DOI: 10.15587/978-617-8360-20-7.CH2

Svitlana Tolochko, Liubov Kanishevska, Oksana Vasiuk,
Svitlana Vyhovska, Viktoriya Prylypko, Anzhelika Lesyk

CHAPTER 2

DIGITAL PEDAGOGY OF OPEN EDUCATION: ESSENCE, CONTENT, AND EFFECTIVENESS

ABSTRACT

This chapter explores the essence, content, and effectiveness of digital pedagogy in the context of open education. It analyzes the state of implementation of digital pedagogy in global and Ukrainian education and science, and examines its development under conditions of digitalization and distance learning through sociological survey data. The findings confirm the unique role of digital pedagogy in formal, non-formal, and informal education, highlighting its effectiveness in educational and scientific activity. Digital pedagogy is defined as a new field of pedagogical science aimed at using online and hybrid learning environments to improve individualized learning, create methodologies that integrate digital tools, and enhance cognitive activity. The chapter also investigates how digital pedagogy overcomes the limitations of traditional approaches – such as fixed curricula, limited classroom hours, and restricted communication – by enabling anytime-anywhere learning with diverse digital methods. A methodological toolkit for applying digital pedagogy in preschool, primary, and adolescent education is proposed.

KEYWORDS

Digital pedagogy, open education, digital technologies, educational process, educational institution, learners.

2.1 RETROSPECTIVE ANALYSIS OF THE INTRODUCTION OF DIGITAL PEDAGOGY INTO GLOBAL AND UKRAINIAN EDUCATION AND SCIENCE

In 2006, the EU identified digital competence as key to lifelong learning. Thus, the digitalization of education is becoming an imperative for reforming the education sector, a dominant and primary task for the effective development of the information society. According to the annual global study of the state of the digital industry Digital 2022 Global Overview Report, 62.5% of the world's population uses the Internet, and the number of users in 2021 increased by 192 million (4%)

and amounted to 4.95 billion people. With the introduction of 5G technology and the COVID-19 pandemic worldwide, the Internet is currently at its peak of growth. The digital transformation of education (digitalization of education) is a crucial aspect of the digitalization of society, which poses new, innovative challenges for the education and science system [1].

Digitalization of education is a modern stage of its informatization, and involves the saturation of the information and educational environment with means, electronic and digital devices, systems; the establishment of electronic and communication exchange between them, which actually enables the integrated interaction of the physical and virtual, therefore creating a cyber-physical educational space. Digitalization of education has two sides: the first is the formation of a digital educational environment as a set of online courses, digital learning tools, electronic educational content, digital services and resources; the second is a deep modernization of the educational process, which should ensure the preparation of a person for life in a digital society and professional activity in a digital economy [2].

The UNESCO report [3] identifies areas of activity of higher education institutions that require the use of digital technologies to improve. Among them:

– administrative activities, in particular, management of a higher education institution;

– the educational process in terms of teachers providing students with educational materials through a virtual learning environment, as well as a learning management system VLE/LMS;

– improving the efficiency of scientific activity through open access research repositories, which is a means of disseminating scientific achievements of scientists of a higher education institution in the open information space and a tool for reporting on research in the institutional and national information space (in the UK, the Research Excellence Framework);

– increasing the level of development of academic digital skills and digital literacy of education seekers, teachers, administrators, which is necessary for effective educational and professional activity in the conditions of a digital society, namely for the creation of online courses by teachers, effective educational cooperation in online, blended and traditional learning formats [4];

– expansion (temporal, spatial, content) of the open educational space of educational resources, the possibility of educational activity in 24/7 mode; ensuring accessibility to high-quality educational content within open educational spaces, in particular MOOCs;

– development of an open space of methodological materials regarding achievements in the field of digital education, i.e. educational and methodological repositories, primarily at interuniversity ones, the use of which allows teachers to improve the design and content of online educational materials, exchange developments and experience, in particular within social networks (Facebook, Twitter, etc.), or sites (for example, Cloudworks);

– cooperation of scientists, teachers and students within the framework of joint scientific projects, implemented on an institutional and inter-institutional basis, in particular in the aspect of cooperation in national and international university research networks;

– conducting training sessions within the framework of online and blended formats, which provides for the possibility of synchronous and asynchronous communication, group video conferences;

– presenting the activities of the university to the external and internal environment using the Internet site, which is a tool for implementing the policy of a higher education institution in the field of information support for educational and scientific activities, popularization of educational achievements of students and teachers, marketing, recruiting, fundraising, etc. [5].

In addition to the development of immersive learning technologies using augmented and virtual reality, voice interfaces, automation of educational processes (robotization of communication), machine analysis of user actions, testing and learning results (using artificial intelligence), certification using blockchain technologies, trends in education development include gamification and inclusion technologies, user identification and personalization of the educational process, microlearning, socialization of educational programs, including the exchange of user experience, the association of education seekers by interests and professional competencies, a team approach to work and learning in common information bases. It is also important to track dominant changes and tendencies in digital educational trends that affect the processes of digitalization and the development of education in the 21st century. This is primarily the implementation of the principles of open education, ensuring access to quality education for each applicant, improving distance learning, implementing the idea of the Internet of Things, robotics, artificial intelligence, developing the latest online tools and scientific and methodological support, implementing educational digital needs in close cooperation with software developers [6].

In higher education, the era of digital technologies begins in the 1980s, when multimedia technologies were first introduced into the educational process, which involved the use of a computer as a carrier of information that can be provided to consumers using video, audio, animation, etc. With the emergence of web resources in the early 1990s, a qualitatively new stage of the application of digital technologies in all aspects of the activities of higher education institutions begins, in particular the distribution of software applications for educational needs.

So, this period includes the use of the *first generation* of digital technologies in higher education: computerized teaching and the use of websites. In universities in developed countries of the world, since the 1990s of the 20th century, web pages of teachers were created, mainly not related to the website of the higher education institution, where contact information, course materials, forums for discussions or links to news sites in a certain field were posted. Learning Management Systems (LMS) are actively developing. The most popular among them are Moodle, Desire2Learn, Blackboard, Instructure, Sakai, which have become the organizational basis for standardizing educational and scientific activities of higher education institutions around the world, developing a quality culture at the university, creating conditions for active interaction between students and teachers, and learning in active interaction of all participants in the educational process online and offline. Other digital technologies of the late 20th century are educational facilities, educational design, mobile devices, gaming technologies, which have become an integral part of university life, the technological basis of its successful functioning.

Gradually, technologies are being introduced into higher education, which were intended to make it publicly accessible, and the information space open: since 2001, the period of open educational

resources, virtual worlds, social media, smart devices, electronic books begins, which contributed to the interactivity of the educational process in addition to the democratization of higher education.

So, in the late 1990s, *second-generation* technologies appear - learning management systems and virtual learning environments (VLE/LMS), which were mainly produced by WebCT and Blackboard. These technologies allowed to expand the educational offers of a higher education institution, were located on its base and controlled by it. Thus, LMS served to place standardized and systematized educational content, organize the educational activity of students and, mainly, limited interaction between participants in the educational process. At this time, the first blogs, wikis and other more complex social digital technologies appeared. In the 2000s, opensource LMS appeared, in particular Moodle and Sakai, later Desire2Learn and Instructure (cloud-based LMS).

During the 1990s and early 2000s, the development of social media attracted considerable interest from the academic community, as such technologies enabled learners to control aspects of the educational process that were previously controlled only by the higher education institution. Since 2004, the concept of Web 2.0 has been gaining popularity, so teachers in the educational process actively use wikis, blogs, RSS, and social bookmarking as technologies that allow for active cooperation between subjects of educational activity. The wide variety of second-generation digital technologies has led to greater opportunities for educational interaction with learners, located in different countries of the world. The factor that hindered the spread of such technologies was the insufficient level of digital competencies of most teachers and learners. In addition, a small number of teachers of higher education institutions possessed the appropriate technologies.

Currently, the most popular learning support system for distance education is the LMS Moodle. In particular, studies, conducted by Spanish scientists, show that of all web-based learning support systems, Moodle is the most widely used (45%), while the Moodle system is gaining recognition not only in traditional educational environments, but also in the advisory system. Thus, the American Extension system, in its educational part and the organization of local, regional advisory communities, is technologically based on Moodle. This learning environment was developed by Australian specialists and provided for use under an open license. According to moodle.org, this system is used in 229 countries in 115 languages. This system has great capabilities for forming and presenting educational material (includes a built-in visual text editor, allows you to enter formulas in TeX or Algebra format, create glossaries), testing knowledge and monitoring progress (creating a database of test questions, statistical processing of test results, self-analysis of test results), communication between students and teachers (e-mail, file exchange, forum, chat), and organizing group work (forum, chat, wiki). The system interface is quite easy to use. This distinguishes the Moodle learning environment from other similar systems [7].

The 2010s were a period of the emergence of massive open online courses (MOOCs) and learning analytics, which fundamentally and radically change the philosophy of modern education and the methods of organizing the educational process. These are third-generation technologies. The task of the first MOOCs was to unite the methods of educational interaction, scattered by various digital means. This approach allowed students to choose and control the means of learning accord-

ing to their preferences and educational interests. At the same time, these technologies allow the teacher to control the process of educational interaction with and between students. Also, at this stage of further development, LMS technologies gained more and more opportunities, provided by social platforms and media. An innovation was the use of blogs and wiki technologies in a limited institutional environment (walled garden) within the framework of a corporate (institutional) LMS, which is a manifestation of the development of a participatory educational model. Researchers call the impossibility of communication of education seekers with foreign partners who are outside the institutional LMS the disadvantage of this innovation. The new generation of platforms includes edX/Open, edX and Coursera, which are constantly being improved.

In addition to social media technologies and MOOCs, the third generation of digital technologies includes E-portfolios, which are combined, mainly, with the use of methods of prior learning assessment and recognition. Currently, there are a significant number of innovative proposals, both non-commercial (Mahara) and commercial (PebblePad or D2L).

Thus, the first three generations of digital technologies in higher education involve a wide range of various technologies of both monofunctional (Mahara) and multifunctional (Bright-Space, Canvas, Blackboard), as well as products of social media technologies (Facebook, Elgg) [5].

The beginning of the 2020s became a period of general forced radical digitalization of higher education activities, which was associated with quarantine restrictions and knockdowns of all levels, caused by the COVID-19 pandemic. This period is characterized by suddenness, insufficient readiness of educational entities for forced forms of activity, determined by the university's mission.

Fourth-generation digital technologies are aimed at implementing models of personalized, adaptive, self-regulating (oriented to the needs of education seekers) learning. They are focused on the formation of professional competencies relevant on the labor market. There is a wide commercial offer of technologies, such as: Knewton, Smart Sparrow, OLI (based on a joint project of Stanford and CMU universities), LoudCloud, etc. The choice of innovative technological products is in favor of large corporations on the international market. They determine the trends in the development of technologies for the educational process of higher education and education in general [5].

Now educators have access to a variety of modern digital technologies, in particular for communication, such as: GoogleMeets, Skype, Zoom, etc. Teachers can collaborate with education seekers regardless of the location of subscribers.

Higher education institutions realize that digitalization will offer a number of advantages and new strategies (approaches) to the education of students. Thus, the intensive development of technologies, such as augmented reality, virtual reality, artificial intelligence, robotics, media education, blockchain, cloud-based environments, gamification, STEM/STEAM education has a powerful impact on the development of digital educational content [8].

One of the most significant positive features of the digitalization of education is the expansion of the research and educational space, the possibility of diversifying methods and forms of learning that are aimed at the needs of education seekers and take into account the requirements and demands of the labor market.

With the digital transformation of the education system, there are a sufficient number of predictions regarding its results:

– full and high-quality personalization of the educational process;

– support for sustainable learning motivation of education seekers at all stages of the educational process;

– ensuring prompt feedback to each education seeker, objective and rapid assessment of learning outcomes during the performance of an educational task;

– ensuring the project aspect of educational activities, the deepest possible integration of practical and theoretical training;

– significantly reducing the periods of development, deployment, and mastering of educational programs;

– increasing information transparency and openness of the education system [6].

The pedagogical effectiveness of the digital approach is determined by a wide range of macro-, meso-, and micro-level factors [5]:

1) macro level (national and global dimensions): the presence of international agreements, support by the digital community for international Internet standards; national and international support for the development of open educational resources; pooling the resources of partner universities, coordinating their actions to achieve common goals, in particular, providing more accessible, cheaper and higher-quality education on a global scale (online platforms Coursera (the best startup of 2012), MIT OpenCourseWare (a project of the Massachusetts Institute of Technology for publishing materials of all courses in open access), Edx (a free online platform for massive open courses, founded by the Massachusetts Institute of Technology and Harvard University in 2012), Udemy (online courses), OpenLearn (an educational website, the contribution of the Open University of Great Britain to the open educational resources project and a place for free open learning from the Open University), etc.);

2) meso-level (institutional dimension), which determine the pedagogical effectiveness of the digital approach to the educational process: a clear strategy and active policy of the university on the introduction of digital innovations into the educational process; technological and financial support for the implementation of digital strategies of the higher education institution; developed technological infrastructure, namely the learning management system, which all subjects of educational activity are connected to; support for teaching staff in mastering and applying digital innovations in the educational process; developed and effective digital leadership, aimed at coordinating the efforts of all members of the academic community in acquiring and continuously developing digital competencies, forming a digital culture in the higher education institution; use of open educational spaces, classrooms for teamwork, multimedia spaces that provide remote communication;

3) micro-level factors determine the effectiveness of the digital approach. There are several groups related to:

– *student:* internal learning motivation; attitude to effective employment; responsibility for one's own learning outcomes; high level of digital literacy; skills of interaction with the learning

interface and other learners within the academic group, with teachers; active position as a stakeholder in the educational process, which includes participation in the development of one's own educational content;

– *teacher:* positive attitude towards digital innovations; significant changes in professional responsibilities (from information provider to group interaction coordinator, facilitator, mentor, coach, team member); high level of digital literacy; continuous improvement of teaching methods and monitoring of learners' educational outcomes, team work skills and shared responsibility with colleagues and students for learning outcomes; skills of group and individual professional reflection; skills of timely developmental and normative digital control of educational outcomes;

– *curriculum*: interactive content; constantly updated student-centered design of educational courses; practice-oriented tasks for independent work of higher education students, etc.;

– *learning technologies*: the existence of a learning management system, which provides a sufficient set of opportunities for presenting educational services in digital format; the ability to connect modern mobile gadgets to the educational platform 24/7;

– *learning methods*: organizing cooperation between higher education seekers within structured online discussions; creating mutual learning groups; using personalized and cooperative learning methods; involving students in compiling educational content;

– *organization of the educational process*: individual educational trajectory of a higher education seeker; taking into account previous learning outcomes of students, obtained within alternative (non-formal, informal) educational models, in particular MOOCs; creating student-teacher educational and scientific online communities; flexible individual schedules for completing tasks; constant monitoring of the students' success by the teacher, providing feedback not only at each control stage of training, but also as needed by the student;

– *monitoring of educational achievements*: a competence-based approach to assessing the educational achievements of students; constant self-assessment and self-monitoring by students of the results of their own activities; evaluation of the process and results of teachers' training; introduction of microcredits, which provide for the assessment of individual procedural aspects and results of educational work and obtaining digital badges.

In the digital educational space, the risks of digitalization of the educational process cannot be ignored. Among the problems of higher education, the following are distinguished [9]:

– loss of basic cognitive skills (counting, reading, writing), decrease in the quality of education;

– "public" model of a teacher-lecturer, rather high requirements for his/her psychological qualities, increase in the number of conflicts;

– decrease in personal contacts, "drainage" of talented youth and teachers abroad, decrease in the level of training, problems of quality control of education;

– change in requirements for the content of education and means of education;

– change in requirements for the qualification of specialists, decrease in the need for an "intellectual" specialist and "attraction" to the technological image of a professional, reduction in the contingent of higher education;

– movement towards "educational services", departure from fundamentalism, change/redistribution of powers of the administration of higher education institutions and teachers, decrease in the quality of education.

A significant disadvantage of online education is its focus on meeting short-term or, at best, medium-term tasks. A specialist who has mastered a limited amount of knowledge and has not received basic fundamental training can only count on intellectual "superstructures", the stability of which is illusory [9]. Not only digitalization is actively developing in educational institutions, but digital educational institutions are also being created. A digital university is an institution of higher education that actively implements information and digital technologies and forms the competences of participants in the educational process, has an innovative structure that is able to provide modern approaches in management, scientific, educational and methodological activities [10]. Digitalization of educational activities contributes to the further development of distance learning.

Back in 1969, the world's first *Open University* was organized in Great Britain, which is an institution of higher education of non-traditional learning and is now known throughout the world. The opening of the university is associated with the impression, received by British Prime Minister G. Wilson during a visit to the USSR from the system of Soviet correspondence education. The Britain Open University is an independent educational institution that creates opportunities for working adults to obtain or continue their education.

The university offers the following types of education: bachelor's degree, postgraduate, extended. The educational process at the university is built on the widespread use of digital technologies. Higher education applicants have the opportunity to receive consultations in almost 400 centers, located in many cities of the country and the world. The university has about 250 thousand students. Since its founding, more than three million students have studied under the programs of the Open University. Undergraduate students at the Britain Open University can choose from over 160 courses, taught by educators from the following faculties and schools:

1. Faculty of Arts.
2. Open University Business School.
3. Faculty of Education and Language Studies.
4. Faculty of Health and Social Care.
5. Faculty of Law.
6. Faculty of Mathematics, Computing and Technology.
7. Faculty of Natural Sciences.
8. Faculty of Social Sciences.
9. Institute of Educational Technology.
10. Institute of Media Studies.

The university is governed by three statutory bodies: the Council, the Senate and the General Assembly. The Open University, headquartered in Buckinghamshire, has offices in thirteen regions of the UK, and outside the EU operates through a network of educational partners who provide the educational process under the Open University programs in more than 50 countries.

Thanks to the distance learning methods used, training under the Open University program has become available to students in Europe and Asia (Canada, Austria, Spain, Pakistan, Holland, Turkey, India, Israel, etc.).

The features of the organization of the educational process of distance learning of the Britain Open University are:

– absence of entrance requirements;

– modular structure of building educational courses;

– possibility of choosing educational tasks, their arrangement;

– learning of one fundamental science, on the knowledge of which special training is based, by students during the first year of study;

– individualized teaching methods;

– choice of the pace of studying courses by the student in accordance with his/her abilities and possibilities;

– continuation of education from 4 to 8 years;

– attachment to each student of a tutor who directs learning and consults in case of problems.

In October 2006, the Open University joined the organization "Open Educational Resources Movement" and launched the "Open Learn" project. A large number of current and past materials for distance learning are published for free access, including file versions for teachers with the ability to edit, as well as free software tools for learning [11].

Also known in the field of distance education in Europe are the *University of Distance Education and the Center for Open Learning* (Spain), the *Open University of the Netherlands,* etc., in Germany – the *Correspondence University* of Hagen (North Rhine-Westphalia), which provides services to more than 50 thousand students per year. The distribution of educational materials is carried out using modern means of communication. The transfer of knowledge from the educational institution to students and the control of their work are carried out using video conferences or access to the university library online, which are constantly researched, evaluated and improved. However, no more than 20% of the contingent receives a higher education diploma, since the qualification requirements at the university are quite high [12].

The *Indira Gandhi National Open University* was established in 1985 by a decision of the Parliament of India. Its network includes 21 schools, 67 regional centers, 2,667 training centers, and 29 foreign partner centers. The university aims to provide educational services to a wide range of people (women, the disabled, the poor, Indian citizens living abroad) and uses case technologies, individual consultations with teachers, satellite communications. Currently, about 1/5 of the students study at the university that is 20% of all students in India. They can choose from 226 programs offered, including courses at the certificate, diploma and degree levels.

The *National University of Technology* was founded in Colorado in 1984 as a non-profit corporation. The academic programs, offered at the university, are approved by more than 40 universities. The educational institution uses modern digital technologies of teaching and educational management in its educational activities.

The *Open University of Israel* is the country's main higher education institution in the field of distance learning. About 30 colleges in Israel actively cooperate with it, providing students with training in the courses of the Open University of Israel. The training involves weekly group meetings of college teachers with a university instructor, which allows attracting a large number of students who obtain higher education working and intensively studying. In 1996, the Council for Higher Education granted the university the right to award a master's degree in computational mathematics and engineering.

The *Kentucky State University* in the United States offers distance learning programs at the undergraduate and certificate levels in English and computer technology, biology, psychology, humanities, office systems, mathematics, economics and history, 12 programs and more than 60 distance learning courses for professional training of students without obtaining scientific degrees, for example, in firefighter training, information technology, travel and tourism training, as well as courses in knowledge management, health care. The university cooperates with private and public institutions and agencies on training of their employees without granting bachelor's or master's degrees. For example, cooperation is organized with the Virtual University of Mexico, which is accredited in the United States by the Southern Association for Colleges and Secondary Schools (SACS) [13].

A feature of modern distance learning in foreign countries is the significant influence of universities on its development. An example of this is a joint project of the Massachusetts Institute of Technology and Harvard University, which created their own distance learning platform and began to place distance courses on it in 2012.

Ukrainian educational institutions that use distance learning technologies are state, non-state and corporate ones. They promote domestic and foreign educational services to the Ukrainian market. In 2000, the Ukrainian Institute of Information Technologies was created on the basis of the National Technical University of Ukraine "Kyiv Polytechnic Institute" in order to coordinate the work, carried out within Ukraine to create a national system of distance education, gradually introduce its elements, and promote its organic entry into the world space.

In 2000 The Ministry of Education and Science of Ukraine approved the "Concept of Distance Education Development in Ukraine", which provided for the creation of an education system that ensures the expansion of the circle of consumers of educational services, the implementation of a system of continuous education "throughout life" and the individualization of learning in the context of mass education. A List of distance learning centers, recommended by the Ministry of Education and Science, Youth and Sports of Ukraine, was published [14].

The Distance Learning Center of the National Academy of Public Administration under the President of Ukraine was established in 2001 with international technical assistance and financial support from the Canadian International Development Agency and the World Bank within the framework of the World Bank project "Ukrainian Center for Global Distance Learning". The center is part of the World Bank's global development educational network, which unites more than 50 similar centers in Europe, America, Asia and Africa.

The International Scientific and Educational Center for Information Technologies and Systems of the NAS of Ukraine and the MES of Ukraine is a scientific and educational organization subordinate to the National Academy of Sciences of Ukraine and the Ministry of Education and Science of Ukraine. It was established in 1997 with the assistance of the Government of Ukraine, UNESCO, the National Academy of Sciences of Ukraine and the Ministry of Education and Science of Ukraine. The areas of its educational activity include: development and use of new computer technologies and telematics tools; training and retraining of masters and other specialists in the basic areas of cybernetics and computer science, etc.

The fact that there are important economic aspects of the impact and spread of distance learning. Every year, the cost of using, processing, storing and transmitting information on the Internet decreases, while the cost of obtaining traditional education increases. In addition, large corporations invest significant funds in supporting and developing educational programs, supporting the creation of a new national strategy in their country. In particular, leading Chinese telecommunications companies have joined forces with such technical giants as Baidu, Alibaba and Huawei to support a digital educational network with 7,000 servers with a total bandwidth of 90 terabytes per second. Cooperation between universities and enterprises has led to the development of a comprehensive educational model for students of all forms of education [15].

The Global Industry Analysts company publishes the following data: the global distance education market is worth about $22.4 billion. Due to the spread of the COVID-19 pandemic, this market is predicted to grow to $80.1 billion by the beginning of 2027. Moreover, spending is expected to increase by billions of dollars on the development of distance education, and as a result, competition in the distance services market will increase in countries, such as the USA, China (expenses are forecast to increase by 25%), Japan and Canada (expenses are forecast to increase by 15.7% and 18.3%, respectively), Germany (expenses are forecast to increase by 17.2%) [15].

2.2 THE CURRENT STATE OF DEVELOPMENT OF DOMESTIC DIGITAL PEDAGOGY IN THE CONTEXT OF DIGITALIZATION OF EDUCATIONAL INSTITUTIONS AND DISTANCE LEARNING (REVIEW OF THE RESULTS OF SOCIOLOGICAL SURVEYS)

The study of the current state of development of digital pedagogy in the context of digitalization of educational institutions and distance learning is carried out in Ukraine systematically through a number of sociological surveys. In this section, we present their results.

Thus, according to the National Report on the results of the international PISA-2022 education quality study in Ukraine, 58% of students achieved the basic literacy level in mathematics, 59% in reading, and 66% in natural science disciplines. The authors conducted a comparative analysis of the performance of Ukrainian students with the average performance in the countries of the Organization for Economic Cooperation and Development (OECD), which includes 35 countries (Australia, Austria, Belgium, Great Britain, Greece, Denmark, Estonia, Israel, Spain, Iceland,

Ireland, Italy, Canada, Korea, Latvia, Luxembourg, Mexico, Germany, Norway, New Zealand, the Netherlands, Poland, Portugal, Slovakia, Slovenia, the USA, Turkey, Hungary, Finland, France, the Czech Republic, Chile, Switzerland, Sweden, Japan). As a result of the study, it was found that in mathematics and natural sciences this difference corresponds to one and a half years of study, and in reading Ukrainian students lag behind by almost two and a half years. Among the problems in educational institutions in Ukraine, their leaders note the lack and low quality of educational materials (i.e. educational tools and infrastructure) and digital resources, which undoubtedly makes digital pedagogy and the need for its development relevant.

The PISA-2022 education quality study showed not only a lower level of reading, mathematical and scientific literacy of Ukrainian students than the average for OECD countries, but also an increase in the volume of educational losses compared to 2018, which in reading are equivalent to two years of study according to PISA standards, in mathematics – one year, and in natural science disciplines they are equivalent to half a year of study [16].

Interesting from the point of view of the aforementioned study are the results of the online survey "Readiness and needs of teachers for the use of digital tools and ICT in wartime: 2023", presented in the analytical report by the authors O. Ovcharuk, I. Ivanyuk, O. Hrytsenchuk, I. Malytska [17].

The survey was conducted among teachers to determine their readiness and attitude to the organization of distance and blended learning in secondary education institutions in Ukraine, to identify their opinion on the most effective digital tools and to define problems in the implementation of distance learning. The researchers note that recently a lot of methodological guidelines and resources for educators on distance learning have appeared, in addition, in-depth courses on the use of digital teaching aids in lessons and to prepare for them in the postgraduate education system are being organized. However, as the authors of the study note, the overall dynamics of the growth of the level of digital competence of teachers is not intensive enough: teachers do not use a sufficiently wide range of information and communication technologies (ICT), are not active in creating their own digital resources, are passive in relation to most activities, dedicated to the safe use of digital resources, do not have the skills to protect personal information and devices.

The respondents themselves confirm the fact that the implementation of ICT and the use of digital tools in the general secondary education system are not sufficiently effective. Among the reasons and problems, educators point to inadequate access to digital devices, poor provision of high-speed Internet connection, and inadequate management of access to IT infrastructure by educational institutions.

It was found that from the available range of digital tools and online resources for conducting lessons, teachers mainly use Viber (77.7%), Zoom (63.8%) and Google Workspace for Education (53.1%). Among online resources for organizing distance learning, Na Urok (88.7%), Vseosvita (83.5%), lessons on YouTube (75.3%), VŠO (51.1%) and EdEra and materials on Facebook (34.3%) dominate.

The respondents' self-assessment of the level of digital literacy and competence provided grounds to state that the majority of teachers are able to search for information at the level of an independent (45.6%) and basic (34.5%) user; assess the reliability of information at the level of a professional (43.3%) and basic (31.9%) user; save the information found at the level of a professional (41.2%) and independent (31.9%) user. In general, the survey in various areas, in particular "Communication and Collaboration", "Creation of Digital Content", "Security", "Problem Solving", made it possible to find out that the level of digital competence of teachers is growing quite slowly, to a small extent this concerns the knowledge and ability to use online tools for collaboration, knowledge of the rules for using content in accordance with copyright protection, and a basic level of programming.

The main problems, mentioned by the respondents (lack of high-quality Internet connection, insufficient material and technical support for students, frequent power outages, low level of self-organization and motivation of students, lack of support from parents, lack of time due to increased workload for teachers), indicate an increase in educational losses and educational gaps in Ukraine [17].

As a result of a survey of teachers on their readiness to use ICT in wartime in Ukraine, the author O. Ovcharuk also highlighted the advantages of digitalization in educational processes: the creation of virtual learning environments, personalized interaction between students and teachers, the possibility of conducting video conferences with large audiences, distance learning, active implementation of cloud services, stimulation of the development of digital competence of teachers and students, updating the methods and content of education in the context of digitalization and new digital solutions. At the same time, the researcher also notes the disadvantages of digitalization, in which she includes the fact that digital resources cannot exist without the Internet, so there is always a need to be online, problems of security on the Internet and the danger of the emergence of cloud monopolists, deepening social alienation, erasing ethical boundaries, reducing cultural development, etc.

In the process of increasing the level of digital competence of teachers, it is undoubtedly important to systematically conduct their survey in order to record the dynamics and changes that occur in the attitude of teachers to the use of digital tools. Such monitoring also allows us to clarify the needs of various target categories in the use of digital tools during education, to suggest ways to overcome educational losses by means of digitalization of education [18].

A study of the quality of the organization of the educational process in war conditions in the 2023/2024 academic year, conducted by the State Education Quality Service of Ukraine, shows that almost half (47%) of institutions worked in distance or blended forms. The transfer of institutions from full-time to blended and distance learning, unstable conditions for organizing the educational process affected the learning outcomes of students and led to losses in the educational process. The main ways to overcome educational losses in the 2023/2024 academic year were: additional tasks and educational materials for independent study, individual and group consultations, additional classes.

The study shows that more than half of the heads of educational institutions (63% of heads of urban educational institutions and 59% of rural ones) use a single electronic educational platform to ensure unified approaches to creating an electronic educational environment in the conditions of organizing the educational process in a distance form. In addition, teachers are trained to use new digital resources for organizing the learning process, assessment tools, etc. At the same time, a significant part of teachers (from 39% to 57% depending on the region) need technical support (providing equipment, stable Internet, power supply) [19].

It is well known that for more than four years, due to the COVID-19 pandemic, and then the full-scale military aggression of russia against our country, general secondary education institutions have not been able to ensure the proper course of the educational process. The result has been educational losses, the scale of which is increasing. The following measures will help slow down and, in the future, overcome the consequences of this process: secondary education; vacation learning; tutoring at state expense; creation of integration classes; revision and adaptation of educational programs; development of additional content on key educational topics; development of additional high-quality educational content; methodological training of teachers for working with students with learning disabilities; strengthening school autonomy, interaction and cooperation of teachers [20].

In the study [21] by the team of authors, namely: Y. Sikora, S. Ivanova and A. Kilchenko, the development of digital competence of scientific and scientific-pedagogical workers using open educational and scientific information systems was analyzed. The scientists studied the domestic experience of developing the digital competence of scientific and scientific-pedagogical workers, which is considered key, one that contributes to the implementation of professional tasks at a high level.

The authors emphasize the need to create favorable conditions for working in the digital educational space in scientific and educational institutions. This involves not only providing access to open educational and scientific information systems, but also providing technical and consulting support. According to the authors, the development of digital competence is aimed at the formation of knowledge, in particular, awareness of digital resources, tools, processes, skills in developing tasks using digital tools in an interactive mode, and skills in conducting training sessions using information and communication systems [21].

Interesting in the context of analyzing the state of digital pedagogy of open education is the All-Ukrainian study of the use of AI in school education. The field stage of the study was carried out by the Projector Creative & Tech Institute and the Small Academy of Sciences of Ukraine with the support of the research company Factum Group.

The Google questionnaire form was distributed through social media channels, mailing lists for teachers and children, channels of the Ministry of Education and other partners. Sample size: teachers, $N = 1747$ respondents; students, $N = 1443$ respondents. Survey period: September–October 2023.

The key results of the study were formulated in the form of the headings "Knowledge of AI services", "Using AI", "Attitude towards AI".

Knowledge of AI services:

1. The most popular artificial intelligence (AI) service, with which both audiences are well acquainted, is ChatGPT. The level of knowledge among students is slightly higher than among teachers (76% versus 68%, respectively).

2. In second place in terms of knowledge is the AI tool from the "Na Urok" project. 49% of the surveyed teachers know about this service, the level of knowledge among students is lower – 35%.

3. Both teachers and students are much less aware of AI services, such as Grammarly, Bard Google, Midjourney, Notion AI, and Stable Diffusion.

Use of AI:

1. Most teachers and students confirmed their experience of using AI services and confirmed the positive results of the process and the experience gained.

2. Teachers claim that they used AI services in their teaching and learning activities to prepare for classes, create tests for homework, during the educational process in classes, test students' knowledge, and even in extracurricular activities. Some teachers involved students in using AI.

3. Representing their own experience of using AI, students most often confirmed its help in completing homework.

Attitudes to AI:

1. Teachers' opinions on the use of AI in the educational process vary. They are aware that these new technologies can be useful, but are hesitant due to the potential problems. Teachers are concerned that the use of AI may lead to limitations in student development, plagiarism, and unethical use of it. A significant result of the survey of teachers' opinions is that they indicate the lack of understanding of AI technology, fears about possible errors in its work, since it is only developing, little studied.

2. Teachers are concerned about the possibility of plagiarism, since some students do admit that they systematically use AI for this very purpose. Most students, however, assume that AI can improve the educational process and their development, make learning activities interesting and exciting. In this context, it seems logical for students to want to receive information from teachers about the correct and ethical use of AI, knowledge of its advantages and disadvantages, and features of use [22].

A monitoring study of teenagers' perception of artificial intelligence technologies was conducted for students by A. Godunova and S. Tolochko [23].

The results of a representative monitoring study of Ukrainian teenagers' perception of artificial intelligence technologies, their concerns, expectations, and perceptions of the opportunities and threats, posed by such technologies, showed certain differences between the respondents – residents of cities and villages, as well as by regions. All questions in the questionnaire are conditionally divided into five blocks:

1) general (name, age, class, interest in the topic);

2) technical (experience of using certain AI services);

3) perceptions of the potential of AI (vision of advantages, benefits for humans, improvements or changes, dreams, expectations, opportunities, assistance in learning);

4) general perception of AI (philosophical, existential);

5) fears and expectations (thoughts, vision of consequences, safety, attitude to use by the military, etc.).

The conclusions, drawn from the study, are: at this time in their lives, the respondents have not encountered problems in the process of using AI, but they expect them in the future; the responses of the adolescents indicate the lack of theoretical knowledge about AI in general, in particular, the lack of understanding of the mechanism of work, its current presence in the devices they use, etc.; the lack of practical skills in using AI in problematic life situations is confirmed; the lack of theoretical knowledge about the possibilities of AI for its application in the educational process is evidenced; the inability to practically use AI in educational and cognitive activities is emphasized.

The monitoring study, conducted on the perception of technologies with artificial intelligence by Ukrainian adolescents, made it possible to identify ways to improve adolescents' attitude towards technology and their readiness to use it in the future [23]:

– development of educational programs, aimed at improving the understanding of AI and its capabilities;

– development of new teaching methods, data analysis tools or educational process management systems;

– creation of more effective and acceptable AI-based technologies for adolescents;

– use of AI as a teacher's assistant through the selection of educational material that is optimal for the relevant audience, the course curriculum, interesting and useful for the future profession;

– improving the quality of distance learning, ensuring effective interaction and personalization.

The impact of digital pedagogy in the context of digitalization of educational institutions and distance learning on the level of digital competence and literacy of the population in Ukraine is studied every two years through sociological surveys. In 2023, the third wave of the study took place, the purpose of which was to track the dynamics of the development of digital skills of the population of Ukraine and analyze the impact of the socio-economic situation on the level of digital security.

The results of the survey [24] showed the following results: the level of digital skills of the population tends to grow steadily. This is manifested in a decrease in the share of adults without digital skills and an increase in the population with a skill level of "basic" and above.

As of 2023, digital skills are possessed by:

– 93% of the adult population of Ukraine aged 18–70 (+8% since 2019);

– 95% of adolescents aged 10–17;

– 99% of people with hearing impairments aged 18–59 (+15% in 4 years).

Increasing the level of digital skills motivates the population to actively deepen knowledge and self-development. This is manifested in an increase in the share of the population that has a relevant demand for training, with an increase in the level of digital literacy (from 22% among "no skills" to 77% among "above basic skills"), among the adult population (18–70).

The approach to choosing an online learning strategy depends on the age characteristics of Ukrainians. The results of focus group discussions indicate a variety of approaches of different age groups to online self-education and the choice of platforms to raise awareness on certain topics. Teenagers prefer to use educational content on a specific request, in particular through messengers, YouTube and short videos on social networks. Young people use YouTube, Prometheus and Go IT. People of elegant age, choosing self-education, usually use search engines, not limited to specific platforms or social networks:

– 58.3% of the adult population sees the relevance of learning digital skills (+10.9% from 2019);

– 85.0% of teenagers see the relevance of learning digital skills (+17.5% from 2019);

– 42.2% of the adult population regularly devote time to self-study and improving their knowledge;

– 22.8% of people with hearing impairments regularly devote time to self-study and improving their knowledge.

The undeniable economic benefits of digital skills in Ukraine have been established. The questions that outlined the role of digital skills of the Ukrainian population for the further development of the economy revealed the following indicators:

– 81% of the surveyed adults believe that the development of digital skills among the population can have a positive impact on the economy of Ukraine;

– 1.7 million vacancies have been analyzed (research on vacancies on job search web platforms);

– 81.3% is the difference between wages among employees who have mastered digital skills and those who have not mastered them.

The next block of questions concerned the role of digital skills in achieving success. The respondents' answers were divided as follows:

– 51% of Ukrainians are satisfied with their daily work. Among people with hearing impairments, this percentage is half as low at 24%;

– more than a third of Ukrainians (36%) do not have policies on cybersecurity and/or cyber hygiene at the workplace, and every fourth (26%) says there are no effective measures to protect confidential information;

– 91% of teenagers believe that digital skills are necessary for their education, and 84% of the respondents perceive them as important for their future career;

– 96% of teenagers use the Internet to communicate with family and friends, and 58% of the respondents do not feel lonely thanks to the Internet.

Therefore, the level of digital skills is one of the key performance indicators in the context of the Digital Decade, which defines Europe's ambitions in the field of digital technologies, namely, by 2030, at least 80% of citizens (defined as the share of people aged 16 to 74) should have at least basic digital skills. The study of the dynamic digital environment requires constant updating and adaptation of the existing research methodology in order to maintain the relevance and topicality of the data obtained. According to the results of the work of the European Commission in 2019–2022, the integrated digital skills indicator DSI 2022 has been modernized and adapted in accordance with the new conceptual foundations of the digital development of European society and technological progress [24].

2.3 THE ESSENCE, CONTENT, EFFECTIVENESS OF DIGITAL PEDAGOGY IN OPEN EDUCATION

Digital pedagogy as an effective practice of the 21st century is aimed at the implementation and study of modern digital technologies in educational and scientific institutions. This is a new branch of pedagogical science that aims to use online and hybrid educational environments to enhance individual learning. Based on constructivist theories, the main tenets of which are that learners acquire knowledge through experience and reflection, digital pedagogy proposes methodologies that integrate digital tools to facilitate and enhance learning and cognition.

Digital pedagogy has undergone a dynamic evolution, as it considers the integral synergistic interaction between technologies and educational practices. It goes beyond the simple application of digital tools in teaching and includes strategic planning for the development of curricula, teaching methods and assessment of learners in the context of digital technologies. The basis of this pedagogical paradigm is the development of digital competencies – skills that educators must acquire to effectively use the potential of technology in education.

The paradigmatic concept of digital pedagogy has its own challenges and involves continuous professional development for teachers, promotes critical interaction with digital content and requires adaptation of traditional pedagogical approaches. Despite these challenges, digital pedagogy is a key response to the development of learning and the diverse needs of learners in the 21st century.

Taking into account the various essential characteristics of digital pedagogy, researchers have characterized it as integral (J. Aroles, W. Küpers [25]), critical (A. Boczar, S. Jordan [26], M. Waddell, E. Clariza [27]), humanistic (V. Bykov, M. Leshchenko [28]), innovative (O. Istrate et al. [29], A. Kukulska-Hulme et al. [30]), etc.

Integral pedagogy in the context of research refers to the creation of a holistic educational experience that prepares learners for life by connecting concepts from different disciplines through digital technologies to educate a generation of learners who are knowledgeable, thoughtful, and ready to face challenges of the future. The potential of integrated pedagogy is unlimited, transforming classrooms into dynamic environments will enable the comprehensive development of individuals [25].

Critical pedagogy as an approach to teaching and learning is based on promoting freedom of will and creating opportunities for learners, provided that opportunities are created for learning in all formats: online, offline, and blended (explicitly and implicitly criticizing repressive power structures). The word "critical" in critical pedagogy functions in several registers: as critically important, essential; as in literary criticism, i.e. providing definitions and interpretations; as in reflective and nuanced thinking about a subject; capable of criticizing institutional, corporate, or societal obstacles to learning; as a disciplinary approach that changes each of these other meanings. The need to provide the possibility of virtual sessions as part of the educational process is becoming more urgent. The digital nature of educational courses gives rise to a recursive pedagogy that "creates" itself and allows for continued adaptation that is complementary to academic cycles [26].

M. Waddell, E. Clariza, in addition, also consider critical information literacy as learning that requires learners to interact with the power structures that support the production and dissemination of information. Critical pedagogy recognizes that education is a political action that can have a negative impact on certain students, criticality is a self-reflexive necessity for intentional application to power structures in order to improve all processes in education and science [27].

Unlike critical, digital *humanistic pedagogy* is a science about the regularities of creating a positive integrated pedagogical reality under the condition of convergence of physical and virtual (created using ICT) educational spaces (environments). Based on the use of modern ICT, educational activity (formal, non-formal and informal) takes place at the intersection of two worlds: real and virtual. Attention is drawn to the fact that the methodology and methods of pedagogical research of classical pedagogy need to be revised and improved in the context of modern realities of the educational process, the needs and interests of all its subjects [28].

Digital pedagogy is *innovative pedagogy*. Perhaps the most important contribution to the development of digital pedagogy is its ability to re-direct pedagogical activity into a modern course, in which it dynamically develops and flourishes, ensuring its relevance, usefulness and value in our time. Theoretical and practical progress in educational science is achieved through the synthesis of environmental influences and opportunities, which can be both immediate (imperative) and more distant (in the form of a wish list), and which are given special significance and legitimacy. That is why digital pedagogy, far from being on the periphery, is now the forefront of pedagogical innovation and a major source of change in both the theory and practice of education [56]. A. Kukulska-Hulme et al. propose ten promising innovations for the post-pandemic world of digital education: hybrid models, dual learning scenarios, microcredit pedagogy, autonomy pedagogy, observation parties, education led by influential people, home pedagogy, discomfort pedagogy, well-being education and walking and talking. The information is presented in a popular manner and is aimed at teachers, politicians, scientists, students, researchers, developers of educational technologies, as well as anyone interested in pedagogical innovations and how education is changing [30].

Digital pedagogy has been defined and implemented in convergence with *open pedagogy* or *open education*. Open education successfully fits into a new paradigm, defined by role fluidity, learner-centeredness, distributed resources, virtual tools, and asynchronous lessons. According to O. Istrate, the many overlaps between the two conceptual areas show us the interdependence between constructs; to a small extent, we can talk about digital pedagogy without taking into account the attribute "open"; the proposals of open pedagogy are currently meaningless without new technologies, because life in social, cultural, personal, and professional dimensions is largely mediated or supplemented by the tools of new technologies. In fact, the development of open and collaborative web technologies has made a significant contribution to the emergence of the "movement" of open pedagogy – which arose almost half a century ago with the Leicester model – by offering new educational resources, techniques, and special teaching methods [31]. Open pedagogy, for its part, has provided the right ideological foundation, largely justifying digital education and facilitating it in practice. Among the first theorists of digital open pedagogy, together with

G. Conole and her approaches that foreshadow new educational approaches in the "open world", B. Hegarty proposes a model with eight interrelated characteristics of open pedagogy [32]:

1) participatory technology;
2) innovation and creativity;
3) exchange of ideas and resources;
4) reflective practice;
5) people, openness and trust;
6) connected community;
7) trained learner;
8) peer review.

Thus, education and digital technologies follow different paths, marked by their own priorities, methodologies and dynamics, but are integrated to expand the boundaries of education and educational opportunities through digitalization. Currently, the process of platforming education is underway through the creation of non-formal and additional education platforms for children, youth, adults or a wide audience without age restrictions. In view of this, many studies warn of the need for such pedagogy that would focus on the development of education through technology, and not only on the application of technology [31]; other, on the contrary, emphasize the need to develop pedagogy as the main conceptual framework for the application of technology in the educational process [33].

Digital pedagogy should create new opportunities for educational and cognitive activities by addressing the limitations of the traditional approach to learning, in particular, a clearly defined scope of learning, materials in different media formats, limited resources and the number of hours of the classroom educational process, communication between teachers and students, supplemented by forms and methods of digital technologies at any time and in any place. The means of digital technologies are diverse: audio and visual in real time, using text messages, online text, audio and video chat, e-mail, communication and discussion forum for feedback and support in learning at any time and in any place, testing, assessment by both the teacher and the machine are continuously integrated into a common formative assessment for final results.

Numerous research by foreign scholars studying digital pedagogy have found convincing evidence of the effectiveness of its application.

Thus, S. Anitha and K. Vijaya conducted a quasi-experimental study of the effectiveness of digital pedagogy in higher education [34]. A comparison of the learning outcomes of students who received education using the traditional model with those who received education using digital technologies revealed that the latter had better programmatic learning outcomes than their peers. A similar meta-analysis was conducted by S. Means et al., who examined the effectiveness of digital learning in K-12 education by comparing online and offline learning conditions, measuring the learning outcomes of students, and publishing reliable information for calculating quantitative indicators [35]. Recall that K-12 is an abbreviation that denotes the education system in the United States, which includes classes from Kindergarten (preschool education) to 12th grade (high school). 99 studies were analyzed and confirmed the higher effectiveness of digital learning

compared to traditional. Another important result was that the study also found that the introduction of digital tools had a positive impact on students' engagement and motivation to learn. A similar study by R. Huang et al. was carried out to establish the possible effectiveness of an integrative approach to the implementation of the educational process with a combination of digital and traditional learning in a secondary school setting [36]. The results confirmed the higher effectiveness of blended learning compared to traditional. Thus, digital pedagogy creates and provides tools for effective individual teaching and learning.

B. Dhakal, focusing on the importance of digital technologies, argues that teachers need to use digital pedagogy tools to organize and implement the educational process of students regardless of their age, generation, level of education, form of education, etc. [37]. The scientist recommends using seven pedagogical principles: the content of education in accordance with the curriculum; definition and implementation of educational goals; use of various digital educational resources; integration of creative tasks into educational activities; intensive educational communication and discussion; educational feedback and support; assessment of learning.

Currently, digital education is associated with the widespread use of artificial intelligence technologies in educational and cognitive activities.

For example, researchers at the Massachusetts Institute of Technology, including the Media Lab, have developed a new website, designed for American K-12 students to help them learn more about AI [38]. K-12 is an abbreviation that refers to the US education system that includes grades from Kindergarten (preschool education) to 12th grade (high school). Education research has also examined ways to increase AI literacy among stakeholders without specific STEM training related to AI. STEM education is aimed at preparing students for careers in these fields, developing critical thinking, problem solving and developing guides for teachers, forms, methods and tools for teaching the principles and practices of Computer Science (CS) – a field that studies computers and computing systems and covers the theory, design, development and application of software and hardware, solving problems using computational methods and algorithms (MIT Media Lab). The activities of the Association for the Advancement of Artificial Intelligence (AAAI) are being updated, this is an international scientific public organization whose activities are aimed at promoting research and education in the field of artificial intelligence, holding conferences, publishing journals and facilitating the exchange of information between scientists and practitioners in this field. The Computer Science Teachers Association (CSTA) is an international organization that supports and promotes computer science education, provides resources and opportunities for professional development for computer science teachers, and develops standards and recommendations for computer science education. The organizations have joined forces to develop a set of teaching aids for K-12 (general education from elementary to high school).

The researchers identified five "big ideas" in the field of AI that they believe educators should know:

1. *Computers perceive the world through sensors*. The ability of computers to collect information about the world around them through sensors (cameras, microphones, and other devices). This information can then be used to make decisions and take actions.

2. *Agents maintain models/representations of the world and use them for reasoning.* The ability of computer agents to create internal models or representations of the world based on information, received from sensors or other sources. These models are then used for logical reasoning and decision making.

3. *Computers can learn from data*. The ability of computers to learn from data using machine learning techniques. This allows computers to improve their models and algorithms to perform tasks better and make more accurate decisions.

4. Making agents interact with humans is a major challenge for AI developers. The difficulty of creating computer agents that can effectively interact with humans. This includes natural language understanding, emotion recognition, and other complex tasks that require "advanced" AI techniques.

5. *AI applications can have both positive and negative impacts on society*. For example, AI can be used to improve health or safety, but it can also lead to job losses or increase inequality [38].

The methodological side of the educational process is being updated, as digital pedagogy provides a new vision for the teaching and learning process, and also changes the idea of what is being taught. Innovative forms of organizing the educational process often shed new light on the content of education, forcing it to adapt to new dimensions. This allows for more efficient learning, interpretation and re-labeling, processing, practicing, internalizing, and reproducing educational material, and also promotes co-creation. Digital technologies facilitate documentation, identification of problems and possible solutions, bring it closer to real life, facilitate communication between participants, structuring the deconstruction and reconstruction process, contact with experts, search for resources, publication of results and (public) verification of approaches.

However, the abundance of possibilities can be both an advantage and a hindrance, as it creates a need for multiple and expanded elements in the didactic process. Pedagogical strategies and established algorithms must be adapted, including new aspects, such as the selection of relevant and scientifically proven content, rethinking the expected learning outcomes, integrating tasks into collaborative (remote) work contexts, ensuring access, motivational methods and involving all team members in learning activities, encouraging independent learning, as well as taking into account elements of digital safety and student protection in the online environment.

Unstructured and extensive content in digital format emphasizes the role of the teacher as a facilitator, who, on the one hand, must guide students to relevant sources of knowledge correspondent to learning objectives, and on the other hand, teach them how to identify, evaluate and distinguish authentic knowledge and valuable ideas from alternative sources that do not meet recognized standards. Digital pedagogy brings more practical aspects to pedagogy. Although pedagogy remains a field of constant innovation, and current knowledge serves as the basis for new hypotheses and theories, it is primarily a tool for understanding and evaluating new educational practices.

Digital pedagogy is a starting point for a variety of interpretations and innovative approaches, from simply transferring traditional learning to a new digital environment to completely reformulating educational methods. In an effort to create effective digital education, we often start with

elements that are already familiar and time-tested. We usually try to transfer familiar learning situations to a digital environment, while preserving traditional ways of organizing groups, methods of interaction, and approaches to learning and assessment. In this case, the type of learning material and outcomes of activities changes first of all – they usually become more multimedia, and some synchronous work sessions are conducted remotely via videoconferencing.

The second stage involves changing the use of time for teaching, learning, and assessment, integrating asynchronous sessions and changing the traditional order or emphasis. For example, in the concept of the flipped classroom, independent learning precedes and partially replaces traditional teaching; formative assessment becomes more natural in the digital environment and is an important tool available to both the teacher and the student.

Typically, educators turn to new digital tools and resources to organize the usual teaching process. The innovation specific to digital pedagogy is that digital learning situations cannot simply be transferred back to an analog environment. It is important to note that today we do not have situations and learning paths that could not be described by concepts that existed before the digital era. Innovations are mainly about form, not substance, and are aimed at optimizing and increasing the effectiveness of teaching and learning. Essentially, we are still within the boundaries of pedagogy, although learning situations that are conducted remotely (synchronously or asynchronously) or in a blended learning format may require a new approach to design.

It is clear that digital pedagogy is a significant step forward for the field of educational sciences. This phenomenon, which reflects ideological changes, is part of our modern culture and constantly changing conditions in the professional and social spheres. Expectations from educational activities are becoming more pragmatic, which affects relationships and didactic communication, forming a new awareness of external variables that are related to roles and relative productivity in society.

Modern educational ideas, such as respect for the individual, inclusion, key competencies, personal development (soft skills), transdisciplinarity, project-based approach and authentic assessment, are a reflection of this new ideology in education. Digital technologies have demonstrated their potential to open up new opportunities for education, its transformation and to shape directions for "rethinking" education based not only on technological, but also on cultural, social, professional, economic and, above all, humanistic principles.

The most important advantage of trying to formulate digital pedagogy is to develop the ability of educators to design, implement and evaluate effective educational situations, adapted to modern times and the needs of students.

As previously mentioned, digital pedagogy open up new opportunities for learning and teaching, offering innovative approaches and tools to improve the educational process. However, for these opportunities to be properly implemented, certain principles and strategies must be followed. Here are five key recommendations, in our opinion, for the correct use of digital pedagogy in the educational process:

1. Planning and integrating digital tools.

Start by developing a clear strategy for integrating digital tools into your educational process. Identify the goals and objectives you want to achieve with digital technologies and choose the tools

that best meet these goals. Assess the available resources and capabilities to ensure effective implementation. Analyze the needs of your learners and teachers to select the most appropriate digital tools. Conduct a survey or interview to understand which tools are already in use and which are unfamiliar or require additional training.

2. Create and adapt content.

Since digital platforms allow for a variety of formats, create learning content that includes video, audio, interactive exercises, and infographics. This will help provide variety in learning material and maintain learner interest. Adapt content to different learning styles. Use tools to personalize the learning experience to take into account the individual needs and preferences of learners. For example, interactive platforms can offer different levels of difficulty of tasks, allowing each learner to work at their own pace.

3. Ensure accessibility and support.

Provide technical support for learners and educators. Organize training and workshops to teach how to use new digital tools. This will help reduce technical problems and ensure that you are comfortable working with new technologies. Make sure that all digital resources are accessible to learners with different levels of technical training and technical capabilities. Avoid using tools that may not be accessible to a portion of your audience due to technical limitations or other factors.

4. Forming and evaluating the educational process.

Implement interactive learning methods, such as virtual discussions, online games, and simulations. This can increase learner engagement and motivation, as well as promote better learning. Use formative assessment to monitor the progress of learners. Digital platforms make it easy to conduct surveys, tests, and feedback, which help to timely adjust the educational process and support learners in achieving their learning goals.

5. Ensuring security and ethics.

Take care of the digital security of learners by ensuring the protection of personal data and confidentiality. Use reliable platforms and adhere to security policies to protect information. Educate learners on the correct use of digital tools and resources. Conduct digital literacy classes that will help them understand the ethical aspects of using technology, avoid plagiarism, and be responsible with information content.

2.4 METHODOLOGICAL TOOLS FOR EDUCATIONAL ACTION OF DIGITAL PEDAGOGY

Modern ***preschool children*** are early involved in life in the virtual world.

In preschool age, the most important need of a child is communication, thanks to which social experience is acquired. In daily interaction and cooperation with adults and peers, he/she learns the rules of behavior and learns to evaluate his/her own actions and the actions of his/her environment through the prism of moral norms. This period is important for teaching children the rules of behavior and safety in the digital space [39].

The reasons for the immersion of a modern preschooler in the digital space include:

1. *Universal curiosity, a high level of cognitive activity*. Quite early, preschoolers realize that the Internet is an endless source of information, because in it children find a variety of educational and entertaining games, video clips, cartoons, numerous ways to obtain knowledge, exchange information, express themselves and purposefully interact with friends, family and the outside world.

2. *The need for communication.* The most important need of a preschool child is communication as an important factor in the formation and development of his/her personality, the assimilation of social experience. Determining the special importance of modern gadgets as a means of broad communication, psychologists at the same time emphasize the importance of real communication in their lives. In preschool age, a child, in daily interaction with adults and other children, learns the rules of behavior and learns to evaluate his/her own actions and gestures through the prism of moral norms. Given that the information space is becoming a real necessity, in parallel with the assimilation of a culture of communication and interaction in real life, an extremely important task is to teach the rules of behavior and safety in the digital space.

3. *The need for bright external impressions.* Children show increased interest in everything new, bright, unusual, because they are most and most quickly influenced by the external environment. The underdevelopment of self-regulatory mechanisms characteristic of preschool age, weak volitional and emotional control, impulsive behavior, make children most vulnerable to information and software-technical threats.

4. *The need for play as a leading activity.* An important factor that encourages children to the digital space is also the priority of play as the child's leading activity [1]. Children like to play computer games. Despite the benefits of games, especially developmental and educational, creative, entertaining computer games should not displace a wide range of real games in a child's life, as this can cause uneven development, delay the formation of readiness for learning, and cause Internet addiction.

Introducing children to gadgets should occur in parallel with the orientation of preschoolers to basic moral values (compassion, mercy, respect, responsibility, justice, etc.); the priority of a value-based attitude to real communication over virtual.

The advantages of early immersion of a preschooler in the digital space are:

1. Expanding the child's interests, opportunities for additional education, development of purposefulness, intelligence, awareness, ability to structure information flows, etc.

2. Satisfying the child's need for external impressions with the help of digital technologies has a positive effect, as it contributes to the development of cognitive abilities and imagination. There are many virtual games that at the same time have an educational and upbringing basis and are able to arouse the child's interest in history, literature, economics, etc.

The risks of immersion of a preschool child in the digital space are:

1. Removal of prohibitions and restrictions of moral, ethical and social plans (removal of the taboo of violence, murder, destruction; the lack of legal norms that operate in reality). Children are subconsciously alienated from fundamental things: the need to follow the rules, the inevitability of

punishment for aggressive behavior and violation of the law, the unity of the space-time continuum. Interest in aggressive games leads to the fact that children may try to apply similar methods of solving problems in real life. All this creates significant risks for the upbringing, development and safety of children.

2. Interest in aggressive games leads to the fact that children may try to apply similar methods of solving problems in real life. Thus, 60–65% of surveyed children of senior preschool age are fond of destructive games, such as "Batman", "Transformers", and various "shooters". Some children noted that they are not afraid of the appearance of blood and murder in games ("just kill – and that's it"). Violent computer games form the corresponding characters [40].

3. Insufficient development of self-regulatory mechanisms, characteristic of preschool age, weak volitional and emotional control, impulsive behavior make children most vulnerable to information and software-technical threats [1].

4. Deterioration of the child's health: morbidity of the organs of vision (rapid fatigue, itching, impaired visual perception at far and near distances); deterioration of concentration and working capacity; diseases of the musculoskeletal system (development of pathological diseases of the spine, osteochondrosis, strengthening or deformation of intercostal discs, etc.); hypodynamia [41].

5. The emergence of Internet addiction in a child. Symptoms of an Internet-addicted preschool child are: refusal to eat for the sake of entertainment on the Internet; irritability of the child if he/she is not allowed to use the gadget; euphoria from being on the Internet; neglect of the interests of relatives, friends and mates for the sake of being in digital space. The reasons for children's Internet addiction are: emotional exhaustion and "unlovedness"; the child's lack of intellectual skills; the lack of support from educators and parents; passive perception of information using new information technologies; distortion of moral norms and values in the process of easy satisfaction; disruption of mental processes [42].

To increase the safety of preschool children in the digital space, it is necessary to:

1. Be interested in the virtual life of children, do not ignore their questions.

2. Teach them the rules of conduct on the Internet; create safe nicknames and passwords to ensure confidentiality; use websites, recommended for children; use protective parental control programs [43].

3. Parents need to regulate the time a child spends on the Internet so as not to harm his/her health. According to the standards, set by the Ministry of Health of Ukraine, continuous computer use during the day for children of senior preschool age should not exceed 30–45 minutes per week [44]. It is necessary to establish rules for family use of the network [43].

4. Develop strategies and tactics for psychological and pedagogical support for involving preschool children in the information environment. Such support should be based on the priority of forming value orientations in preschool children in the field of digital education. Additional investments in the development of digital skills and literacy formation among parents and educators are needed to help children develop critical thinking and evaluation skills, which will allow them to quickly

explore the current flows of information of different quality, as well as information from parents and educators for children, in order to become modern digital citizens [1].

Modern ***younger schoolchildren*** are active representatives of the new digital generation of Internet users. In the younger school age, verbal-logical thinking, verbal discursive thinking, semantic memory, and voluntary attention are actualized; the need for play, movement, and external impressions remains [43]. Younger schoolchildren strive to independently explore the world around them, satisfying their interest in cognition, in particular with the help of the Internet [44]. Modern children are characterized by "clip thinking" – the peculiarity of perceiving the world through short, bright images; the surrounding reality is perceived as a sequence of completely unrelated phenomena [45]. Thus, the younger school age is a transitional period in mastering the digital space.

Of primary importance for primary school children is video content of an entertaining and educational nature, which is placed on the You Tube platform or by subscription on streaming platforms, such as Netflix. Children also actively master and use such social networks as Instagram, Tik Tok, Like, etc. Formally, according to the rules of social networks, children under the age of thirteen cannot create an independent account, but only under the supervision and control of their parents. However, according to rough estimates, about 20 million children under the age of 13 are registered on Facebook alone. 40% of Tik Tok users are children, and the company does not provide reliable and accurate data on the age structure of users; according to the parental control service Jiminy, 70% of ten-year-old girls in the United States use Tik Tok [1].

Naturally, primary school pupils are interested in the fascinating fairy-tale world of adventures. The ability to repeatedly play such content allows you to return to viewing it at any time. A social media product, such as peer video blogs, is gaining importance, where young bloggers are mainly engaged in the presentation of children's toys and related attributes, offered by the global industry; they play, act out scenes based on popular cartoons using the corresponding toy heroes or transform into the image of a popular hero. In fact, this line of powerful educational influence on the personality of a primary school pupil can be controlled by parents. Despite the possibility of parental control and the editorial policy of digital platforms and streaming services, the content of the video series itself and the represented behavior models in the video blog affect the formation of values and interests. A separate aspect of digital interaction of primary school pupils are online games and mobile entertainment applications. In particular, educational, creative and adventure games and applications remain popular among parents and children. However, gradually, as children grow older, games with complex plot structures become more attractive [1].

According to the standards, set by the Ministry of Health of Ukraine, continuous computer use during the day should not exceed 10 minutes in grades 1–2; 15 minutes in grades 3–4 [44].

Immersion in the digital space has positive and negative aspects for a younger schoolchild.

Positive aspects:

1. Social networks act as a convenient platform for developing communication skills.

2. Educational videos, thematic communities, online libraries have great opportunities for the development of the personality of a younger schoolchild. This allows a child to develop with minimal effort.

3. Games, during which the interaction of a younger schoolchild with a virtual environment occurs (cartoon games), contribute to increasing test intelligence indicators [46].

4. Development of logical, operational thinking, the ability to predict, the formation of business motivation.

5. Formation of an active life position, emotional expression, the possibility of self-realization [47].

Negative aspects:

1. Problems with physical and mental health (spinal deformity, vision impairment, etc.), mental health disorders (inability to adapt to the real world, irritability, aggressiveness and depression, Internet addiction).

2. The attractiveness of one's virtual image for a younger schoolchild leads to a loss of self-presentation abilities.

3. Inability to communicate with peers and adults in real life; the lack of real friends; decreased empathy.

4. The danger of virtual seduction of a child – the anonymity of Internet communication gives sexual perverts a chance to use children's curiosity about adult life with impunity and involve them in virtual intimate relationships.

5. Social networks have a noticeable negative impact on the formation of language in children, since the free use of profanity in articles, comments and advertisements can form a subconscious belief in a child that this manner of communication is socially approved.

6. Formation of incorrect value orientations, inability to distinguish virtual reality from real reality.

7. Loss of interest in learning, reading, manual labor. Thus, a child becomes a passive consumer of information [43].

8. The emergence of Internet addiction in a child [46].

Here are some rules for *personal safety on the Internet* that parents should teach their children:

1. Tell your child about the risks and dangers that he or she may encounter in the digital space. Teach your child the rules of confidentiality on the Internet, as this can be used by attackers.

2. If your child tries to hide from you what he or she is doing on the Internet, install a computer program for parental control [48].

3. Try to regulate the time your child spends on the Internet in order not to harm his or her health and prevent Internet *addiction.*

4. Create family rules for safety on the Internet, explain to your child why they need to be followed.

5. Show a special interest in your child's virtual life; study online habits; join your child's online friends. Become your child's friend and advisor, a role model. Together with your child, learn to live and create in the digital space, which is constantly becoming more complicated [43].

Adolescence is a period of intensive formation of worldview institutions and a system of evaluative judgments. Changes in the behavior of a teenager are caused by hormonal restructuring of the body and psychological changes, the desire for self-knowledge, self-observation. During this period,

the main interest is aroused by Internet resources that allow a teenager to communicate with real and virtual acquaintances, as well as entertainment and educational networks [44].

Digital space for teenagers is a regular living space, a way of their cognition and communication, and at the same time it is a territory of risks (addiction to online games; communication in social networks; access to pornographic content; access to materials that increase the risk of teenage suicide, cyberbullying, etc.) [43].

Nowadays, the opportunities to overcome adverse circumstances and communication limitations, to establish connections, to learn, to exchange information, to express thoughts and express views on one's own life and communities are becoming limitless thanks to the world of the Internet, which also serves as a platform for entertainment, participation in projects, flash mobs and the formation of a media culture of relationships [1]. Therefore, digital space for adolescents and high school students is a common way of their cognition.

The use of the digital space leads to various influences on the personality of adolescents and high school students: positive developmental, socializing, creative, collaborative, cultural, psychological, health-preserving, educational.

The *developmental* impact of the digital space on adolescents and high school students is carried out through developmental programs, documentary, informational and propaganda, educational films on TV channels, podcasts on the radio, the creation and operation of exciting and interesting content of high quality with an orientation to the age characteristics of users for reflection, performing a certain task, assistance and filling their own activities with meaning, prosocial games for computers and mobile phones. Many adolescents and high school students use the Internet to complete homework, update forgotten or unlearned information, independently filling gaps in knowledge [1]. Thus, the digital space contributes to mental development, creating and providing new opportunities for learning and self-education of adolescents and high school students.

The *socializing* impact of the digital space on adolescents and high school students is extremely significant, as it is associated with the formation of their desire for positive participation in the life of civil society, further ensuring sustainable development and livelihoods of communities, including through participation in various social campaigns (regarding environmental protection, against bullying in schools, information wars, volunteer assistance, etc.).

The *creative* impact of the digital space on adolescents and high school students occurs through gamification (active participation in online games), thanks to which communication networks are created, new social interaction is created, and innovative solutions to problems are sought.

The *collaborative* impact of the digital space on adolescents and high school students is to form teamwork skills, the ability to understand and interact in the digital world, to express one's own opinion and influence a collective decision, to be ready to make a choice and bear responsibility for it, to feel a sense of belonging to a group, team, community, people. Thus, teamwork develops in adolescents and high school students the ability to accept criticism and give an adequate response with maximum respect for each member of the team; contributes to the formation of a citizen's ability to perform social functions, using various platforms, forms, chats, blogs, etc. [1].

The *cultural* impact of the digital space on adolescents and high school students is caused by the spread of various information, knowledge, ideas, beliefs, cultures in the digital space without restrictions in time and space. It manifests itself in the ability to find a common language when communicating with peers or like-minded people from other countries without a sense of civilizational, social, linguistic or cultural barriers, provided that cultural values and national identity are preserved. The formation of virtual communities, social groups is accompanied by the development of slang, concepts, abbreviations, ways of thinking, ethics and cultural values, which in turn affects the worldview and diversification of forms of socialization and social behavior at the everyday level. The psychological impact of the digital space on adolescents and high school students is significant, since in the process of active formation of self-esteem, interests, moral ideas, social attitudes, the need for communication with peers, mutual understanding and mutual support become important. Communication with peers will contribute to the formation of: tolerance, empathy, tact, truthfulness, kindness, the use of gadgets and the digital environment to realize the ability to make independent choices and be responsible for them, increasing self-esteem and developing feedback skills in understanding how others will perceive messages, sent by teenagers and high school students.

The *health-preserving* educational impact of the digital space on teenagers and high school students lies in the need to develop a healthy style of behavior and habits of working on the Internet, skills to maximize the use of digital technologies at minimal health costs, acquiring their own safe online experience and the indispensable use of available health care tools.

The *educational* impact of the digital space on teenagers and high school students through the development of critical thinking is designed to teach them safe and responsible digital citizenship, related to creating and maintaining a reputation in the digital environment, monitoring and protecting against harmful content, grooming, etc. Developed critical thinking skills of teenagers and high school students will enable them to check sources of information, take into account comments to understand positive news, ask for advice from adults on incomprehensible or suspicious information, monitor the presence/absence of questionable materials in their own profile, and develop the habit of complaining about unreliable data to the website or social network administration [1]. Thus, the educational impact of the digital space on adolescents and high school students consists in creating a safe, inclusive, child-centered environment with the possibility of receiving individually selected content to implement the concept of a happy and healthy digital environment, built on the norms of universal morality and ethics.

At the same time, digital space is a territory of risks (addiction to online games, access to pornographic materials; access to materials that increase the risk of teenage suicide, cyberbullying, etc.).

Ways to increase the safety of adolescents and high school students in the digital environment are:

– formation of a socially responsible attitude towards their activities on the Internet in adolescents and high school students;

– development of motivation of students, aimed at forming a conscious need for digital competence, which gives them the opportunity to improve their life in the modern world, while avoiding various risks;

– development of students' skills of orientation in information, the ability to analyze, critically evaluate, and structure the information received;

– orientation of adolescents and high school students to observe the rules of hygiene in using cyberspace;

– organization of various types of activities of students, involvement in sports, creativity, and implementation of socially oriented projects;

– establishing subject-subject interaction between teachers and students, establishing trust and confidence between them, forming a positive self-concept in students, faith in their abilities, success and uniqueness [49];

– developing communication skills with peers and parents in adolescents and high school students: effective communication, self-presentation; ability to work in a team;

– developing healthy behavior and skills in adolescents and high school students on the Internet and maximum use of digital technology at minimal health costs;

– increasing the professional competence of teachers, in particular their awareness of the risks of the digital space, the impact on the health of students and ways to minimize it;

– cooperation of teachers with other specialists, in particular psychologists, psychotherapists, other doctors, who are able to provide timely assistance to the teenager, his/her parents and the family in general [43].

CONCLUSIONS

The presented material makes it possible to conclude about the intensity and effectiveness of the implementation of digital pedagogy in world and Ukrainian education and science. Educational and scientific institutions are aware that digitalization offers a number of advantages and new strategies (approaches) to the education of students. The intensive development of technologies, such as augmented reality, virtual reality, artificial intelligence, robotics, media education, blockchain, cloud-based environments, gamification, STEM/STEAM education, has a powerful impact on the development of digital educational content.

Research into the current state of development of digital pedagogy in the context of digitalization of educational institutions and distance learning is carried out in the world and Ukraine systematically through a number of sociological surveys.

The results of the conducted questionnaires and interviews confirm the unique role of digital pedagogy in formal, non-formal and informal education, its effectiveness in educational and scientific activities. It is likely that after a period of intensive exploration and rediscovery, digital technologies will find their significant place in an enriched and renewed pedagogy, influencing aspects, such as teaching methods, external learning environments, psychological climate, classroom management and other areas. In some situations, education naturally adapts to digital conditions, integrating them as an essential part of the process.

Attempts to limit education to "conventional" spaces and frameworks, called "traditional" education, are often a reflection of anachronistic, reductionist pedagogies that do not correspond to modern realities. There is a complex relationship between "traditional" and "innovative" pedagogies. New didactic models and the use of technological resources in education contribute to the development of a new pedagogical paradigm. The need to explore how technology, open access and the concept of an educational institution without walls are changing the way we learn, as well as the long-term consequences of these changes for individuals, communities and society remains urgent.

There is a pressing need to justify and prepare for the transition to a new stage in which educational policymakers, decision-makers, educators and parents will understand, accept and support new adapted approaches that largely include digital technologies and the concept of open education. Regardless of what these approaches are called - digital, multimedia, distance, innovative or interactive, the essence remains the same - it is a living, open to new ideas, transformative and, above all, effective pedagogy.

REFERENCES

1. Kremen, V., Sysoieva, S., Bekh, I., Voznesenska, O., Havrysh, N., Honchar, L. et al. (2022). The concept of education of children and youth in the digital space. Herald of the National Academy of Educational Sciences of Ukraine, 4 (2), 1–30. https://doi.org/10.37472/v.naes.2022.4206
2. Bykov, V. Yu. (2008). Modeli orhanizatsiinykh system vidkrytoi osvity. Kyiv: Atika, 684.
3. Guide to measuring information and communication technologies (ICT) in education (2009). UNESCO. Institute for Statistics. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000186547
4. Jenkins, H. (2009). Confronting the challenges of participatory culture: Media education for the 21st century. MIT Press. Available at: http://library.oapen.org/handle/20.500.12657/26083
5. Sbruieva, A. A. (2021). Comparative Higher Education: National, European and Global Contexts. Sumy: SumDPU imeni A. S. Makarenka, 319.
6. Kremen, V., Bykov, V., Liashenko, O., Lytvynova, S., Lugovyi, V., Malovanyi, Y. et al. (2022). Scientific and methodological provision of digitalisation of education in ukraine: status, problems, prospects. Herald of the National Academy of Educational Sciences of Ukraine, 4 (2), 1–49. https://doi.org/10.37472/v.naes.2022.4223
7. Mokriev, M. V. (2013). Informatciina pidtrimka distantciinogo navchannia v silskogospodarskomu doradnitctvi. Sovremennye napravleniia teoreticheskikh i prikladnykh issledovanii "2013", 1, Odessa: KUPRIENKO, 87–91.
8. Bykov, V. Yu., Burov, O. Yu., Hurzhii, A. M., Zhaldak, M. I., Leshchenko, M. P., Lytvynova, S. H. et al. (2019). Rozvytok teoretychnykh osnov informatyzatsii osvity ta praktychna

realizatsiia informatsiino-komunikatsiinykh tekhnolohii v osvitnii sferi Ukrainy. Zhytomyr: ZhDU im. I. Franka, 214.
9. Sysoieva, S. (2021). Tsyfrovizatsiia osvity: pedahohichni priorytety. Osvita i suspilstvo, 10–11, 8–9. Available at: https://naps.gov.ua/ua/press/about_us/2545/ Last accessed: 04.04.2023
10. Khudaverdiieva, V. (2022). Trends in the digital transformation of education in modern conditions. Pedahohichni nauky ta osvita, XL–XLI, 102–109.
11. Pylaieva, T. V. (2013). Orhanizatsiino-pedahohichna struktura Vidkrytoho universytetu Velykoi Brytanii. Pedahohika formuvannia tvorchoi osobystosti u vyshchii i zahalnoosvitnii shkolakh, 28 (81), 279–284.
12. Maiboroda, O. V. (2011). Distance education as a priority direction in post secondary education. Information Technologies and Learning Tools, 25 (5). https://doi.org/10.33407/itlt.v25i5.452
13. Shunevych, B. I. (1970). Tendencies of distance learning development at foreign higher schools. Information Technologies and Learning Tools, 7 (3). https://doi.org/10.33407/itlt.v7i3.122
14. Tsentry dystantsiinoho navchannia. Available at: http://vnz.org.ua/dystantsijna-osvita/tsentry-do
15. Luzik, E., Demchenko, N., Proskurka, N. (2020). World models of higher education in the system of distance learning. Visnyk Natsionalnoho aviatsiinoho universytetu. Seriia: Pedahohika. Psykholohiia, 2 (17), 41–47.
16. Bychko, H., Vakulenko, T., Lisova, T., Mazorchuk, M., Tereshchenko, V., Rakov S. et al.; Tereshchenko, V., Klymenko, I. (Eds.) (2023). Natsionalnyi zvit za rezultatamy mizhnarodnoho doslidzhennia yakosti osvity PISA-2022. Kyiv, 395.
17. Ovcharuk, O., Ivaniuk, I., Hrytsenchuk, O., Malytska, I. (2023). Rezultaty onlain-opytuvannia "Hotovnist i potreby vchyteliv shchodo vykorystannia tsyfrovykh zasobiv ta IKT v umovakh viiny: 2023". Analitychnyi zvit. ITsO NAPN Ukrainy, 81.
18. Ovcharuk, O. (2024). Organization of teachers' surveys regarding readiness to use ict during wartime in Ukraine. Academic Notes Series Pedagogical Science, 1 (212). https://doi.org/10.36550/2415-7988-2024-1-212-29-35
19. Doslidzhennia yakosti orhanizatsii osvitnoho protsesu v umovakh viiny u 2023/2024 navchalnomu rotsi (2024). Derzhavna sluzhba yakosti osvity Ukrainy, 71. Available at: https://sqe.gov.ua/wp-content/uploads/2024/05/Zvit_Osvita_pid_chas_viyni_2023_SQE-22.05.2024.pdf
20. Navchalni vtraty: sutnist, prychyny, naslidky ta shliakhy podolannia": analitychnyi material vid fakhivtsiv. UTsOIaO. Available at: http://surl.li/goznk
21. Sikora Я., Ivanova C., Kilchenko A. (2024). Development of digital competence of researchers' using open education and scientific information systems: domestic experience. Education. Innovation. Practice, 12 (5), 73–79. https://doi.org/10.31110/2616-650X-vol12i5-011
22. Vseukrainske doslidzhennia vykorystannia ShI u shkilnii osviti. Available at: https://mon.gov.ua/storage/app/media/news/2023/12/20/Vseukranske.doslidzhennya.vykorystannya.20.12.2023.pdf

23. Hodunova, A., Tolochko, S. (2023). Monitoring study of teenagers perception of technologies with artificial intelligence. Perspektyvy Ta Innovatsii Nauky, 12 (30), 185–195. https://doi.org/10.52058/2786-4952-2023-12(30)-185-195
24. Doslidzhennia tsyfrovoi hramotnosti v Ukraini (2023). Ministerstvo tsyfrovoi transformatsii Ukrainy. Available at: https://osvita.diia.gov.ua/uploads/1/8800-ua_cifrova_gramotnist_naselenna_ukraini_2023.pdf
25. Aroles, J., Küpers, W. (2021). Towards an integral pedagogy in the age of 'digital Gestell': Moving between embodied co-presence and telepresence in learning and teaching practices. Management Learning, 53 (5), 757–775. https://doi.org/10.1177/13505076211053871
26. Boczar, A., Jordan, S. (2021). Continuity during COVID: Critical digital pedagogy and special collections virtual instruction. IFLA Journal, 48 (1), 99–111. https://doi.org/10.1177/03400352211023795
27. Waddell, M., Clariza, E. (2018). Critical digital pedagogy and cultural sensitivity in the library classroom: Infographics and digital storytelling. College & Research Libraries News, 79 (5), 228–233. https://doi.org/10.5860/crln.79.5.228
28. Bykov, V. Yu., Leshchenko, M. P. (2016). Digital humanistic pedagogy: relevant problems of scientific research in the field of using ICT in education. Information Technologies and Learning Tools, 53(3), 1. https://doi.org/10.33407/itlt.v53i3.1417
29. Exploring the digital pedagogy toolkit. Helping academics to make informed choices when embedding digital into the curriculum (2020/2021). JISC. Available at: https://www.jisc.ac.uk/guides/digital-pedagogy-toolkit
30. Kukulska-Hulme, A., Bossu, C., Charitonos, K., Coughlan, T., Ferguson, R., FitzGerald, E. et al. (2022). Innovating Pedagogy 2022: Open University Innovation Report 10. Milton Keynes: The Open University.
31. Selwyn, N., Hillman, T., Eynon, R., Ferreira, G., Knox, J., Macgilchrist, F., Sancho-Gil, J. M. (2019). What's next for Ed-Tech? Critical hopes and concerns for the 2020s. Learning, Media and Technology, 45 (1), 1–6. https://doi.org/10.1080/17439884.2020.1694945
32. Istrate, O. (2022). Digital Pedagogy. Definition and Conceptual Area. Journal of Digital Pedagogy, 1 (1), 3–10. https://doi.org/10.61071/jdp.0313
33. Suárez-Guerrero, C., Gutiérrez-Esteban, P., Ayuso-Delpuerto, D. (2024). Digital Pedagogy. Systematic Review of the Concept. Teoría de La Educación. Revista Interuniversitaria, 36 (2), 157–178. https://doi.org/10.14201/teri.31721
34. Anitha S., Vijaya K. B. Effectiveness of digital pedagogy in higher education: A quasi-experimental study. Education and Information Technologies, 26 (1), 159–174. https://doi.org/10.1007/s10639-020-10313-5
35. Means, B., Toyama, Y., Murphy, R., Bakia, M., Jones, K. (2010). Evaluation of Evidence-Based Practices in Online Learning: A Meta-analysis and Review of Online Learning Studies. US Department of Education. Available at: https://www.ed.gov/sites/ed/files/rschstat/eval/tech/evidence-based-practices/finalreport.pdf

36. Huang R., Chen G., Wu J., Chen Y. The effectiveness of blended learning for secondary school students: A meta-analysis. Journal of Educational Computing Research, 58 (6), 1251–1273. https://doi.org/10.1177/0735633120917809
37. Dhakal, B. P. (2023). Digital Pedagogy: An effective Model for 21st Century Education. Academic Journal of Mathematics Education, 5 (1), 1–9. https://doi.org/10.3126/ajme.v5i1.54534
38. Learning about artificial intelligence: A hub of MIT resources for K-12 students (2020). MIT Media Lab. Available at: https://news.mit.edu/2020/learning-about-artificial-intelligence-hub-of-mit-resources-k-12-students-0407
39. Vasiuk, O., Kondratenko, Ya. (2021). Model of using electronic training resources in professional training of future welders. Youth & market, 9 (195), 27–32. https://doi.org/10.24919/2308-4634.2021.240143
40. Semeniako, Yu. (2019). Vplyv informatsiinoho prostoru na osobystist dytyny doshkilnyka. Praktychna mediahramotnist: mizhnarodnyi dosvid ta ukrainski perspektyvy. Kyiv: Tsentr Vilnoi Presy, Akademiia ukrainskoi presy, 82–93.
41. Kindrat, I. R. (2013). Influence of Modern Mediaspace for the Formation of Philosophical Concepts Child of Pre-school Age. Visnyk LNU imeni Tarasa Shevchenka, 13 (3), 97–110.
42. Hurevych, R. S., Kademiia, M. O. (2006). Informatsiino-telekomunikatsiini tekhnolohii v nachalnomu protsesi ta naukovykh doslidzhenniakh: navchalnyi posibnyk dlia studentiv pedahohichnykh VNZ i slukhachiv instytutiv pisliadyplomnoi osvity. Kyiv: "Osvita Ukrainy", 390.
43. Zhurba, K. O., Kanishevska, L. V., Malynoshevskyi, R. V., Kharchenko, N. V., Fedorenko, S. V. (2022). Vykhovannia ditei ta molodi u tsyfrovomu prostori. Kyiv, 124.
44. Lytovchenko, I. V., Maksymenko, S. D., Boltivets, S. I., Chepa, M.-L. A., Buhaiova, N. M. (2010). Dity v Interneti: Yak navchyty bezpetsi u virtualnomu sviti. Kyiv: Vydavnytstvo: TOV "Vydavnychyi budynok "Avanpost"-Prym, 48.
45. Savchenko, L. (2017). Klipove myslennia ta shkola: sumishchaiuchy nesumisne. Osvita.UA. Available at: https://osvita.ua/school/57359/
46. Kanishevska, L., Lesyk, A. (2023). Formation of safe behaviour of primary school students in the digital space. Scientific Papers of Berdiansk State Pedagogical University Series Pedagogical Sciences, 1 (1), 115–121. https://doi.org/10.31494/2412-9208-2023-1-1-115-121
47. Petrushko, H. V. (2020). Mistse i rol internetu u zhytti molodshykh shkoliariv. Innovatsii u roboti vchytelia pochatkovykh klasiv: vyklyky i realii NUSh. Lviv: Tsentr Prohresyvnoi osvity "Henezum", 203.
48. Alieksieienko, T. F., Honchar, L. V., Kanishevska, L. V., Rohovets O. V.; Shakhrai, V. M. (Ed.) (2019). Zhyttia pidlitka yak tsinnist: porada vchyteliam i batkam. Kyiv, 100.
49. Kanishevska, L., Shakhrai, V. (2022). Featuresof education in school and family under the condition of digitalization. Perspektyvy ta Innovatsii Nauky, 4 (9). https://doi.org/10.52058/2786-4952-2022-4(9)-144-155