DIGITAL EDUCATIONAL ENVIRONMENT IN INSTITUTIONS OF HIGHER EDUCATION

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The monograph presents modern educational technologies that can be used in the educational process of a higher educational institution. The monograph is aimed mainly at students of various study specialties, teachers. The monograph collects the opinions of scientists and teachers regarding the possible use of information technologies in the learning process, considers the main services and tools for evaluating written works, conducting an oral survey, and organizing online testing.

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2.2. Principles of technological support of the educational process: prerequisites, realities and prospects of introducing modern technologies into the system of education and science

Modern realities of life and ensuring the educational process of schoolchildren, students and postgraduates require the introduction of digitalization as an essential element of education for those seeking education. Reforming Ukrainian education in the direction of integration into the European educational space involves the development and implementation of innovative educational systems and technologies. According to the Law of Ukraine "On Education" Art. 51. among the professional competencies of a pedagogical worker are practical skills in the application of modern methods and technologies of education.

The digital transformation of Ukrainian education aims to increase its quality, achieve new educational results, adequate to the requirements of the modern digital society. Today, there are new requirements for all participants of the educational process: from personal and professional qualities, creativity, creative possibilities to knowledge and skills of operating them. In a digital society, human education takes place in the

conditions of a digital educational environment, the purpose of which is the development of the digital competence of an individual [1].

Today, the governments of most European countries are making significant efforts to modernize education systems based on the use of digital technologies. The development of digital education initiates the emergence of new educational practices, which in turn contributes to the transformation of the educational system as a whole. The field of education, localized by institutional, temporal and spatial frameworks, is significantly modernized due to the introduction of digital technologies into the educational process. As shown by the conducted psychological-pedagogical and didactic studies (N. Morse, E. Mashbyts, O. Spirin, E. Polat), ICT-based learning methods are able to ensure individualization of learning, adaptation to the abilities, opportunities and interests of participants in the educational process, their development independence and creativity, access to new sources of information, use of computer modeling of researched processes and objects [2; 3].

Today, digital technologies play a significant role in the development and improvement of the quality of modern education. Scientists offer various ways to solve the problem of the quality of education. In many studies, the quality of education is considered as an educational process and as its result. The quality of the educational process (the level of its organization, the appropriateness of teaching methods and tools, the qualifications of teachers) in itself does not guarantee the quality of education as a whole, since its goals may not fully meet the new needs of society.

Modern realities force us to slightly change the meaning of the concept of "educational results", the totality of which can be interpreted within the framework of the competent approach adopted in the world educational practice. They are key competencies. In the context of modern ideas about the goals of education as the development of individual competencies, its readiness to solve new tasks and problems is important. The most traditional for modern methods of evaluating the quality of education are indicators of the quality of educational conditions, in particular, the quality of the implementation of the educational program is considered first.

In the process of researching this topic, a number of requirements were defined for the provision of digital technologies in the educational process, as prerequisites for improving its quality:

– motivation in using various didactic materials;

– a clear definition of the role, place, purpose and time of use of digital educational resources and digital learning tools;

– introducing into the technology only such components that guarantee the quality of education;

– conformity of the teaching methodology with the use of digital tools to the general strategy of the educational session;

– revision of all components of the system and changes in the general teaching methodology;

– ensuring a high degree of individualization of education; – providing feedback in training.

These aspects are the main prerequisites and, in a way, a step-by-step instruction, which is necessary for the optimal implementation of the system of modern technologies, as a prerequisite for ensuring the level of education at a high and satisfactory level, and will also help to ensure the achievement of the main goal of domestic education and science, namely, ensuring the process of promotion its qualities.

The implementation of the above-presented principles of education and the specified requirements for the use of digital technologies in the educational process will contribute to the improvement of the quality of training of specialists. Because of this, they should be considered in the context of the goals of education and the scientific understanding of the practice of educational activity, based on the principles of expediency and effectiveness of using digital technologies in the educational process. The unique role that digital technologies play in improving the quality of the educational process is based on their ability to effectively contribute to the fulfillment of both necessary and sufficient conditions for ensuring the quality of education.

The new content of education, based on the formation of competencies necessary for successful self-realization in society. One of the key points of NUS is a modern educational environment, which will provide the necessary conditions, means and technologies for the education of students, teachers, and parents not only in the premises of the educational institution.

The modern level of development of digital technologies significantly expands access to educational resources in the field of education, science and culture. Speaking about the definition of the quality of education in the field of the use of digital technologies, we have singled out several groups of indicators:

– regulatory support for the use of digital technologies in education; – digital technologies in curricula and programs;

– hardware support of educational institutions;

– availability of educational system and software;

– access to the network Internet and means of communication;

– increasing the digital competence of scientific and pedagogical workers.

Therefore, the introduction of digital technologies into the educational process significantly accelerates the transfer and assimilation of knowledge, contributes to the improvement of the quality of education, which enables future specialists to successfully and quickly adapt to modern society.

Digital technologies play an increasingly important role in ensuring the quality of education, contributing to ensuring its accessibility and openness, improving the quality of education. Along with this, the increased requirements for the digital competence of teachers are the basic procedure for ensuring the further effective educational process, taking into account today's realities.

The rapid and large-scale spread of digital technologies leads to the transformation of methods of providing quality education, the system of remote work, the problem of choosing the necessary resources and appropriate technologies, as well as the formation of a favorable environment for learning. The necessity and efficiency of digital transformation is explained by the fact that most graduates of educational institutions see the use of information and communication technologies not only in professional activities, but also in the field of socialization and communication. In addition, the creation and preservation of a competitive advantage by an educational institution in the field of educational competencies will be increasingly determined every year by the timeliness of the introduction of new technologies and readiness for fundamental shifts in the direction of the demanded educational system of the future.

The modern education system must be adapted to the requirements of the times and the expectations of young people through the massive and effective use of innovative educational technologies and didactic models based on modern information and communication technologies.

This problem becomes especially relevant in the context of the forced transition to distance education, caused by the spread of COVID-19 and

the tragic impact of the state of war in our country on education in general. The pandemic and the war revealed global problems in the functioning of the education system of Ukraine and actualized the need for its balanced digital transformation.

The tense situation made it possible to assess the degree of importance and effectiveness of the use of information and communication technologies as a tool for the formation of the education system, where competitive personnel will be trained for various industries and types of activity. At the same time, it actualized the need to reorient all areas of activity to the use of advanced technologies: this should simultaneously affect educational programs, methods, tools, technologies and forms of educational activity, assessment procedures, etc.

The study of the problem of the application of innovative computer technologies and corresponding teaching methods in the educational process has been carried out since the emergence of information and communication technologies in the 1980s and 1990s. During this time, a significant array of theoretical and empirical data was accumulated, which became the basis for research into the process of digitization of modern education.

This aspect of the transformation of the industry is the subject of study in the works of Ukrainian researchers, in particular V. Bykov, O. Bazelyuk, I. Vlasenko, S. Karplyuk, B. Kuzikova, M. Leshchenko, I. Lapshina, L. Lishchynska, S. Tolochko, Yu .Trach, O. Fidanyan and others. However, the acquired experience of analyzing the digitalization of education still requires generalization, highlighting the positive and negative consequences of the implementation of this process, and clarifying the most promising technologies for their application in the educational process.

The digital transformation of education involves not only the organization of the educational process using digital technologies, but also the implementation of information systems for the management of the educational institution and the individual student (for example, assessing the level of mastery of the material, competencies, building and adjusting individual educational trajectories). This approach to the educational process requires the inclusion of digital technologies in the process of developing a flexible learning system that would correspond to the concept of an open education system, as well as the formation of digital competencies of teachers and students (pupils). In this way, the creation of an innovative space of an

educational institution can be ensured as a necessary condition for the continuity of education. During the creation of an innovative space, an educational institution can choose and use different interfaces, taking into account its own capabilities (services used in an educational institution, for example, for the organization of distance learning, an electronic reading card, etc.). Thanks to the digitization of education, time is freed up among teachers for research work, the results of which can later not only be included in electronic educational materials, but also be transferred to production solutions, new scientific engineering and management systems implemented in modern market structures and relations.

For students and pupils, the distance education system provides access to the best lecture courses created by specialists from all over the world. In addition, an indisputable achievement of digital content is the ability to study relevant materials at a time and place convenient for students and pupils.

However, the lack of direct contact between the teacher and the student (pupil) negatively affects the quality of training, which may adversely affect future professional activity.

Information and communication technologies can provide various opportunities for perceiving and processing information, understanding ideas and expressing learning. It is common knowledge that the vast majority of students (learners) learn best through visual and tactile aids and opportunities. In this aspect, information and communication technologies can help to "perceive" information, as opposed to simply reading and listening to it.

Mobile devices can also have built-in applications that provide additional support to students (students) with the necessary tools that can meet modern learning needs.

Today, such features as simplified screens and instructions, sequential placement of menus and control functions, graphics combined with text, audio feedback, the ability to set the pace and level of difficulty, appropriate and unambiguous feedback, convenient error correction, etc. are very relevant today.

The most promising in educational institutions may be the use of big data processing technologies, in which the possibilities of artificial intelligence are built in, accompanied by educational activities. These can

be educational programs based on deep immersion in the professional environment (if it is about higher education):

1. Cloud technology (English: Cloud Technology) is a paradigm that involves remote data processing and storage. This technology provides Internet users with access to the computer resources of the server and the use of software as an online service. Cloud technologies are focused on the integration of various information resources within the scope of the topic, scientific field, section of the curriculum in order to simplify their use, the implementation of various work projects in clouds;

2. Mobile learning is closely related to electronic and distance learning, the difference is the use of mobile devices. Training takes place regardless of the location and takes place using portable technologies. The prerequisites for mobile learning were laid in the 70s of the last century, when Alan Kay (an American scientist in the field of computational systems theory) proposed using a computer the size of an ordinary book for educational purposes.

3. QR code (from the English Quick Response Code "quick response") is a graphic image in which certain information, a link to a site or a separate page of it is encrypted. The QR code is read using a standard smartphone camera. To do this, the appropriate scanner program must be pre-installed on it. The principle of such coding was created by the Japanese company DensoWave in 1994 for the needs of mechanical engineering.

4. The acronym STEM is used to denote a popular direction in education that includes natural sciences: (Science), technology (Technology), technical creativity (Engineering) and mathematics (Mathematics). This is a direction in education, in which the natural and scientific component + innovative technologies are strengthened in the educational programs. Technologies are used even in the study of creative and artistic disciplines.

5. STEAM (S – science, T – technology, E – engineering, A – art, M – mathematics) is a modern approach to learning that combines natural sciences, technology, engineering, art and mathematics. The purpose of the technology is to comprehensively form the key professional and social personal competencies of young people, which determine their competitiveness in the labor market.

6. Storytelling (story – story; telling – to tell) is an effective method of conveying information to the audience by telling funny, touching or instructive stories with real or fictional characters. It combines psychological,

managerial and other aspects and allows not only to effectively convey information to the audience, but also to motivate them to certain actions and obtain the highest possible results. This technique was developed and successfully tested on personal experience by David Armstrong, chairman of the international company Armstrong International.

7. The case method (or the method of concrete situations, analysis of situations) is a means of active problem-situational analysis based on learning by solving problem-situations (cases). Its main purpose is not to provide ready-made knowledge, but to develop in students the ability to solve problems and find their solutions independently. The birthplace of the case-study method is the United States of America, namely the Harvard Business School.

8. Crossens is a modern methodical method of visualizing educational material. The word "crossense" means "intersection of values" and was created by analogy with the word "crossword". This unique idea belongs to the writer, teacher and mathematician Serhiy Fedin and Doctor of Technical Sciences, artist and philosopher Volodymyr Buslenko. Crossense was first published in 2002 in the journal "Science and Life". It is an associative chain enclosed in a standard field of nine squares (as in the game "Ticket-noughts").

9. "Fishbone" ("fish bone", "fish skeleton") is the simplified name of the method of the Japanese scientist Kaoru Ishikawa. This graphic technique of presenting information allows you to graphically demonstrate the process of analyzing any phenomenon by highlighting the problem, clarifying its causes and supporting facts, and formulating a conclusion on the issue.

10. Game technologies are one of the unique forms of learning, which allows you to make the study of subjects interesting and exciting, activates attention, and increases interest in learning. V. O. Sukhomlynskyi wrote: "The game is a huge bright window through which a life-giving stream of ideas and concepts about the surrounding world flows into the child's spiritual world. Play is the spark that lights the fire of curiosity."

11. Gamification or gamification is the use of certain elements of games in non-game practices. The term "gamification" first appeared in 1912, when the well-known company "Cracker" began to include a surprise toy in its own products, which later became popular among other companies as well.

12. Web quests. Translated from English, quest is a search, web is a web, network, Internet. For the first time, the web-quest model was presented by

San Diego University teachers Bernie Dodge and Tom March in 1995. The web-quest is defined by them as "an approximate activity where almost all information is taken from the Internet." The quests are designed to develop students' and teachers' ability to analyze , synthesize and evaluate information.

13. Quest (from the English quest – search, adventure – adventure) is an adventure game. In pedagogical science, the concept of "quest" is defined as a technology, method or form of organization of research activity, for the performance of which students search for information, analyze, systematize it and perform certain tasks.

14. Health-saving technologies. One of the 10 key competencies of the New Ukrainian School is "Environmental literacy and healthy life. The ability to intelligently and rationally use natural resources within the framework of sustainable development, awareness of the role of the environment for human life and health, the ability and desire to follow a healthy lifestyle."

15. A biologically adequate technique is a set of coordinated actions of the teacher and the student, aimed at activating integral dynamic images of the educational disciplines and forming the skills of instrumental work with them. And, as a result, this is the creation of motivation for cognitive activity. A biologically adequate teaching method was first described in the early 90s of the 20th century. Academician of the Russian Academy of Natural Sciences, Doctor of Psychological Sciences, Professor N. V. Maslova.

16. Block-chain technologies for automating or increasing the efficiency of the functioning of the components of the educational process; BYOD technology (Bring your own devices) is a technology that encourages the use by students (students) of their own gadgets (smartphones, tablets, laptops, etc.) in the educational process, with the help of which they perform educational tasks.

17. VR, AR technologies based on the use of virtual worlds and simulations. It is also worth mentioning the digital technologies of control and self-control; technologies designed to create new ways of delivering educational materials to students (pupils); educational institution management technologies and building a new format of interaction between teachers and students (pupils).

Particular hopes are placed on artificial intelligence technologies, which can provide a potential opportunity to acquire fundamentally new knowledge and information, although then the question arises as to what exactly in the

teacher's activity can be automated and transferred to artificial intelligence, and what should remain the teacher's function.

The main goal of using artificial intelligence in education is to make calculations accurate and explicit forms of educational, psychological and social knowledge, which often remain implicit, that is, to present this knowledge in a formalized form in order to use computer programs to analyze the obtained results and, based on the research carried out, to obtain appropriate learning model.

In general, artificial intelligence technologies in education are focused on the intellectualization of educational systems, the performance of the function of not only drawing up the individual educational trajectory of students (pupils) and supporting their educational activities, but also forecasting their achievements, organizing work and adaptation in the learning process, as well as checking completed tasks and conducting exams.

Considering the above, we note that the introduction of artificial intelligence can make the learning process more effective and convenient for both the teacher and the student (pupil), provide feedback, that is, can help in building the necessary communications.

An illustrative example is the Century system, developed by the British IT company "Century Tech", which has been implemented in 700 municipal schools in Belgium since 2019. Century is a computer program in which a student takes a short test on their interests and existing knowledge during registration. Taking into account its results, the program determines the student's strengths and weaknesses, gaps in knowledge, and then assigns tasks to fill them. Teachers have access to student data and track learning progress (Anderson, 2019).

According to experts, the promising areas of using artificial intelligence technologies in education include:

1) Personalized and adaptive learning (selection of learning content, learning pace and learning approach in accordance with the needs of an individual student (pupil), taking into account his cognitive and personal characteristics, with the possibility of tracking learning progress and changing its trajectory depending on the achieved results);

2) An automatic assessment system that allows you to assess the level of students' knowledge, analyze information about learning outcomes, provide recommendations, and develop individual study plans;

3) Intermediate interval training, which enables the student (pupil) to effectively consolidate the passed material;

4) Smartcampus (chat campus, smart campus) – a project that allows you to quickly and at any time of the day provide information related to education (class schedule, classroom number), and ensure communication with the teacher, etc.;

5) Chat-bots that make it possible to automate the work of managers of educational programs (sending mail, new information on topics of interest, as well as sending reminders, etc.);

6) Proctoring a mechanism for observing the behavior of a student (pupil) during tests intended for verification, which are carried out remotely; able to perform biometric identity verification, analyze behavior and record violations during testing.

These artificial intelligence technologies are already being used in practice. Yes, the Knewton program takes into account the specifics of each student's studies and develops a personalized study plan for him (https://www.knewton.com/).

On the online platforms Coursera (https://ru.coursera.org/), EdX (https://www.edx.org/) and Udasity (https://www.udacity.com/) artificial intelligence offers assessment tools ; use chatbots during mass open online courses. For example, the Examity platform allows you to automate proctoring functions, as well as the platforms mentioned above (https://www.examity.com/solutions/auto-proctoring/).

However, artificial intelligence technologies contain potential risks related to the potential possibility of improper use of data about teachers and students (pupils), copying by artificial intelligence of inappropriate behavior of people, with a high cost of its use, etc. Today, artificial intelligence technologies are just beginning to be used in education, and therefore they are used fragmentarily. It is likely that in the near future, although they will not be able to completely replace the teacher, they will be able to take part of his load on themselves, reduce the time needed for actions that can be performed automatically.

Therefore, artificial intelligence technologies should be perceived as an auxiliary, but valuable tool that will allow automating a large number of different functions performed by the teacher in the process of work, help to effectively meet the various needs of students (pupils).

It should be expected that in the future artificial intelligence will become an integral part of educational programs, and it will be impossible to imagine education without the participation of artificial intelligence, which will control the educational process.

As a result, with the constant use of artificial intelligence technologies, we will have significant changes in the field of education, providing new opportunities. It should be noted that it is almost impossible to stop or limit its use, since the role of technologies, especially those based on artificial intelligence, in particular in education, is continuously growing.

Therefore, the trends in the development of advanced technologies force teachers not only to use digital technologies in the educational process, but also to master the platforms of massive open online courses (English: Massive open online courses, MOOC).

The use of various digital technologies in the educational process should increase the quality of independent work of students (pupils), and in the system of higher education should also stimulate the development of research activities of both teachers and students. To create a new didactic and methodical basis for the activity of higher education institutions that would meet the requirements of the digitalization process, to promote the intensification of the educational process, to make higher education more accessible. The result of the process of obtaining higher education in the conditions of digitalization should be the mastering of digital competences by graduates – a set of skills and knowledge necessary for carrying out professional activities using digital technologies.

Among the digital competencies that must be mastered by graduates of educational institutions, it is possible to single out the skills of working with applied programs, digital equipment, digital information (search, transformation, transmission, inclusion in a new array of information), communication skills in a digital environment, creating one's own digital products, etc.

However, the digital transformation in the field of education must start with teachers, since only a teacher who possesses digital educational technologies and "digital" thinking is able to ensure quality training of the future graduate. The teacher must possess not only general technical and technological competence, but also modern information and communication technologies necessary for the technical implementation of the educational process in a remote form.

In particular, the teacher must possess the skills of working in an electronic learning environment, programs for conducting audio and video conferences, as well as programs for creating electronic educational materials, which determines his readiness to participate in the distance educational process (creation of graphic, sound and video information).

In Ukraine, the issue of developing the digital competence of teachers is very relevant today. In particular, the Ministry of Digital Transformation has published for public and expert discussion the Digital Competence Framework for pedagogical and research-pedagogical workers, which is based on European standards of digital competences for educators and is the result of research of international projects, in particular Erasmus+ "Framework of digital competences for Ukrainian teachers and of other citizens" (dComFra), "Modernization of pedagogical higher education using innovative teaching tools" (MoPED), work of working groups of the Ministry of Education and Science of Ukraine.

This framework should become a tool for the creation of educational standards, including professional ones, the development of educational programs by providers of educational services for the training of future teachers and further professional development, as well as for the self-education of pedagogical and scientific-pedagogical workers. The framework can also be used to assess digital competence, including during attestation, to improve certification criteria, to determine requirements for the level of digital competence in job duties during staff recruitment, etc. (Conceptual and reference framework of digital competence of pedagogical and scientific and pedagogical workers, 2021).

However, the changes that have taken place in education in the last decade under the influence of digital technologies increasingly force us to pay attention to the relationship between traditional and innovative (with the use of digital and other technologies) teaching methods in the educational process. In a number of cases, a complete transition to online education is impractical, given the need to provide work in laboratories in a "live" format during the study of many disciplines. Even when mastering subjects of a purely humanitarian cycle, it is necessary to provide seminars and practical classes in the classroom (classroom) in the educational course, during which it is possible to quickly organize a discussion of the topic being studied with the teacher, fellow students (classmates).

A student (pupil) can study theoretical material with the help of online learning, using the educational interfaces of the educational institution. This format of learning the material is more effective than a purely remote form of learning, because it:

– saves a significant part of the time of the participants of the educational process, providing the opportunity to combine studies with work on a flexible schedule, hobbies or travels;

– the classroom fund is released, students from other regions and countries are attracted, educational institutions reduce costs.

In addition, students with limited physical capabilities receive more comfortable inclusion in all educational processes and social communications with teachers and fellow students.

Among the negative effects of digitalization of the educational process, it is necessary to note:

– Firstly, there are possible technical risks associated with the occurrence of malfunctions in the operation of programs and equipment, with incorrect saving and archiving of data, etc., as well as with the probability of increasing cyber risks associated with hacker attacks on university servers and software. To minimize these risks, a staff of qualified IT specialists is needed, which will lead to an increase in labor costs;

– Secondly, for some teachers, working in the format of online education is a problem, because they need to learn to master the operational process of working with electronic resources, computer programs and various services, and this sometimes causes resistance, fears, etc. But at the same time, it is worth remembering that the content of education is no longer the unique intellectual property of a specific teacher, because the younger generation is increasingly turning to the opportunity to acquire knowledge in a convenient, comfortable way, therefore teachers must meet the expectations of young people, and therefore, assimilate technologies, diversify the process teaching in new, more effective forms, etc.

– Thirdly, if "live" communication of students (pupils) with teachers or with each other is minimized, a persistent feeling of "communicative vacuum" may be formed. Under the condition of online learning, the value of the educational process as a way of transferring social and professional experience from the teacher to the student decreases as the educational process transforms towards its digitalization.

In particular, the experience of the Kyiv National University of Culture and Arts regarding the implementation of an online form of education due to the COVID-19 pandemic, and then also due to the war in Ukraine, presented a unique algorithm for working online. Thus, the distance learning algorithm described by the author demonstrates that the need to improve the digital competence of teachers and other employees is beyond doubt.

At the same time, forced urgent mastery of digital tools made it possible to implement new pedagogical approaches and methods. The use of distance learning technologies not only revealed gaps in the digital competence of all participants in the educational process, but also caused a huge impact on the rethinking of approaches to the organization of education and the search for new models of the organization of the information and educational environment of the university. After all, the advantages of the implementation of digital technologies in the educational process will be used even during the return to education in the usual mode.

Despite the disadvantages of using digital technologies in education, we can still highlight the undoubted benefits of their introduction into the educational process:

1) Synthesis of distance and autonomous education models;

2) Development of software applications that will develop the practical experience of students (students);

3) The learner gets access to high-quality and diverse sources of information;

4) Individual approach to each student (pupil), taking into account his abilities;

5) The student (pupil) can take an active part in the learning process;

6) Collection of accurate and timely statistical data on the success of students within the region, the country.

Such system of education is, without a doubt, designed for great independent cognitive activity of education seekers, and this should lead to their intellectual and creative development.

Information and communication technologies are changing the field of education at different speeds in the direction of organizing the educational process and transforming the infrastructure of the educational institution. The feasibility of using information and communication technologies and, in particular, educational software tools in distance education is determined

by their use as a means of visualizing educational information, formalizing knowledge about the subject world, as well as tools for measurement, reflection and influence on the outside world.

The digital transformation of the education sector should rebuild with the help of digital technologies not only the process of acquiring knowledge and managing an educational institution, but also the knowledge itself, form digital competences in future graduates. A modern educational institution must go through the path of digital transformation, otherwise it will not meet market demands.

The transition to a digital educational institution involves the use of flexible processes taking into account the formation of an adaptive corporate culture and the optimization of educational and social processes. Digitization of education can be successful if the educational process, based on the application of information and communication technologies, is aimed at specific users, has a specific content, is based on the correct methodology and approaches, interesting content, good motivation of students (students), a clearly established program and technical base.

The wide range of programs to provide distance learning requires a comparative analysis.

Informatization of education is one of the key conditions for the successful development of modern society, however, a consequence of the rapid development of the latest information technologies in the world has become a new socio-economic problem – information inequality.

The main goal of the introduction of distance education is to solve this problem, as well as quick and convenient dissemination of knowledge, ensuring the availability of education to all segments of the population. To a large extent, this goal is realized with the help of software tools built on modern information and communication technologies, which received the general name of "distance learning systems" (DLS) (Fig. 2.1).

Having carried out a comparative analysis, the educational possibilities of the most common SDLs were revealed, and the peculiarities of their application in accordance with the organization of distance learning were clarified. In this contex

1. Lotus Learning Space distance learning system. This SDL, developed by IBM, provides an opportunity to learn and teach in an asynchronous mode, accessing course materials at a convenient time, and

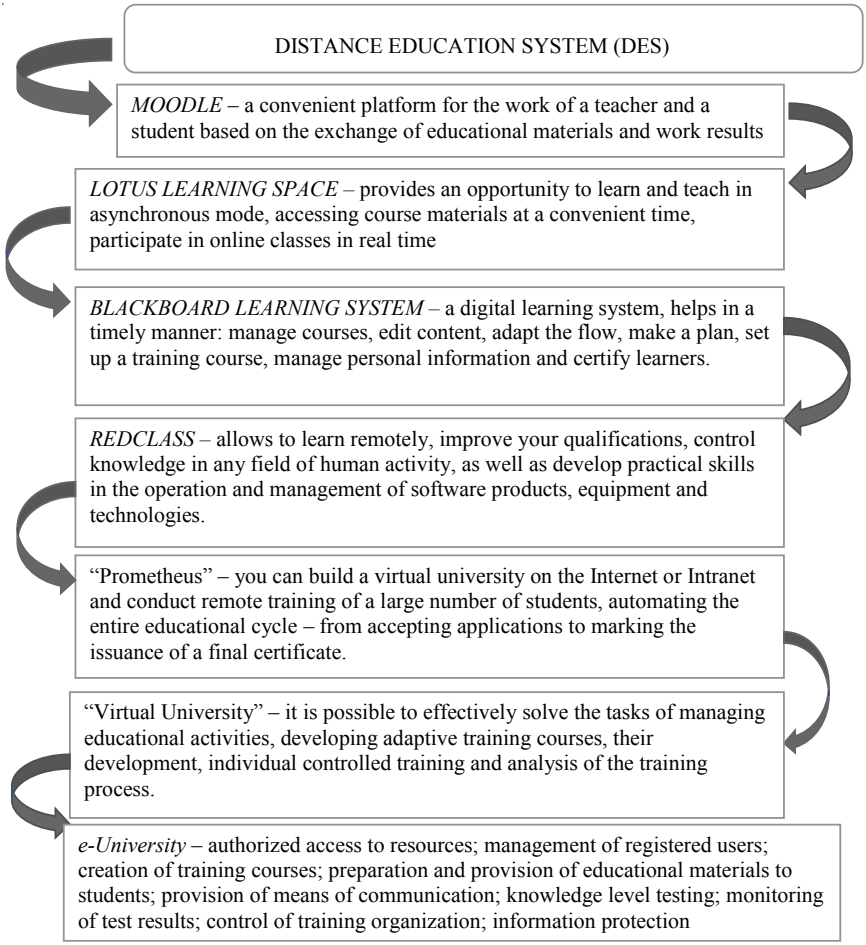

Fig. 2.1. The most popular distance learning systems (DSL) in the form of a diagram

participating in online classes in real time. The teacher can create the content of the course in any programs and then place the created material in the Learning Space.

The program has a flexible course editing and administration system, allows you to choose different teaching modes and monitor the current results of students' work. The courses are organized in the form of

consecutive classes, which can be independent, interactive or collective. Self-study usually includes reading materials and tests to be completed after studying the material.

Interactive classes include lectures in a virtual classroom, participation in an online discussion or chat, working with a virtual board (Whiteboard) and a system of simultaneous viewing of websites (Follow me). Interactive classes are scheduled for a specific date and time and are conducted by a teacher in a virtual classroom in real time. Current student results (course completion stage, grades, time spent, number of appeals, etc.) are stored in the database. This information is available to the teacher at any time in the form of reports of various forms. Collective classes involve classes in off-line and online discussions, chats [9].

There are five specialized databases (DB) in the Lotus system [1]:

– Schedule – allows participants to review educational materials and exercises, participate in tests, solve tasks and conduct research; reflects the structure of the training course created by the teacher;

– Articles, news, book chapters, essays and reports are stored in the MediaCenter database; provides access to the World Wide Web and other external sources of information; can store additional information that goes beyond the course of study and allows students to conduct individual research;

– DB CourseRoom – an interactive environment in which students communicate and conduct discussions among themselves and with the teacher; Modern information technologies and innovative teaching methods in the training of specialists: methodology, theory, experience and issues;

– The Profiles database contains information about students and teachers, contacts (address, phone number, etc.), photos and information about the learning process, gained experience and hobbies;

– The Assessment Manager database is a means by which teachers evaluate the work of each student and inform him of the results.

The current version of Lotus Learning Space 5.01 provides migration of distance courses from previous versions of Lotus Learning Space; has the ability to develop distance courses using Adobe Flash, Adobe AuthorWare, Adobe DreamWeaver software; equipped with a testing system; meets the latest international recommendations in the field of distance

learning standardization; has the possibility of embedding sessions with text or audio chat, video conferences into the distance course; supports the mode of quick display of web pages on users' computers and the mode of copying fragments of the desktop of the lecturer's computer to users' computers, as well as real-time testing.

2. Blackboard Learning System. A special feature of the Blackboard virtual learning environment, developed by Blackboard Inc., is the presence of a control unit that can be configured according to the principle of open architecture. The Blackboard system has the following components:

– "Course Management" – allows you to create streams of students for joint training and provides the opportunity to monitor the migration of students semester by semester;

– "Editing content" – using Wysiwig (visual editor);

– "Stream adaptation" – management of the educational process, coordination with educational programs, reporting activities, etc.;

– "Creating a plan" – allows you to use a saved or create a new lesson plan;

– "Educational groups" – to establish the sequence of classes;

– "Course package" – all packaged content in Blackboard format (additional literature, multimedia materials, questionnaires);

– "Teacher and student toolkit" – glossary, bulletin boards, Electric Blackboard;

– "Personal information management" – calendar, task list, e-mail;

– "Attestation" – provides opportunities to check the level of knowledge of those who study using the software packages "Assessment", "Tasks", "Diary", "Report and preparation board" [2].

Version 9.0 of the Blackboard Learn program was developed in cooperation with teachers from different countries to solve a common, difficult task for them – organizing the learning process for diverse groups of students both in the classroom and outside the classroom. Blackboard 9.0 provides a number of effective tools for solving this task – from social learning tools to Web 2.0 innovations, as well as integrated components that allow educational institutions to conduct higher quality evaluation of individuals, groups, programs and schools. In addition, the release of this version greatly increases the openness and flexibility of the Blackboard platform, allowing educational institutions to enhance the capabilities of

the program in one way or another, or to use it as an expanded base for additional technologies that they need to support their own approach to learning.

Openness is enhanced in this version of Blackboard by including elements that provide integration of open source systems and programs created by amateurs – including Sakai and Moodle course management systems, which do not require separate registration, but are accessed through a single sign-on within platform Blackboard [12].

3. Distance learning system "Prometheus". With the help of the "Prometey" educational system, developed by the Russian company "Virtual Technologies in Education", you can build a virtual university on the Internet or Intranet and conduct remote training of a large number of students, automating the entire educational cycle – from accepting applications to issuing a final certificate. SDL "Prometheus" version 4.2 has the following new features:

– management of access to courses for different groups of users;

– management of the distance learning process using the Internet or Intranet;

– placement of informational and reference materials on the educational portal;

– preparation and control of training plans and conducting classes;

– creation, import of tests, as well as educational materials in various formats, including import of electronic courses in IMS and SCORM formats;

– ensuring the interaction of students and teachers with the help of forums (consultations), chats (seminars) and other electronic means of communication;

– conducting examination and self-testing, working on errors;

– formation of various reports on the consequences of training.

The advantages of the Prometheus system include 10 types of tests, the ability to use graphics and multimedia in tests, the ability to build additional reports, the ability to create a distributed distance learning system (based on central and branch nodes), the ability to integrate with HR, accounting, information and ERP-systems, etc.

For the organization of training at SDL "Prometey" they use: registration for courses by the type of electronic store; calendar plans for studying courses; a new principle of organizing educational and methodical materials – any

number of electronic books can be attached to the course; flexible payment accounting subsystem (expenses); subsystem of registration/issue of certificates; a student can join any number of groups with one login; the possibility of combining roles (the tutor can be the organizer at the same time); the history of interaction with the listener, which is filled in by the organizer; training programs combining several courses; total control of the activities of participants in the educational process; automation of administrative operations through the web server interface.

SDL "Prometheus" of higher education institutions, colleges and other educational institutions can be used to organize: remote preparatory courses for applicants; distance learning and counseling of students; independent work of full-time students; network testing; teaching for a separate fee additional disciplines of the student's choice (except for the officially approved study program); post-graduate studies (distance advanced training courses); involvement of teachers (from other universities, cities and countries).

The Prometheus system has a modular architecture, so it is easily expandable, modernized and scalable. At the current stage, access to the free Internet services of Microsoft Live@Edu is automatically provided at the "Prometheus" SDL. Moreover, access to these services is carried out directly from the interface of the "Prometheus" SDL. Such integration significantly expands opportunities for students and teachers to work together, while significantly reducing network infrastructure costs [4].

4. The REDCLASS distance training system (DTS). The REDCLASS version 2.1 DTS has a modular structure and can be delivered to the customer in different configurations depending on his goals and requirements. SDT REDCLASS has the following functional modules, presented in Table 2.1.

This complex of hardware and software tools, educational materials and teaching methods allows remote learning, improving qualifications, monitoring knowledge in any field of human activity, as well as developing practical skills in the operation and management of software products, equipment and technologies.

Basically, this SDT is used to organize a corporate system of distance learning and professional development of company employees; organization

Table 2.1

Classification features of the system in terms of the functionality of REDCLASS distance learning modules

MODULE	FUNCTIONAL FEATURES OF THE MODULE
Authorization module	Management of access rights of different categories of users to SDT REDCLASS functions, management of the registration form, role directory, user registry, directory груп
Adaptation module	Formation of group/individual training programs/plans, management of training applications, management of access to training based on initial knowledge testing.
Electronic textbook	Implementation of comprehensive submission of educational materials to students.
Testing system	Checking students' knowledge for the purpose of self-control and control by the organizers of the educational process
Exercise emulation environment	Providing the opportunity to master practical skills of working with hardware and software complexes in the emulation mode of the user interface. For example, it can emulate the work of MS Word to train users of this system.
Virtual laboratories module	Providing the opportunity to master practical work skills through the implementation of remote access to software and hardware
Learning materials management module	Management of the course catalog, course versions, external resources, learning modes and methods of creating courses. AICC and SCORM standards are supported.
Learning materials management module	Organization of interaction of participants in the educational process in asynchronous (e-mail) and synchronous (text conference)
Statistics module	Collection of statistical data and presentation of statistical information in the form of reports intended for the user
Administration module	Providing access to the online event log and user log, as well as access to delete functions
Questionnaire module	Questionnaire module
Author system	Creation and editing of educational materials.
Creation and editing of educational materials.	Creating and editing exercises with a branched execution scenario and various systems for evaluating user actions.
Custom portal	Provision of individualized access to services.
Web-сайт	Informing system users, providing user registration functions.

of a system of professional development of specialists in various fields of activity on the basis of specialized training centers; the organization of distance testing for the control of knowledge acquired through both traditional face-to-face and distance learning, as well as for the purpose of use in higher and secondary educational institutions in the process of training and testing students [3].

5. System of differentiated Internet education HEKADEM. This system was developed at the Baikal International Business School of Irkutsk State University. It allows to ensure a modern level of education in educational institutions and educational centers based on the use of modern telecommunications and information technologies. The HEKADEM system can effectively solve the tasks of managing educational activities, developing adaptive training courses, their development, individual controlled training and analysis of the training process. The system is built on the basis of the author's model of presentation of knowledge of the training course, which allows you to organize differentiated, individual training of Internet technology.

HEKADEM can be used not only for the organization of distance learning, but also as a tool for increasing the efficiency of classic day learning. HEKADEM ensures reliable operation of the following groups of users: teachers – developers of Internet courses; students studying on specific courses; teachers accompanying the course; heads and administration of an educational institution; system administrator. For each user, the system supports authorized access to its resources according to his authority.

The HEKADEM system enables the management of an educational institution to implement its policy in the field of Internet education, namely: prepare training programs for majors and specializations; determine the list of requirements for training courses; to build study plans for each program; work with course developers; to organize the learning process in accordance with the educational plans.

There are 4 subsystems in the Hekadem system:

1. The dean's office enables the management of the educational institution to implement its policy in the field of distance learning.

2. The course designer, organized for the teacher – the course developer, in which the structure of the training course is formed from training blocks,

training material is placed in the appropriate form: text, graphics, sound, video, hypertext, games, etc.

3. The tutor enables the teacher who accompanies the course (tutor) to monitor the course study process of each student, evaluate the individual tasks completed by him, his work at seminars and, if necessary, provide him with help or advice.

4. The student allows the student to choose the most convenient way of studying for himself and to work in an individual mode at a time convenient for him. The HEKADEM system can be freely used by educational institutions and enterprises cooperating with the Baikal International Business School of ISU [15].

6. E-University online educational platform (OEP). OEP eUniversity is designed for training and testing using modern information technologies. It provides solutions to the following tasks:

– authorized access to OEP resources; management of registered users; creation of training courses;

– preparation and provision of educational materials to students; provision of means of communication; knowledge level testing;

– monitoring of test results; control of training organization; information protection.

OEP e-University can be used for the purpose of: teaching and testing students of higher educational institutions using modern educational tools; organizations of distance learning in full-time and correspondence courses; retraining of personnel on the basis of graduating departments; pre-university training and testing; organization of open distance education and paid education on additional courses. The e-University platform can be used both directly for distance learning, when students are physically distant from the learning center, subscribe to a certain set of training courses, receive methodological instructions, perform tests and tasks, and for face-to-face forms of learning. eUniversity provides the necessary set of tools for implementing the concept of distance learning, management interaction, teaching and learning. The system administrator manages the educational process, adjusts the system to the structure of the institution, creates a library of educational resources, manages users and groups, courses, information flows.

The teacher develops his own training courses: lectures on sections, electronic textbooks, audio-video materials, a system of testing and

assessment of knowledge. He maintains close contact with students through e-mail, online consultations, and bulletin boards, identifies benefits, recommends additional educational resources, and analyzes test results. The student studies the course independently, interacting with the teacher. All information resources are at his disposal: curricula, lectures, electronic textbooks, tests and their statistics, ratings. He receives the teacher's recommendations, consults with him, conducts correspondence, passes control and training tests at a time convenient for him [11].

7. Web system of corporate-level distance learning "Virtual University". "Virtual University" is one of the SDLs of domestic origin, which is designed to solve distance learning tasks in companies and educational institutions of Ukraine of any scale and level. Developed with the participation of the professors of the department of ASIOI FIOT NTUU "KPI", the system meets the requirements of the Ministry of Education and Science of Ukraine and has various possibilities for testing students, recording and developing courses, submitting statistics and generating the necessary reports.

The main advantages of this system are:

– insignificant costs for installation and maintenance of the distance learning system; speed and high quality of providing/teaching educational materials;

– convenient and effective level of assessment of acquired knowledge and performance of independent work;

– attracting more applicants; convenient interactive interface; access to the system from the Internet allows you to participate in the educational process from any corner of the world;

– increasing the competitiveness of the educational institution and the use of the latest modern information technologies in the work.

"Virtual University" consists of the following additional modules: Library, Statistics, Synchronization, Publisher, Search, Schedule Manager, Analytical module, Data backup. Thanks to these modules, you can automate any educational process. Configuration options allow you to create a virtual environment of any scale: group / class; stream / department; faculty / enterprise; university / corporation. SDL "Virtual University" allows you to implement any directions in the educational process: starting from the creation of an internal communication environment to a full-fledged virtual university' on the worldwide Internet [7].

8. Virtual educational environment – "Web-class-KhPI". This SDL was developed by the problem laboratory of distance learning of NTU "KhPI" and is intended for the creation of a dynamic information space, which aims to provide productive educational activities and take into account all the cognitive needs of students, namely: the presentation of structured and motivated educational materials; support of users' cognitive and activity activity; the necessary communication and cooperation of participants in the educational process in various forms; means of administration of the educational process and its active support; the system has a dynamically adjustable interface language (Ukrainian, Russian or English).

The following subsystems are part of "Web-class-KhPI":

– access to background information (preface to the course, information about authors and tutors);

– administration (registration of new students, monitoring of activity); access to basic information materials – course;

– access to dynamically formed educational materials through the course menu; preparation and conduct of online testing (includes knowledge testing, adaptive and psychological testing, questionnaires, interviews);

– access to system web dictionaries; intra-course mail; forum – course discussion club; chat lines There are several user groups in "Web-class-Khpi".

The system administrator has the highest priority to access system resources. Its activities are aimed at maintaining the integrity of the system, maintaining databases, and exercising general control over the educational process. He controls the process of registration of listeners, monitors possible violations of the rules of operation in this system. The author of the course creates a distance course, which includes informational materials, a set of tests, topics for discussion in the Forum and the Chat Line. The system gives the author the opportunity to make part of the classes dynamic, if an individual approach to an individual student or group of students requires it.

The tutor is responsible for successful distance learning. It monitors the filling of course databases by students and, if necessary, clears part of the records. The tutor monitors the progress of the Forum, organizes and conducts chats. If necessary, he can create dynamic lessons. Listeners are those who sign up for a distance learning course [8].

So, the described distance learning systems (DLS) have a common goal – software support for the distance learning process, but have different parameters and capabilities. We consider it expedient to present a comparative analysis of the capabilities and functions of distance learning systems (Table 2.2).

Table 2.2

Comparative table of functions of distance learning systems

System name / Criteria	Moodle	Lotus	Blackboard	Redclass	e – University	Web class
Monitoring of students' actions	+	+	+	+	+	+
Portfolio	+	-	+	+	+	-
Support	+	+	+	+	+	+
Group work	+	+	+	-	+	+
Search by course	+	+	+	-	-	-
daybook	+	-	-	+	-	-
Self-assessment	+	+	+	+	+	+
assistance	+	+	+	-	+	+
Planner	+	+	+	+	+	+
Forum	+	+	+	+	+	+
Chat	+	+	+	+	+	+

According to the results of a comparative analysis of distance learning systems, it should be noted that among the total population presented above, Moodle is the most optimal. It is appropriate to emphasize that it includes the possibility of a maximum set of functions that meet the modern requirements of distance learning. It should also be added that Moodle's SDN also includes internal correspondence functions, course templates, a system of compliance with teaching standards, a glossary, integration with external applications, etc.

In addition to the programs presented above, it is also appropriate to mention the SDN OFFICE 365, which includes the TEAMS system and GOOGLE CLASS. These systems are also modern software products that fully satisfy the needs of both teachers and pupils, students, graduate students, etc.

Thus, it should be noted that the joint efforts of programmers and teachers have developed a sufficient number of distance learning systems for the organization of distance learning in educational institutions of various

types. Information and communication technologies are constantly developing, and new versions of the considered distance education platforms will have new opportunities for improving the educational process.

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2.3. Digital technologies: opportunities, tools, advantages, ensuring implementation of planned results

Information systems have entered all spheres of life. The development of digital technologies opens up a huge range of opportunities. Progress in all fields of science and industry proceeds at a tremendous speed, never ceasing to amaze and fascinate.

The corona virus pandemic, military actions on the territory of Ukraine – became a powerful stimulus for the introduction of digital technologies in all spheres of economic and social life. Quarantine measures have provoked the transfer to the online environment of not only a significant part of trade in goods and social services, but also the development of education based on digital technologies. Of course, digitization is due not only to the quarantine, but also to the general development of the countries of the world in the post-classical era. Digitization, which has acquired a global character in recent decades, has become one of the strategically important vectors of the development of civilization, the results of which we observe everywhere