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TEACHING TECHNOLOGIES FOR TRAINING ELEMENTARY SCHOOL TEACHERS IN THE UNITED STATES

The article examines modern teaching technologies applied in the professional training of elementary school teachers in the United States within the context of the rapid digital transformation of education. The study focuses on key instructional approaches that significantly influence teacher preparation programs, including interactive learning technologies, blended learning, project-based learning, problem-based learning, and the integration of artificial intelligence tools. Particular attention is paid to the systemic and institutional mechanisms that support the implementation of these technologies in American higher education institutions. The paper analyzes the role of university-based centers for teaching and learning, project-based learning hubs, and instructional technology teams that provide methodological guidance, professional development opportunities, and technological infrastructure for faculty and preservice teachers.

The research highlights the growing importance of blended and hybrid formats in teacher education, especially after the COVID-19 pandemic, and examines how future teachers are trained not only to learn in such environments but also to design and implement technology-enhanced instruction in elementary schools. Special emphasis is placed on the rapid expansion of generative artificial intelligence in higher education between 2022 and 2025, including its applications in lesson planning, assessment design, reflective practice, and institutional strategic development. The findings demonstrate that the American system of teacher education is characterized by innovation, strong institutional support, and a practice-oriented approach to technology integration. The United States experience is considered valuable for informing the modernization of elementary school teacher training in Ukraine, particularly in the context of European integration and the digitalization of education.

Keywords: *professional training of elementary school teachers; teaching technologies; interactive learning; blended learning; project-based learning; problem-based learning; artificial intelligence; generative AI; United States education system*

ПЕДАГОГІЧНІ ТЕХНОЛОГІЇ ПІДГОТОВКИ ВЧИТЕЛЯ ПОЧАТКОВОЇ ШКОЛИ У США

Здійснено аналіз сучасних педагогічних технологій, які використовуються у професійній підготовці майбутніх учителів початкових класів у Сполучених Штатах Америки (США). Розглянуто особливості впровадження інтерактивних технологій навчання, змішаного навчання, проєктно-орієнтованого та проблемно-орієнтованого навчання, а також використання штучного інтелекту в освітньому процесі.

Визначено інституційні механізми підтримки технологізації підготовки вчителів у закладах вищої освіти США, зокрема діяльність спеціалізованих центрів, програм професійного розвитку та систем оцінювання готовності до впровадження інновацій. Проаналізовано сучасні тенденції інтеграції генеративного штучного інтелекту в систему вищої педагогічної освіти (2022–2025 рр.). Обґрунтовано значення американського досвіду для модернізації системи підготовки вчителів початкових класів в Україні в умовах цифрової трансформації освіти.

Ключові слова: *професійна підготовка вчителів початкових класів; педагогічні технології; інтерактивне навчання; змішане навчання; проєктно-орієнтоване навчання; проблемно-орієнтоване навчання; штучний інтелект; генеративний ШІ; система освіти США*

Statement of the problem. Modern training of elementary school teachers takes place in the context of rapid development of teaching technologies, which radically change approaches to learning, teaching, and professional development of teachers. Technologies in education support and enhance the learning process, making it more flexible, personalized, and practice-oriented. Their role is becoming decisive, as modern teachers must possess not only professional knowledge but also the competence to effectively organize learning in a digital environment, apply innovative methods, and critically evaluate technological capabilities.

Particular attention is paid to the experience of the United States because the American education system is one of the most innovative and technologically advanced in the world. The United States is a leader in the implementation of technologies such as blended learning, project- and problem-based methods, interactive learning, and artificial intelligence tools in the professional training of future teachers. This allows future

teachers to simulate real classroom situations, receive instant feedback, improve their practical skills, and develop digital pedagogical competence. Studying the American educational experience is also important for the Ukrainian context, as the transformation of elementary education requires the training of teachers who are able to work effectively in an innovative educational environment.

Analysis of previous research and publications. Basic definitions of learning technology (UNESCO; Ukrainian academic dictionaries) emphasize the systematic nature and optimization of the educational process through the interaction of technical and human resources [15] and interactivity as the organization of purposeful interaction between participants in the learning process [9].

The founders and researchers of interactive learning technologies are the following foreign (E. Mazur, M. Chi, S. Freeman, D. Johnson) and Ukrainian scientists (O. Pometun, L. Pyrozhenko, O. Savchenko). The development and research of project-based learning is carried out by such foreign scientists as B. Jones, K. Rasmussen, D. Thomas, B. Peterson, A. Denton, M. Hodara. S. Hmelo-Silver, H. Barrows, and H. Schmidt contribute to the development of problem-based learning.

Blended learning and teaching is more relevant than ever before. As a growing number of elementary and secondary schools switch to a blended learning format, there is a rapidly increasing demand for qualified teachers who can work successfully in this format. Researchers at Brigham Young University, D. Archibald, C. Graham, and R. Larsen, have created the Blended Teaching Readiness Instrument (BTRI), which can not only help prepare teachers for blended learning, but also pave the way for future research in the area of teacher preparation for blended teaching. (http://bitly.com/K12-BTR) [1].

Purpose of the article. The purpose of the study is to characterize modern teaching technologies used in the United States for training elementary school teachers, specifically: blended learning, project-based and problem-based learning, interactive technologies, and the use of artificial intelligence, with consideration of institutional practices.

Presentation of the main research. One of the fundamental teaching technologies used in practically all high-quality teacher training programs is interactive learning technology.

The Terminological Dictionary edited by O. Ohiienko defines *interactive learning technologies* as "learning technologies based on purposeful, specially organized group and intergroup activities, "feedback" between all subjects of the learning process with the aim of achieving mutual understanding and correction of the learning and development process, individual communication style based on reflective analysis. The organization of interactive learning involves modeling real-life situations, using role-playing games, and jointly solving problems based on an analysis of the circumstances and the situation at hand, which contributes to the formation of skills and abilities of the learners; the development of values, the creation of an atmosphere of cooperation, interaction, and the formation of motivation for learning activities, readiness for self-improvement, the ability to think critically and make informed decisions" [9, p. 45].

It is interesting to experience not only the practical application of interactive technologies in the United States higher education institutions, but also the access teachers have to examples and lesson plans for various subjects for inspiration and to develop their own concepts for use. For example, Harvard University provides a detailed description of research on interactive technologies such as Concept map, Debates, Discussion, Do now, Jigsaw, Pair and Share, Role-play, and Speed dating on its website [5].

Kent State University has a Center for Teaching and Learning, which provides detailed descriptions of the characteristics, applications, and even some lesson plans for interactive technologies such as Think-Pair-Share (TPS), Jigsaw, Concept maps, and Critique [8].

In the above-mentioned dictionary, *blended/hybrid learning* is defined as "the combination of formal learning methods (classroom work, studying theoretical material) with informal ones, such as discussions via email and online conferences, which successfully combines both daytime and distance learning forms" [9, p. 25]. According to the National Education Association, blended learning is an educational approach that thoughtfully combines traditional face-to-face classroom learning with online or digital classroom activities [11].

An overview of the teacher training programs for elementary school teachers at leading United States universities and colleges shows that most institutions offer a blended learning format. The number of programs in this format has increased significantly since the start of the COVID-19 pandemic. It is worth noting that there are institutions that offer both mixed-format elementary school teacher training programs and programs that specifically prepare teachers for mixed teaching in schools (i.e., teaching future teachers to design and conduct hybrid lessons).

For example, Anderson University offers blended seven-week courses that are conveniently designed for busy working professionals. At the University of Hawaii's College of Education, one option is a program designed for students from neighboring islands and distance learners, consisting of online classes and 2-4 weekends per semester that require in-person meetings. Applicants must complete practicum requirements and complete an internship at a local school on the island where they live. At the University of Missouri-Kansas City, the format for training elementary school teachers is completely blended («in-person with some online courses»). The blended program at La Verne University is designed to provide students with the in-person learning they desire while enhancing their knowledge through online assignments. The proportion of time spent in the classroom and online is usually 60% in the classroom and 40% online. During the 16-week semester, students can expect 10 classes with a teacher, and the remaining 6 classes will be conducted online.

To describe the higher education institutions that prepare elementary school teachers to teach in a blended format in schools, the following universities are worth mentioning: Arizona State University with its «Blended Learning Pedagogy and Practices for K-12» program, and George Mason University, which specializes in «Blended and Online Learning in Schools».

The Instructional Technology and Development team at Michigan State University supports faculty in developing engaging online, hybrid, and traditional courses through consulting and creative services. They use data-driven instructional design strategies to help develop, launch, and refine online, blended, and technologically enhanced face-to-face courses. The team regularly tests new systems and software to identify effective technologies for creating accessible learning experiences for students. Workshops and consultations are held on the development of technology courses and their accessibility. In addition, assistance is provided to teachers in creating video and media content for their courses and programs.

Project-based learning (PBL) is a model that organizes learning around projects. According to definitions provided in PBL guides for teachers, projects are complex tasks based on current issues or problems that engage students in designing, problem solving, decision making, or research activities; give students the opportunity to work relatively independently for an extended period of time; and culminate in the creation of realistic products or presentations [12].

PBL has its roots in the progressive education movement, which advocated for more student-centered and experiential approaches to education that support "deeper learning" through active exploration of real-world problems and challenges [10].

The Center for Project-Based Learning at Worcester Polytechnic Institute has been providing institutional support for the implementation of PBL in higher education since 2016, drawing on more than 50 years of experience [1].

The report "Preparing Teachers for Project-Based Learning" describes practical examples from the project "Out of the Gate: Preparing Preservice Teachers to Use Project Based Learning through PBL", a professional development project focused on building the capacity of teacher education faculty members to prepare teachers to be ready «out of the gate» to use high-quality PBL as a core instructional strategy with all students. This report details the experiences of faculty, their students (future teachers), and cooperating K–12 teachers in three Teacher Education Programs (TEPs) – University of Mary, Otterbein University, and Grand Valley State University – from the 2017-18 school year to the 2020-21 school year [2].

Problem-Based Learning (PBL) is a teaching method in which students learn through facilitated problem solving. In problem-based learning, students focus on a complex problem that does not have a single correct answer. Students work in collaborative groups to determine what they need to learn in order to solve the problem. They engage in self-directed learning and then apply their new knowledge to the problem and reflect on what they have learned and the effectiveness of the strategies they have used. The teacher acts to facilitate the learning process rather than provide knowledge [7].

This technology is widely used at the University of Delaware's Institute for Transforming University Education (ITUE). The ITUE's Problem-Based Learning Resource Center is a dynamic and inclusive open repository of materials for problem-based learning, providing educators, researchers, and students with a comprehensive collection of high-quality assignments across a range of disciplines and levels. All tasks in the information center have been thoroughly reviewed and are ready to be adapted for a wide range of courses [13].

Finally, let's consider the most widespread, modern, and relevant technology: *artificial intelligence (AI)*. The dictionary of artificial intelligence terms for educators states that «AI is a branch of computer science. AI systems use hardware, algorithms, and data to create "intelligence" to do things like make decisions, discover patterns, and perform some sort of action» [4].

Over the past two years, there have been significant changes in higher education: the integration of generative AI into teaching, learning, and institutional practices. This transformation has led to a boom in education research aimed at understanding the applications and impact of generative AI in the context of post-secondary education. To better understand how the field is responding, the global organization Digital Promise has created Artificial Intelligence in Higher Education, a collection of over 300 studies examining the application, impact, and design of generative AI in higher education institutions. Published between 2022 and 2025, these articles include empirical studies, descriptive analyses, and opinion pieces that explore how generative AI is interpreted, applied, and evaluated in the context of higher education.

Many studies examine AI in relation to writing and assessment. However, as the technology evolves, new research is uncovering diverse and inventive ways to use generative AI to support teaching, learning, and faculty development. Examples include curriculum vulnerability assessment (tools such as dashboards are being developed to flag parts of the curriculum that are vulnerable to abuse by generative AI); dialogue simulation agents; support for self-regulated learning; and professional development for teachers. Research shows how generative AI can assist in lesson planning and teaching preparation, as well as promote more reflective pedagogical practices among higher education faculty [3].

In January 2025, the United States Department of Education published a report entitled "Navigating Artificial Intelligence in Higher Education" to help higher education leaders implement artificial intelligence technologies in institutional operations and the academic environment [14].

EDUCAUSE's Generative AI Readiness Assessment for Higher Education is designed to give higher education leaders visibility into their institutions' readiness for strategic AI initiatives [6].

Conclusions. An analysis of current teaching technologies in the training of elementary school teachers in the United States confirms that the American system of professional education for teachers is characterized by a high level of innovation. The study identified key technologies that are transforming the training of future teachers: interactive learning technologies (Think-Pair-Share, Jigsaw, Concept Maps), blended learning, project-based and problem-based learning, and the use of artificial intelligence. A distinctive feature of the American approach is not only the use of these technologies in the educational process, but also the targeted training of future teachers to apply them in their own professional activities.

Institutional support for the implementation of teaching technologies is provided through the creation of specialized centers (the Center for Project-Based Learning at Worcester Polytechnic Institute, the Center for Teaching and Learning at Kent State University, and the Institute for the Transformation of University Education at the University of Delaware), which provide teachers with methodological assistance, task databases, tools for assessing readiness, and opportunities for professional development.

The rapid integration of generative artificial intelligence into higher education (2022-2025) deserves special attention. American institutions are not only experimenting with the use of AI, but also systematically studying its impact and developing tools to assess the readiness of institutions to implement AI technologies, which demonstrates a conscious and responsible approach to the digitalization of education.

The United States experience demonstrates the importance of a systematic approach to the technologisation of teacher education, which includes the development of conceptual foundations, the creation of institutional support infrastructure, the training of teaching staff, and the continuous monitoring of the effectiveness of technology use. These findings can serve as a valuable guide for modernizing the system of training elementary school teachers in Ukraine, especially in the context of European integration processes and the digital transformation of education.

Perspectives of further research. The perspectives of further research lie in a comparative analysis of teacher training practices and the formulation of recommendations for adapting international experience to the Ukrainian context.

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ВПЛИВ РЕАЛІЗАЦІЇ СПІЛЬНИХ ПРОЄКТІВ ЗАКЛАДУ ВИЩОЇ ОСВІТИ ТА ТЕРИТОРІАЛЬНИХ ГРОМАД НА ЯКІСТЬ ОСВІТНІХ ПОСЛУГ

А *Досліджено вплив реалізації спільних проєктів закладів вищої освіти(ЗВО) та територіальних громад на якість освітніх послуг і розвиток освітнього середовища на регіональному рівні. Спільна діяльність ЗВО та громад формує умови для розвитку ефективної моделі управління освітою, підвищує якість освітніх послуг, сприяє інноваційному розвитку територій і забезпечує соціальну відповідальність університетів. Отримані результати можуть бути використані для розроблення стратегій інтегрованого розвитку освітньої сфери, оптимізації ресурсного забезпечення, підвищення мотивації учасників спільних проєктів і створення сталих механізмів взаємодії університетів із громадами.*

Ключові слова: *заклади вищої освіти; територіальні громади; якість освітніх послуг; практико-орієнтована освіта; інноваційний розвиток; соціальна відповідальність університету; інфраструктурні проєкти; партнерська взаємодія; децентралізація*

THE IMPACT OF THE IMPLEMENTATION OF JOINT PROJECTS BETWEEN HIGHER EDUCATION INSTITUTIONS AND TERRITORIAL COMMUNITIES ON THE QUALITY OF EDUCATIONAL SERVICES

S *The article examines the impact of joint projects between higher education institutions and local communities on the quality of educational services and the development of the educational environment at the regional level. The author emphasizes the strategic role of universities as active agents of the social, economic and innovative development of territories, capable of forming practice-oriented educational programs and increasing the efficiency of local government bodies. The main areas of partnership are explored: updating educational programs with the involvement of community representatives and public organizations to integrate practical experience; scientific and research cooperation through joint laboratories, conferences, and data exchange; social and educational initiatives, including workshops, and cultural and environmental events; and infrastructure projects that involve the modernization of educational buildings, libraries, and laboratories through joint grant programs.*

It is stated that such interaction contributes to increasing the practice-oriented nature of education, developing the professional and leadership competencies of students and teachers, integrating theoretical knowledge with the real needs of the community, and increasing the competitiveness of the institution at the national and international levels. Particular attention is paid to examples of the successful implementation of joint initiatives in Ukraine: in the Dnipropetrovsk region; in the Vinnitsa region; in the Kyiv region; in the Lviv region; in the Poltava region, and in the Cherkasy region.

The conclusions emphasize that the joint activities of higher education institutions and communities create conditions for the development of an effective model of education management, improve the quality of educational services, promote the innovative development of territories and ensure the social responsibility of universities. The results obtained can be used to develop strategies for integrated development of the educational sphere, optimize resource provision, increase the motivation of participants in joint projects, and create sustainable mechanisms for interaction between universities and communities, which will contribute to the long-term development of both education and regional communities.

Keywords: *higher education institutions; territorial communities; quality of educational services; practice-oriented education; innovative development; social responsibility of the university; infrastructure projects; partnership; decentralization*