interactive learning and promotion of a flexible form of education; increase access to education and provide students with a wide range of educational opportunities (Dashko, 2023). The creation of information and digital platforms can be considered through the following steps and aspects: determining the needs and goals of students, employees of the institution of higher education in order to develop a platform that meets their requirements; choosing technology solutions that best suit the needs, including web platforms, mobile applications, online collaboration tools, etc.; creation of electronic scientific and methodological materials, tests, discussion forums, etc.; development of a

convenient and understandable interface for students and teachers to facilitate the use of the platform; use of measures to protect personal data of students and information about studies; providing accessible and effective support to users, including online chats, e-mail, supporting documentation, etc.; continuous evaluation of the platform and implementation of appropriate improvements based on user feedback. These steps will help to provide an effective and innovative platform for online student learning.

The implementation of analytics systems (**IAS**) for tracking student success, the effectiveness of education and training, and improving programs is manifested in the collection and analysis of data on academic achievements, participation in classes and other aspects of student life. For the successful implementation of analytics systems for tracking student performance, firstly it is important to determine the purpose of the system, select the necessary metrics and performance indicators, collect and store relevant data, develop and configure analytical tools, and ensure protection of student privacy. After the implementation of the system, it is important to constantly monitor and analyse the received data, make the necessary adjustments to improve the quality of education. This allows to identify trends, personalise learning, support students in important aspects, identify possible difficulties and problems in time to improve the learning process. The provision of access (**PA**) to information and digital resources and platforms for students, taking into account their capabilities and needs. Ensuring access to information and digital resources and platforms for students includes: establishing access rights for users, using authentication and authorisation, monitoring network security, regularly updating the information and digital security system to effectively manage access and prevent unauthorised actions.

The security and privacy (**SP**) of the development of considered computer technologies is carried out using cybersecurity measures, data encryption, ensuring access only to authorised users, network and system security audits, as well as regular software and hardware updates to prevent potential threats. Security and privacy can be considered through the following aspects: using measures to protect information using encryption methods, etc., to protect the privacy of data during transmission and storage; requiring complex and unique passwords to access systems, using two-factor authentication to increase the level of security; installation of security measures, including antivirus software, intrusion protection, etc. against cyber-attacks; conducting regular security audits of systems and software, including the rapid implementation of patches and updates to close vulnerabilities; training users in the basics of cybersecurity, including awareness of threats, proper use of programs and services, procedures for behaviour in the event of a suspected cyber-attack;

collection, processing and storage of users' personal data according to the requirements of data protection legislation, ensuring users' rights to be forgotten and access to their data; regularly creating backup copies of data to prevent information loss in the event of cyber-attacks, accidental deletion or equipment failure.

Support and development (**SD**) should be systematic. Evaluation and optimisation (**EO**) determine the continuous evaluation of the effective implementation of solutions and optimisation taking into account changes in the educational environment. The needs analysis for the assessment of the high school in digital solutions takes into account the following aspects: surveying students, teachers and administration to determine their needs and expectations from digital solutions; market analysis to examine education and digital trends, competitive landscape and potential opportunities for improvement; evaluation of existing digital solutions in the educational institution and their compliance with educational tasks and the needs of the modern market; involvement of experts in the field of education to receive advice and recommendations on improving digital solutions.

Raising the level of qualifications may include the following stages and measures: studying the current level of formed competencies of scientific and pedagogical staff regarding the use of modern ICT during teaching and educational work; development of educational programs and courses taking into account the individual needs of employees; conducting trainings, master classes, advanced training courses and other forms of training for the purpose of improving the qualifications of teachers; carrying out an assessment of the effectiveness of educational activities, as well as tracking changes in the work and effectiveness of scientific and pedagogical workers after the completion of training; creation of a support and motivation system for employees involved in professional development, for example, providing access to resources for self-study, awarding for achievements, etc. These measures will help to ensure the effective promotion of teachers and improve the quality of teaching. The modernisation of educational programs in higher schools is manifested through the introduction of modern technologies, the updating of the content of mandatory and optional subjects, as well as educational, production, technological and pedagogical practices. The modernisation of educational programs has the following aspects: the inclusion of modern topics that reflect modern technological and social trends, including artificial intelligence, cybersecurity, data processing, media education, etc.; use of interactive platforms, online resources, video lectures, virtual reality and other digital tools to improve the learning process; focusing on the formation of competencies needed in the digital world, in particular critical thinking, problem solving, online communication, etc.; using innovative assessment methods (projects based

on real tasks, skills development portfolios, as well as the use of digital tools for data collection and analysis; providing teachers with access to professional development so that they can effectively use new technologies and approaches in their practice.

The creation of information and digital platforms for online education of students allows: to ensure the opportunity to use various resources during training, remote communication, the possibility of interactive learning and promotion of a flexible form of education; increase access to education and provide students with a wide range of educational opportunities. The creation of information and digital platforms can be considered through the following steps and aspects: determining the needs and goals of students, employees of the institution of higher education in order to develop a platform that meets their requirements; choosing technology solutions that best suit the needs, including web platforms, mobile applications, online collaboration tools, etc.; creation of electronic scientific and methodological materials, tests, discussion forums, etc.; development of a convenient and understandable interface for students and teachers to facilitate the use of the platform; use of measures to protect personal data of students and information about studies; providing accessible and effective support to users, including online chats, e-mail, help documentation, etc.; continuous evaluation of the platform and implementation of appropriate improvements based on user feedback. These steps will help to provide an effective and innovative platform for online student learning.

The security and privacy of the development of information and digital technologies is carried out through the implementation of cybersecurity measures, data encryption, ensuring access only to authorised users, network and system security audits, as well as regular software and hardware updates to prevent potential threats. Security and privacy can be considered through the following aspects: use of information protection measures using encryption methods, etc.; requiring complex and unique passwords to access systems, using two-factor authentication to increase the level of security; installation of security measures, including antivirus software, intrusion protection, etc. against cyber-attacks; conducting regular security audits of systems and software, including the rapid implementation of patches and updates to close vulnerabilities; training users in the basics of cybersecurity, including awareness of threats, proper use of programs and services, procedures for behaviour in the event of a suspected cyber-attack; collection, processing and storage of users' personal data according to the requirements of data protection legislation, ensuring users' rights to be forgotten and access to their data; regularly creating backup copies of data to prevent information loss in the event of cyber-attacks, accidental deletion or equipment failure.

Ensuring access to information and digital resources and platforms for students includes: establishing access rights for users, using authentication and authorisation, monitoring network security, regularly updating the information and digital security system to effectively manage access and prevent unauthorised actions. The implementation of analytics systems for tracking student success, the effectiveness of education and training, and improving programs is manifested in the collection and analysis of data on academic achievements, participation in classes and other aspects of student life. For the successful implementation of analytics systems for tracking student performance, it is important to determine the purpose of the system, select the necessary metrics and performance indicators, collect and store relevant data, develop and configure analytical tools, and ensure protection of student privacy. After the implementation of the system, it is important to constantly monitor and analyse the received data, make the necessary adjustments to improve the quality of education. This allows to identify trends, personalise learning, support students in important aspects, identify possible difficulties and problems in time to improve the learning process.

Modernisation of curricula in high school was manifested through the introduction of modern ICT, updating the content of mandatory and elective disciplines, as well as educational, faculty, production, technological and pedagogical practices. As shown by the practice of working with students at such departments: theory and methods of vocational training of the Hryhorii Skovoroda University in Pereiaslav, as well as on the basis of the educational and scientific centre based on the National Centre for Vocational Training, the creation of information and digital platforms for online learning of students allowed: to provide access to educational resources, remote communication, the possibility of interactive learning and promote a flexible form of learning; to increase the accessibility of education and provide students with a wide range of educational opportunities. The security and confidentiality of the development of modern ICT, was ensured through the implementation of cybersecurity measures, data encryption, ensuring access only to authorised users, network and system security audits, and regular updates of software and hardware to prevent potential threats. The authors of this article believe that ensuring access to information and digital resources and platforms for students included: establishing access rights for users, using authentication and authorisation, monitoring network security, and regularly updating the information and digital security system to effectively manage access and prevent unauthorised actions. The implementation of analytics systems to track student performance, teaching and learning effectiveness, and program improvement was manifested in the collection and analysis of data on

academic achievement, class participation, and other aspects of student life. This allowed to identify trends, personalise learning, support students in important aspects, and timely identify potential difficulties and problems to improve the learning process.

The obtained results indicate that the development of the studied technologies takes its rightful place in the work of educational institutions. The role of informatisation in education, which is one of the priority areas, that was studied by the Chinese scientist Z. Kai (2022). The researcher defined the properties and functions of ICT in education, didactic tasks for their use. It is noteworthy that the choice of a particular method and means of teaching is determined by the specifics of the academic discipline, the specific solution of the didactic task, the didactic properties of specific teaching aids, and ICT are considered as an important means of organising the cognitive activity of students. Ukrainian researchers O. Chubrey *et al.* (2021) in their work dedicated to the formation of computer literacy of students in higher education, rightly argue that the formation of a competent specialist of a new generation is impossible without the creation of a holistic educational space at its various levels and stages when using digital technologies in higher education. Taking this into account, it is appropriate to agree with the opinion of the Ukrainian scientist Ya. Yurkiv (2022) that during the formation of a teacher's information and digital competencies, information and media literacy, analytical thinking, programming and information security competencies, and computer ethics are gradually formed.

The authors of this article were convinced of the correct conclusion of Ukrainian scientists I.A. Bekhta & T.I. Kovalevska (2022) that the emergency digitalisation of education corresponds to the realities of the modern educational process, due to the limitation of social contacts. According to the co-author of this article M. Vaintraub (2021), the success of organising the effective use of ICT is to timely adjust the conditions changing in the information environment, organise constant monitoring and control measures to manage these conditions. The well-founded result of the study by scientist O. Sukhomlin (2022) is noteworthy, who summarised students' skills in more effective possession of digital competence and developed a number of didactic tasks for the development of students' digital and professional competence. It is worth emphasising that scientists L. Sultanova & M. Prokofieva (2022) in their work rightly concluded that for the safety of the uncontrolled spread of fake information, teachers and students need to improve their digital competence. It should be agreed with scientists that this is facilitated by the creation of interdisciplinary courses based on digital educational platforms, etc. In this case, it is appropriate to cite the study of A. Samko (2021), who carefully analysed framework documents on digital competencies, and also fairly and reasonably

considered the conditions for teachers to acquire digital competence during teacher training.

A. Lytvyn *et al.* (2023) indicated that the effectiveness of distance learning depends on the platform, mutual communication between teachers and students, as well as the interaction of students with each other. O. Kucheryaviy (2022) studied the system of professional digital competencies of a teacher of a higher pedagogical educational institution and rightly identified three main professionally determined functions: heuristic-digital, managerial-digital, and self-developing-digital. S. Tolochko (2021) thoroughly researched and theoretically substantiated the ways of digitalisation of educational institutions, sufficiently fully revealed the essence and features of teachers' competencies related to computer technologies, in particular digital and distance learning. It is worth noting that scientists L. Kosharska *et al.* (2022) rightly showed in their work that digital technologies for the educational process are an important, but not a necessary condition for increasing the efficiency of the educational process. The authors have sufficiently clearly and reasonably formulated the hypothesis about the need for scientifically based implementation of digital technologies in the work of higher and vocational educational institutions. However, one should agree with the opinion of researchers O. Braslavskaya & L. Ozerova (2022) that a teacher have to develop professional competence, and pedagogical skills, be ready to process significant amounts of information and use modern information technologies. The European Commission panel considered and approved the vision of digital development of the EU until 2030, which defines the goals of digital transformation and ways to achieve them until 2030. European Commissioner Thierry Breton stated on the European Commission website, regarding the European Digital Decade, which manifests itself in the fact that Europe must give its citizens and businesses access to modern technologies for a better and safer life. This is exactly the way a digitally sovereign Europe can be rebuilt (European Commission sets..., n.d.). Many studies by scientists emphasise the idea that the development of computer technology during learning creates a new paradigm of education, and the digital capacity of the country in the future depends on how effectively these technologies are implemented.

■ Conclusions

In the conditions of war as a result of the aggression of the Russian Federation against Ukraine, higher education institutions were forced to switch to distance and blended learning, which emphasised the importance of implementing the considered information technologies. Possession of digital and information technology competencies by students, teachers and administration of higher education institutions is important and extremely necessary in modern conditions. The analysis

showed that ICTs provide effective training and prepare graduates for competitiveness in the labour market in Ukraine. Regarding this, a high level of digital literacy becomes an integral part of high-quality professional training of graduates and teachers of higher education institutions, who must adapt to the modern labour market.

During a survey of teachers, students and management personnel in the transport industry and labour protection at the departments of Hryhorii Skovoroda University in Pereiaslav, as well as at the National Centre for Vocational Training, it was found that 28% of respondents regularly use ICT per week. Searching for information on the Internet, preparing research papers, essays and other educational tasks of the educational process are used by 25% of respondents several times a week. The majority of respondents (75%) noted that popular educational platforms, such as Moodle, Google Classroom and Teams – allow for the organisation of blended and distance learning, which in martial law conditions is in many cases a necessary condition. A smaller number of respondents (10%) determined the convenience of implementing video courses and

cloud technologies into the educational process, among which they singled out Microsoft 365 for the security of data storage during work. According to the analysis of the obtained results, it was found that the implementation of the elements of the developed schedule (needs analysis, teacher training, modernisation of curricula, creation of electronic resources, implementation of analytics systems, ensuring access, security and confidentiality, support and development, evaluation and optimisation) has a positive effect on the educational process. Further research will be devoted to examining the development of the system of integrated technologies in various educational institutions in Ukraine and abroad.

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■ Conflict of Interest

None.

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Розвиток інформаційно-цифрових технологій в закладах вищої освіти

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■ **Анотація.** Актуальність дослідження зумовлена необхідністю впровадження та розвитку цифрових інструментів та систем для будь-яких спеціальностей, зокрема транспортної галузі й логістиці, професійної освіти з охорони праці, технологічної освіти. Метою статті було обґрунтування планування розвитку інформаційно-цифрових технологій в закладах вищої освіти. Під час дослідження було використано педагогічні, наукові методи дослідження: теоретичний аналіз (порівняльний, системний, аналітико-синтетичний, індуктивний, дедуктивний) для обґрунтування стратегічного плану розвитку інформаційно-цифрових технологій в закладах вищої освіти; синтез (загальнонауковий, міжгалузевий, міжпредметний) для обґрунтування єдності взаємопов'язаних інструментів та систем в закладах вищої освіти, формулювання висновку; класифікація, систематизація, узагальнення з метою узагальнень методів, електронних ресурсів, інтерактивних засобів, платформ тощо. Стаття була присвячена проблемі розвитку інформаційно-цифрових технологій в закладах вищої освіти. Обґрунтовано актуальність і необхідність розвивати інформаційні й цифрові технології для визначення: планування, впровадження та розвитку цифрових інструментів та систем; кроків по модернізації навчальних програм; навчання викладачів цифровим навичкам; створення електронних ресурсів для навчання. Розроблено граф розвитку інформаційно-цифрових технологій в закладах вищої освіти. Обґрунтовано специфічні напрями його розвитку: аналіз потреб, підвищення рівня кваліфікації науково-педагогічних працівників, модернізація навчальних програм, створення електронних ресурсів, впровадження систем аналітики, забезпечення доступу, безпека і конфіденційність, підтримка і розвиток, оцінка та оптимізація. Обґрунтовано елементи розвитку інформаційно-цифрових технологій. Практична значимість цієї роботи полягає у визначенні планування розвитку інформаційно-цифрових технологій в закладах вищої освіти за відповідними напрямками, що дозволяє спрогнозувати підвищення професійного розвитку рівня науково-педагогічних працівників, надавати якісну освіту студентам та слухачам у складних умовах

■ **Ключові слова:** граф; інноваційні технології; технологічна освіта; охорона праці; транспорт; логістика