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**TECHNOLOGY OF EDUCATION AND TRAINING IN THE USA:
STRATEGIC DIMENSION**

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Circle of scientific interests: comparative pedagogy, reforms and trends in the development of school education abroad, scientific and informational support of education.

Abstract. The results of the analysis of the experience of the USA in technological education and training are presented, in particular regarding the use of immersive technologies, which can potentially become one of the main tools in education. Strategic documents focusing on technological innovations in the American educational policy are considered. The practice of implementing immersive technologies is considered on the example of the Stanford Laboratory of Virtual Human Interaction, in particular, the use of the ENGAGE and Expeditions Pro platforms for VR training. Examples of the functioning of virtual schools in different states of the USA as important components of online education are given. The issue of eliminating the digital divide in education is outlined. It was concluded that for modern Ukrainian society, the most important task is the development of perspective guidelines for development and effective practices for the introduction of educational innovations, reforming the educational system by transforming it into an effective model of education that would meet international standards.

Keywords: virtual reality, virtual school, e-environment, immersive technologies, educational innovations, technologization of education, digital divide.

The problem statement. Modern society is characterized by the scale of globalization, the increase of information, the complication of social problems, the

unpredictability and ambiguity of the development of all spheres of life, the reinterpretation of stereotypes and the change of accents. In such conditions, the role of education is gradually transformed into a toolkit for acquiring innovative skills, including creativity, self-motivation and self-development based on socialization, increasing digital competence, etc. In this context, we consider the technologization of education and training as an imperative for the development of the educational sphere and as an innovative tool for demanded and positive changes, a radical improvement in the quality of education.

In the course of the study, it was taken into account that the transformation of the educational system in Ukraine into an effective model in accordance with international public demands is currently at the main stage, therefore, the analysis and generalization of theoretical and strategic guidelines for the technologization of general secondary education in the USA, the identification and consideration of innovative educational technologies, such as the introduction of Edtech technologies, the development of virtual schools in a comparative perspective on Ukraine is quite timely and is not only of theoretical interest for us, but also of practical significance.

Literature Review. The relevance of the problem of creating an innovative environment, taking into account the technology of education and training, is evidenced by international strategic documents: the UN Program «Transforming our world: the 2030 Agenda for Sustainable» (2018), Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4 (2016), Digital Education Action Plan (2021–2027) (2021), Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills (2016).

In the context of scientific research, the works of foreign scientists are significant, in particular research on school reform (L. Kuban), online learning (S. Aaron, M. Cole, L. Swartz, D. Shelley), development of the latest educational technologies (E. Barbera, B. Gros, P. Kirchner), strategies for the development of education in the XXI century. (A. Kamins), introduction of educational innovations (D. Crichton, A. Levasseur, T. Haik, L. Jiang) and others.

Important for the analysis of the issue outlined by us are the results of scientific investigations by Ukrainian scientists who conduct comparative studies in terms of the

problems of globalization, integration and modernization of education, the formation of educational policy and the content of secondary education in English-speaking countries (N. Avshenyuk, A. Ligotskyi, I. Lytovchenko, O. Matvienko, A. Sbruyeva, S. Sysoeva, I. Schemprich), trends in the development of secondary education in the USA and leading European countries through the prism of reforms and innovations (O. Lokshina, O. Glushko, A. Zhurylo, S. Kravchenko, O. Maksymenko, N. Nikolska, O. Shparyk).

Dissertation studies on the reform of general secondary education and the development of pedagogical thought in this country at the beginning of the 21st century provide a clear reference point for the theoretical foundations of educational reforms in the United States (O. Litvinova, K. Shikhnenko, M. Shutova), media education, adult education in the USA (G. Golovchenko, N. Prykhodkina, O. Terenko).

The analysis of the latest publications convincingly confirms the deepening of the study of the introduction of the latest digital tools in education, the implementation of distance learning as a pedagogical technology, the design of the educational environment in the conditions of the COVID-19 pandemic by scientists of the National Academy of Pedagogical Sciences of Ukraine. These are, in particular, analytical and methodical materials «Dystantsiine navchannia v umovakh karantynu: dosvid ta perspektyvy», which presents the experience of organizing distance learning in general secondary education institutions under quarantine restrictions and promising directions for its development, considers the issue of implementing distance learning as a pedagogical technology, designing an educational environment taking into account the features of distance and mixed learning, organization of distance learning in primary school and institutions of secondary education of the II and III levels, assessment of learning results in the conditions of distance education, implementation of certification assessment of students of general secondary education, organizational and legal basis for the implementation of distance learning, characterization of the features of the management activity of the head of an educational institution during distance learning (Topuzov O., 2021).

In a scientific and analytical report «Zahalna serednia osvita Ukrainy v konteksti osvity krain Yevropy: tryvalist i struktura» a comparative analysis of the structure of

the national system of general secondary education of Ukraine and the educational systems of 38 European countries was carried out, and proposals were formulated to improve the organization of the educational process in Ukrainian schools in accordance with the transformational processes currently taking place in general secondary education of Ukraine (Kremen, V.H., Liashenko, O.I., & Lokshyna, O.I., 2020).

In scientific work «Digitalization of Education: pedagogical priorities» the impact of globalization and technological development of society on scientific activity, the education system, the organization and technologies of the educational process is comprehensively characterized, as well as the pedagogical priorities of digitalization of education are determined, which consist in the interdisciplinary solution of modern problems of the digital educational environment, the development of pedagogical principles of digitalization of education, the formulation of conceptual provisions of digital pedagogy, the definition of the main pedagogical concepts of digital education, the development of digital didactics, which involves the review of forms, methods, means and technologies of education, upbringing and development of , who learns in the digital space (Sysoieva, S., 2021).

Publications prepared by comparativists of the Department of Comparative Education of the Institute of Pedagogy of NAES of Ukraine: «Osvita v realiiakh viiny: oriientyry mizhnarodnoi spilnoty» (Lokshyna, O., et al., 2022), «Vidpovid svitovoi spilnoty na vyklyky COVID-19 v osviti (liutyi – cherven 2020)» (Lokshyna, O., et al., 2020), «Osvita ta navchannia v konteksti pandemii COVID-19» (Kravchenko, S., 2020), which analyzed the experience of foreign countries in responding to COVID-19 in education, summarized the recommendations of leading international organizations, primarily UNESCO, regarding the organization of education in pandemic conditions, revealed the formats of the international community's response to the challenges of COVID-19 and the complexity of initiatives implemented within global guidelines with taking into account the national context, and also presented the position of the international community on the problems of education in the conditions of military operations in Ukraine with an emphasis on the analysis of the motives of the attack on education, ensuring the continuity of education in the languages of war and the inclusion of refugees and internally displaced persons in the educational

process, characterized the EU support for the integration of Ukrainian children and youth to the education and training systems of the member states.

So, the review of scientific literature showed that the issue of technologization of education and training is relevant, multidimensional and requires further study.

Research aim. To analyze and justify separate theoretical and strategic orientations of technological education and training in the USA in a comparative projection on Ukraine.

Research methods. During the research, methods were applied, the combination of which contributed to a comprehensive vision of the aspects analyzed by us. Informative and descriptive methods together with systematization ensured the search and synthesis of factual scientific material. With the help of a structural and analytical method, concepts related to the topic of our research were considered, in particular, «technologization of education», «digital divide», «virtual school», «immersive technologies» and the intensification of the processes of technologization of education and training in the USA as a result of the rapid digitalization of society and development was investigated e-environments.

Presenting main material. The issue of introducing innovations in the field of education is extremely important. This is especially relevant during the global pandemic of COVID-19 and the war in Ukraine, when all links of the educational system in our country switched to distance learning mode.

In the process of research, it was established that the USA is one of the first to respond to innovative educational trends. Intensively implementing educational reforms, this country is implementing the most important pedagogical problems of global importance, in particular, updating the educational space through the use of the latest digital tools, cloud services in the management of educational institutions and the educational process, updating the content of education in accordance with scientific and technological progress, introducing immersive technologies into education, improvement of adaptive training methods, primarily differentiation and personalization of training, development of specialized skills.

Technologization has become a kind of catalyst for the formation of an educational e-environment both in the USA, the EU countries, and in Ukraine,

transforming the traditional education system in the direction of forming its new quality, which is characterized by an increase in the number of virtual educational platforms on the basis of which distance learning takes place.

Therefore, one of the priority innovative educational trends of the 20s of the XXI century. technology can be considered as an important progressive tool for reformatting the traditional educational space into an educational e-environment (Kravchenko, S., 2021a).

The strategic reference in this context is the plan for the transformation of American education using innovative technologies, developed by the Office of Educational Technologies of the US Department of Education «Transforming American Education Learning Powered by Technology. National Education Technology Plan 2010» (2010).

Through this document is the provision that the result of learning in all disciplines (English, mathematics, the basics of fundamental sciences, social sciences, history, fine arts, etc.) should be 21st century competencies such as creativity and innovation, critical thinking, problem solving skills, communication skills and cooperation skills. These skills are consistent with the principles of humanization and are necessary for successful adaptation to the rapidly changing demands of the world (Holovchenko, H., 2020).

It is worth noting that the EU countries also approved a political initiative to support the sustainable and effective adaptation of the education and training systems of the EU member states to the digital era – «Digital Education Action Plan (2021–2027) (2021). This document approved a long-term strategic vision of high-quality, inclusive and accessible European digital education, analyzed the challenges of the COVID-19 pandemic, which accelerated the use of technologies for the development of distance education and training, and strengthened the desire for stronger cooperation at the EU level in digital education. It also emphasizes the importance of synchronizing activities and interaction between different sectors of education in order to accelerate the transition of educational systems to an e-environment, foresees the digitization of teaching methods and pedagogical tools and the provision of the infrastructure necessary for inclusive and sustainable distance learning, including improving the

quality and quantity of digital teaching technologies. To achieve these goals, the Action Plan defines two priority areas: 1) promoting the development of a highly productive digital ecosystem of education, which requires appropriate infrastructure, connectivity and digital equipment, effective planning and development of digital potential; competent and digitally confident scientific and pedagogical workers; high-quality educational content, user-friendly tools and secure platforms that comply with e-privacy and ethical standards; 2) increasing digital skills and competencies for digital transformation. In order to implement this, it is necessary: formation of basic digital skills and competences from an early age; development of digital literacy, including combating disinformation; computer education; awareness of immersive technologies, including artificial intelligence (AI); acquisition of the latest digital skills that are constantly updated; ensuring gender equality in digital studies and careers. Therefore, the Digital Education Action Plan is a key factor in realizing the vision of creating a European Education Area by 2027 (Digital Education Action Plan, 2021).

Another equally important document of the European Union is the manifesto «Europe's Digital Decade: digital targets for 2030», in which on March 9, 2021 the European Commission presented the vision and ways of digital transformation European countries by 2030. Developers singled out four main aspects of the development of the digital decade and visualized them as a digital compass: skills, government, infrastructure and business (Fig. 1).



Fig. 1. Compass of digital transformation of the European Union until 2030.

Let us emphasize that during the pandemic distance learning has already become the norm. This is an evolutionary stage in the provision of educational services, which became possible thanks to the global digitalization of the educational process. Digital technologies in education are not only a tool, but also a living environment that opens up new opportunities, namely: learning at a convenient time, designing individual

educational routes, continuous education. Digitization has already changed the traditional education system in the direction of forming its new quality, which is characterized by an increase in the number of virtual educational platforms based on which electronic (distance) learning takes place.

How can educational technology improve learning for all? The solution to this question is based on the theoretical framework created two decades ago by two of the most famous educational researchers in the United States: David K. Cohen and Deborah Levenberg Ball. They argue that the most important thing for improving learning is the interaction between teachers and students around learning materials. Digital technologies used in the educational systems of developing countries differ in many aspects, and each such system has different needs in the field of electronic technologies, different infrastructure and potential for implementing technological solutions (Vegas, E., Hess, F.M., 2022).

Digitization of education requires proper technical and informational support, in particular, the development and implementation of a national IT strategy, ensuring equal access to electronic educational resources, forming digital competence among students and teaching staff, eliminating the digital divide, etc. However, such educational innovations require coordination of actions at the state level of all education stakeholders, as well as adaptation of schools during the digitalization of the educational process, reconfiguration of the educational space, changes in approaches to the management of educational institutions and the educational process. In particular, distance learning programs should be aimed at developing students' self-learning competencies and self-motivation. A certain autonomy of learning is important even in the conditions of a classical educational environment, especially distance education. However, many children, especially those of primary school age, have not yet acquired sufficiently developed autonomy skills for independent learning. Distance learning programs lack mechanisms that allow teachers to assess students' knowledge and provide feedback to them. For example, distance learning programs based on television or radio are unidirectional interfaces that do not allow teachers to evaluate and adjust the learning process. When students lack regular feedback from

teachers, they may not maintain their current level of learning, but instead develop new knowledge and skills through self-directed learning as needed (Dzhurylo, A., 2021).

Currently, the issue of eliminating the digital divide is being actively lobbied in the USA. This is detailed in a collaborative study by S. Chandra, et al. «Closing the Digital Divide in US Education – for Good» (Chandra, S., et al., 2021). The authors note that in 2020, when, due to quarantine restrictions, distance learning was introduced in all educational institutions, the scale of the digital divide among students was suddenly revealed. According to a 2020 Boston Consulting Group study with Common Sense, 30% of children (an estimated 15-16 million students) did not have adequate internet service or e-learning devices to effectively learn from home. While it's a problem in every state, the digital divide most tangibly affects students from rural and southern American communities. However, the digital divide is most prevalent among Black, Hispanic, and Native American students, as well as children from low-income families. At the same time, there is a problem of low digital and technical literacy in the US. Eliminating these problems together with investing in innovative educational technologies, which are primarily based on digitalization, will contribute to step-by-step changes in education. Thanks to the formation of digital skills, scientific and pedagogical workers can modernize and improve teaching methods, implement innovative education models.

Processes of technological education actualized the development of virtual schools, which gained popularity in the USA.

State virtual schools are organizations created by legislation or state bodies, which are usually financed in part or in full by state appropriations, tuition fees and/or grants. Such schools collectively serve more than 500,000 students, conduct about a million online courses in 23 US states during the year. They are one of the largest developers of online courses, online instruction, technology infrastructure development, professional development and other services related to online learning for schools and districts in the states where they are located. In the USA, public virtual schools began to appear approximately in 1997 and became one of the first providers of educational services online. The purpose of their establishment is to supplement the education of students in a traditional school. Over the last decade, public virtual schools

have significantly expanded the types of services and the list of products they offer, while maintaining the traditional role of an additional provider of online courses. Innovative public virtual schools are now implementing and leading changes in the delivery of online learning services.

Most virtual schools in the US are not schools in the traditional sense, as they do not issue high school diplomas and do not perform the traditional functions provided by schools. Instead, they offer online courses and related virtual services for schools. As a rule, students are enrolled with the approval of the local district. Public virtual schools may be operated by a state education agency, or they may be separate nonprofit organizations, charter schools, or regional service agencies with the approval of the state education agency. For example, virtual schools in Georgia and Virginia, Oregon Academy of Online Learning, and other virtual schools are part of state departments of education. Instead, the Idaho Virtual School is a governmental entity separate from the state education agency that operates under the direction of a Board of Directors and operates under applicable law. The Montana Digital Academy is affiliated with the state university system. The Michigan Virtual School receives legislative funding and operates under the direction of a Board of Directors that provides oversight. The Illinois State Virtual School is operated by the Regional Office of Education, which has been awarded a contract by the Illinois State Board of Education to manage and administer the state's virtual school. New Hampshire Public Virtual School «Charter School of Virtual Learning Academy» was created according to charter school rules. Although public virtual schools have different organizational and management structures, they share similar characteristics. They conduct online courses, provided with the appropriate administrative and pedagogical staff, enroll students, improve the qualifications of teachers, and also develop the technological infrastructure for conducting and supporting online education. The services of public virtual schools, as a rule, are fully or partially provided at the expense of budget funding. Sometimes districts may require payment for the entire course of study or for a portion of the cost of the courses. In some cases, courses are offered free of charge to students, as in Montana, South Carolina, or for a nominal fee to cover costs, as in Idaho.

US public virtual schools may qualify for federal or private grants to start and operate, but the bulk of public funding for virtual schools comes from state appropriations and/or tuition.

The largest public virtual school in the USA is the Florida Virtual School, which has 485,000 course attendees per year. North Carolina Virtual School has over 100,000 course participants. Other great schools include virtual schools in Alabama, Arkansas, Georgia, Idaho, New Hampshire, and South Carolina (Kravchenko, S.M., 2021b).

In these and other institutions of secondary education in the USA, at the current stage of the digital development of society, immersive technologies are actively implemented.

Immersive technologies – technologies of full or partial immersion in the virtual world or various types of combination of real and virtual reality. Immersive technologies are also called augmented reality technologies, which provide the effect of full or partial presence in an alternative space. These include: RR (real reality) – or the objective reality in which we are and which is perceived by the senses; VR (virtual reality) – it is a simulated reality with the use of modern technologies, when sound is added to 3D projections, and sometimes tactile sensations; AR (augmented reality) - supplemented (added) reality, when elements of virtual, simulated reality are added to real reality (RR); MR (mixed reality) – it is VR with certain additions of RR, or AR; XR (extended reality) is a general name for AR and VR technologies; 360° photo, video content consisting of one three-dimensional 360° photo or video or several combinations of photos and video images (Imersyvni tekhnolohii, 2020).

In the US, there are several platforms for immersive VR learning, such as ENGAGE. This is a professional platform of the so-called metauniverse, where you can independently create your own unique virtual world for teaching, showing and viewing VR demonstrations, lectures, conducting professional events on a virtual basis, etc. For example, Stanford University used the ENGAGE platform for a 2021 VR-based Virtual Humans course. This course is one of the first and largest in the US education system to be taught almost entirely in virtual reality (VR). Learners participate in the distance learning session using a virtual reality headset that is worn

over the eyes like an opaque diving mask and uses two handheld controllers to navigate the virtual environment.

Stanford's Virtual Human Interaction Lab (VHIL) has launched a number of projects using immersive technologies: «Environmental Education», «Medical Virtual Reality», «Telepresence», «Design Thinking», «Virtual Becomes Reality - Immersion and Presence», «Psychology of Augmented Reality», «Integration of Virtual Reality into Classrooms and Curriculum» (Integrating VR into Classrooms and Curricula), Empathy and Perspective Taking (Virtual Human Interaction LAB, 2022).

Specialists of this laboratory also conduct research with the involvement of education seekers, scientific and pedagogical workers and other stakeholders regarding the effectiveness of virtual reality educational programs in various learning conditions. In particular, in the virtual reality study «Education in times of global crisis», they examine how quarantine restrictions related to COVID-19 affect the use of educational virtual reality. The results of these studies (surveys, in-depth interviews, etc.) prove that virtual reality increases self-efficacy, helps to solve certain problems faced by teachers, especially when teaching natural sciences and other disciplines (Integrating VR into Classrooms and Curricula, 2022).

Another interesting example for studying abroad educational experiences is Expeditions Pro, a program for creating tours in virtual reality, which is designed for education, for example, immersive history lessons, virtual school trips, lesson notes, as well as entertainment. With Expeditions Pro, you can add local 360° panoramas, 4k 360° video, still images, audio files and more. This app is free. Educators can use Google Earth VR to engage learners on virtual journeys around the world while staying safe at home.

Immersive technologies take educational activities to a new level with many options for online learning games, as well as online courses. This can be particularly useful for encouraging and engaging learners in learning.

Experts predict that immersive technologies will fully enter the market of educational services in the coming years. According to BlueWeave Consulting, the global market for immersive educational technologies will grow by at least 29% by 2027 and already in 2020 it was \$697.26 million (Hadhazy, A., 2021).

Conclusions. Technologization of education is an important progressive tool for updating the educational space. In recent years, the development of technologies has become one of the most important trends for educators. Thus, innovation in education is of particular importance, as it plays a crucial role in the digitalization of society, the technologization of education and the sustainability of the digital future. The USA rightly holds the position of the world leader in the field of scientific and technical research and innovation. State and private investments in education ensure the development of this area and are a catalyst for the technological advancement of education. By investing in education, and particularly in educational innovation, the US government is enabling the development of a digital future that can serve as an example for other countries to follow.

Technologization of education and training is one of the most relevant trends of the 20s of the 21st century. Worldwide. However, the technologization of education requires proper not only technical, but also informational support. In particular, the development and implementation of the national IT strategy, ensuring equal access to electronic educational resources, the formation of digital competence among students and teaching staff.

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ТЕХНОЛОГІЗАЦІЯ ОСВІТИ І НАВЧАННЯ У США:

СТРАТЕГІЧНИЙ ВИМІР

Анотація. Представлено результати аналізу досвіду США з технологізації освіти і навчання, зокрема щодо застосування імерсивних технологій, які потенційно можуть стати одним із основних інструментів в освіті. Розглянуто стратегічні документи, що орієнтують на технологічні інновації в американській освітній політиці. Розглянуто практику впровадження імерсивних технологій на прикладі Стенфордської лабораторії віртуальної взаємодії людей, зокрема використання платформ ENGAGE та Expeditions Pro для VR-навчання. Наведено приклади функціонування віртуальних шкіл у різних штатах США як важливих складників онлайн-навчання. Окреслено питання ліквідації цифрового розриву в освіті. Зроблено висновки, що для сучасного українського суспільства надважливим завданням є вироблення перспективних орієнтирів розвитку й ефективних практик упровадження освітніх інновацій, реформування освітньої системи шляхом трансформації її в ефективну модель освіти, яка б відповідала міжнародним стандартам.

Ключові слова: віртуальна реальність, віртуальна школа, е-середовище, імерсивні технології, освітні інновації, технологізація освіти, цифровий розрив.