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НАУКОВО-ПРАКТИЧНОЇ
ІНТЕРНЕТ-КОНФЕРЕНЦІЇ

СВІТ ДИДАКТИКИ: ДИДАКТИКА В СУЧАСНОМУ СВІТІ

9–10 грудня 2025

До 100-річчя заснування
Інституту педагогіки
НАПН України

Київ
2026

ОРГАНІЗАЦІЯ ОСВІТНЬОГО ПРОЦЕСУ В УКРАЇНІ В УМОВАХ ВОЄННОГО СТАНУ

ОРГАНІЗАЦІЯ ОСВІТНЬОГО ПРОЦЕСУ В УКРАЇНІ В УМОВАХ ВОЄННОГО СТАНУ

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INTEGRATION OF MODERN INFORMATION TECHNOLOGIES INTO TEACHING MEDICAL AND BIOLOGICAL DISCIPLINES IN THE MEDICAL EDUCATION SYSTEM

The integration of modern information technologies into medical and biological education has become one of the most important tendencies in contemporary medical education. Rapid digitalization of society, the growth of biomedical knowledge, the transition to competency-based education, and the experience gained during the COVID-19 pandemic and periods of martial law, have fundamentally transformed traditional approaches to training future physicians. Disciplines such as anatomy, histology and medical biology require not only the transmission of large volumes of theoretical information, but also the formation of spatial thinking, analytical skills, and the ability to integrate basic science knowledge with clinical reasoning. Today, information technology is not merely an auxiliary tool, but a powerful catalyst for qualitative changes in the educational process (Yeung, et al., 2022, 8-10; Yang, 2023, 7-8).

Traditional lecture-practical models, primarily based on chalk-and-board explanations, glass slides, and paper atlases, are gradually being replaced or supplemented by digital educational environments that provide flexible access to content, interactivity, visualization, and personalized learning trajectories. Learning systems, such as Microsoft Teams and others, have become the organizational core of modern medical education, ensuring structured access to educational materials, video lectures, virtual laboratories, test systems, and communication resources (Popovych & Aliyeva, 2025, 282-284). Through these platforms, students gain the opportunity to prepare in advance for practical classes of medical and biological disciplines, revise complex topics at their own pace, perform self-assessment, and receive prompt feedback from instructors. For teachers, these systems provide powerful instruments for monitoring learning progress, analyzing student activity, and adjusting educational strategies based on objective learning analytics.

One of the most significant achievements of digital transformation in preclinical education is the widespread introduction of virtual microscopy and digital morphology. In histology, traditional work with glass slides and light microscopes, although still valuable, increasingly gives way to whole-slide imaging and online slide viewers (Zviahina, et al., 2023, 157-158). High-resolution digital slides allow

students to examine tissues and organs with unlimited zoom, annotate microstructures, compare normal and pathological specimens, and revisit material anytime and anywhere. This not only increases accessibility and standardization of practical training, but also fundamentally changes the didactics of histology by shifting the emphasis from mechanical slide identification to analytical interpretation of microstructural features and clinico-morphological correlations (Nurunnabi, et al., 2023, 79).

In anatomy, three-dimensional visualization technologies, virtual dissection tables, and extended reality systems have gained exceptional importance (Wang, et al., 2024, 9-10). Three-dimensional digital models of the human body provide layered, interactive views of organs and systems, enable cross-sectional visualization in any plane, and allow integration with radiological images.

Virtual and augmented reality technologies immerse students in three-dimensional anatomical space, enhancing spatial perception and long-term retention of complex topographical relationships (Heather, et al., 2019, 4-5). These tools are especially valuable for studying regions that are difficult to understand using traditional atlases and for situations where access to cadaveric material is limited. At the same time, digital technologies do not eliminate the educational value of traditional dissection but complement it, making anatomical training more flexible, safe, and clinically oriented.

Simulation technologies and virtual patients represent another powerful direction in the digitalization of medical education. High-fidelity manikins, computer simulators, and virtual clinical scenarios allow students to integrate knowledge from anatomy, histology, and physiology into realistic decision-making processes (Lobachev, et al., 2021, 4). For preclinical disciplines, such simulations create a bridge between molecular and cellular mechanisms on the one hand and clinical manifestations on the other, helping students understand how biochemical, physiological, and pathological processes translate into real disease.

Virtual laboratories and remote experiments have further expanded these possibilities, allowing students to perform simulated experiments in molecular biology and genetics.

Mobile learning and web-based educational resources also play an increasingly important role in medical education. Mobile applications for anatomy, histology, and clinical reference provide instant access to atlases, databases, and reference materials. Spaced-repetition flashcard systems support memorization of large volumes of factual information, while video platforms and social networks enable peer interaction, and the formation of professional learning communities. These tools support continuous learning beyond the classroom and help students efficiently use of time for educational purposes.

A particularly promising and rapidly developing area is the use of artificial intelligence in medical education. AI-based systems are already being applied for automatic analysis of histological images, identification of pathological patterns, adaptive testing, and personalized learning recommendations. Intelligent tutoring systems and chatbots are capable of answering student questions, generating

individual exercises, and even acting as conversational virtual patients (Diwan, et al., 2022; Alam, et al., 2023, 3).

The future of medical education is inseparably linked with further development of digital technologies. Extended reality, artificial intelligence, adaptive learning platforms, and global digital educational environments will continue to reshape the way future physicians acquire fundamental knowledge and professional competencies. At the same time, the central role of the teacher as a mentor, guide, and ethical authority will not diminish, but will transform in accordance with new educational realities. Therefore, the integration of modern information technologies into medical education should be understood not simply as a technological upgrade, but as a profound pedagogical transformation aimed at improving the quality, accessibility, and relevance of training for the needs of modern healthcare.

Thus, the integration of modern information technologies into medical and biological education is a logical and necessary stage in the development of higher medical education in the context of the digitalization of society, the growth of scientific knowledge, and the transition to competency-based learning. The digitalization of medical education is not a temporary trend, but a strategic direction of development focused on enhancing the quality of training for future doctors, fostering readiness for continuous learning, and ensuring effective professional activityin the conditions of the digitalization of the healthcare system.

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RESILIENT PEDAGOGY AND DIGITAL TRANSFORMATION OF HIGHER EDUCATION IN UKRAINE UNDER MARTIAL LAW

The experience of organising education in Ukraine under martial law has become an unprecedented challenge and, at the same time, a demonstration of national resilience. Since February 2022, the Ukrainian educational system has been functioning under conditions of constant uncertainty, security threats, and forced displacement. Teachers, administrators, and students have had to rebuild the entire structure of learning within a few weeks. The purpose of this paper is to analyse the main strategies, difficulties, and pedagogical transformations that ensured the continuity of education during wartime (War and education: two years of full-scale invasion, 2024).

When martial law was introduced, the education system faced a dual challenge: safeguarding the safety of all participants and ensuring that learning continued. Universities and schools immediately shifted to remote or hybrid formats. The first weeks were chaotic — many institutions lacked stable Internet connections, power supply, or equipment. However, by the middle of 2022, a new digital infrastructure began to develop (Ihnatenko, Shorena, 2024).

Teachers quickly mastered online learning platforms such as Moodle, Google Classroom, and Microsoft Teams—tools that had already become familiar during the COVID-19 pandemic. However, under martial law, their use reached an entirely new level. What had previously been an auxiliary instrument of blended learning had become the primary form of educational interaction. Teachers no longer relied on technology as a temporary substitute but as an essential part of pedagogical design. Students, in turn, learned to organise their time independently, access materials from cloud repositories, and participate in discussions from any location. For many, this became their first experience of genuine academic autonomy supported by digital tools.

Regional and volunteer initiatives played a crucial role. NGOs and local educational departments supplied laptops, mobile internet routers, and psychological support to internally displaced students. Many universities collaborated with international organisations to receive humanitarian and technical assistance. Consequently, Ukraine succeeded in maintaining a unified academic space despite fragmented physical conditions (Youth for democracy in Ukraine, 2025).