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DIGITALIZATION OF MEDICAL EDUCATION: PROSPECTS OF IMPLEMENTATION AND CHALLENGES OF TODAY

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ДІДЖИТАЛІЗАЦІЯ МЕДИЧНОЇ ОСВІТИ: ПЕРСПЕКТИВИ ВПРОВАДЖЕННЯ І ВИКЛИКИ СЬОГОДЕННЯ

Abstract. This article highlights the key trends in using digital technologies in the professional training of future doctors. It emphasizes that the digitalization of education in the XXI century is a major trend in modern society. Digital technologies are a unique mechanism for the comprehensive development of contemporary higher education institutions. The article emphasizes that digitalization not only integrates into traditional healthcare but also creates new opportunities for more personalized patient care. In 2021, the European Commission approved the Digital Education Action Plan for 2021–2027, aimed at supporting the sustainable and effective adaptation of education systems to the digital era. It is emphasized that traditional methods of knowledge transfer in higher education should be supplemented with technologies that enhance student motivation, prepare young professionals to work with large volumes of data in medical information systems, and navigate a constantly changing environment. Key components of digital competence that determine an individual's suitability for studying and working in medicine are also characterized.

Key words: digitalization of medical education; professional training; digital competence.

Анотація. У статті висвітлено основні тенденції використання цифрових технологій у професійній підготовці майбутніх медиків. Наголошено, що діджиталізація освіти у XXI ст. сприймається як один із трендів сучасного суспільства. Цифрові технології – це унікальний механізм для різнобічного розвитку сучасного вищого навчального закладу. Підкреслено, що діджиталізація не лише інтегрується в традиційну охорону здоров'я, а й створює нові можливості для більш персоналізованого догляду за пацієнтами. У 2021 р. Єврокомісія схвалила План дій щодо цифрової освіти на 2021–2027 рр., спрямований на підтримку стійкої та ефективної адаптації системи освіти до цифрової ери. Наголошено, що традиційні методи передачі знань у вищій школі мають бути доповнені технологіями, що дають змогу підвищувати мотивацію студентів, готувати молодих людей до роботи з великим обсягом даних у медичних інформаційних системах за умов постійних змін. Охарактеризовано ключові компоненти цифрової компетентності, які визначають придатність особи для навчання та умов роботи у сфері медицини.

Ключові слова: діджиталізація медичної освіти; професійна підготовка; цифрова компетентність.

Introduction. A fundamental requirement for the integration of the national higher education system into the international educational space is first of all the quality of educational services. The relevance of ensuring this quality is tied to the complex market conditions in which educational institutions operate and develop. Each institution must find its place in the market and in such an environment the development of an educational institution, especially a medical one, depends on its competitiveness and successful market positioning (Malakhov, & Khmelʹna, 2021, p. 400).

Nowadays young medical professionals expect their education to include a deep immersion into current medical practices and technologies. They seek an education that provides not only theoretical knowledge but also the practical skills necessary to work in a dynamically changing medical landscape. The digitalization and widespread application of information and communication technologies, as well as systematic reforms aimed at increasing the quality and competitiveness of medical education in line with modern challenges are key priorities for modernization.

The aim – to explore the possibilities of enhancing traditional learning methods by using digital technologies in the professional training of future doctors.

Theoretical framework. The digitalization of education has significantly accelerated with the start of the war in Ukraine. Society was forced to learn to live, work and get an education in new ways. The restrictions on social contacts created a need for alternative forms of communication and of course affected the educational process.

The term «digitalization» means converting various types of information, such as text, sounds, videos and other data into a digital format (Korda, Shulhai, & Mashtalir, 2023, p. 46). Digital transformation is an inevitable process of fundamental change occurring worldwide, which has been ongoing for decades and impacts all aspects of social life.

In scientific discourse, the term «digitalization of society» began to be used in the early 1970s in connection with the broad penetration of electronic computing systems into many areas of society (My Slovo: onlain-slovnyk). E. Toffler was one of the first to raise the issue of education digitalization in his work, Future Shock. He argued that a person's future standard of living is directly dependent on their level of education, while noting that he considered the education system hopelessly outdated. He believed the time had come for a new, «super-industrial» education system, whose task was to teach people critical thinking and the ability to navigate a rapidly changing world. According to E. Toffler, the tools of such a system would be computer-based learning and electronic video recordings.

Nowadays, we can confidently state that digital technologies are a unique mechanism for the comprehensive development of a modern higher education institution. They facilitate the rapid exchange of experience and knowledge, the adaptation of online learning, the development of digital libraries and digital campuses, and broaden the circle of individuals who can access unique information that was previously available only to a narrow group of experts and scientists. Thanks to digital technologies, we can confidently speak of the globalization of the scientific world and the active development of academic mobility (Kotukha, Fonaryuk, & Kotsan-Olynets′, 2022, p. 135).

Digitalization defines the life of a modern individual, and the digitalization of education in the XXI century is perceived as a key trend in contemporary society. The rapid development of digital technologies is evident in various fields of medicine. In the healthcare sector, digital transformation concerns not only the digitalization of healthcare processes but also the ability to predict negative trends in medical services. Globally, digital systems are widely used to automate processes in clinics and other medical facilities. Digitalization not only integrates into traditional healthcare but also creates new opportunities for more personalized patient care. Overall, this has great potential: digitalization minimizes bureaucratic efforts and frees up time for patient care. This includes the implementation of «electronic queues» in hospitals, the possibility of remote health diagnostics and creating conditions for conducting online consultations.

In Ukraine, medical information systems successfully connected to the eHealth MIC include: Helsi, Paracelsus, NEIRON, MEDEIR, MedCore, MIA: Zdorovya, MedCar, EMCI, Selenium, MedCenter+, HeiTich, Lakmus, Polyclinic without queues, MedStar and others. These electronic information systems allow for electronic patient records, and anyone can choose a convenient time to visit a family doctor and schedule an appointment.

The undisputed advantages of electronic information systems are electronic medical databases, electronic prescriptions and temporary disability sheets. The use of mobile applications, such as My BP Control and Angina Control, as well as devices for tracking vital signs like heart rate, blood pressure, blood sugar, and blood oxygen levels, has become commonplace. This became especially relevant in late 2019 during the COVID-19 pandemic.

In 2021, the European Commission approved the main document guiding the transformation of educational systems in EU member states – the European Commission's Digital Education Action Plan for 2021–2027. This document aims to support the sustainable and effective adaptation of education systems to the digital era. It emphasizes that traditional knowledge transfer methods in higher education should be supplemented with technologies that increase student motivation and prepare young people to work with large volumes of data in medical information systems in a context of constant change.

In the professional training of doctors in many countries, the catalog of competency-oriented learning objectives includes skills for the proficient use of digital technologies. Provisions for acquiring these competencies are included in the curricula of all faculties. Learning objectives for developing the skills necessary for doctors to work effectively in the digital age are integrated into relevant sections. For example, the diagnostic procedures section includes an introduction to current developments in the field of artificial intelligence, personalized medicine and digital image processing.

Integrating digital literacy seamlessly into medical education is crucial for preparing students for their professional careers. The EUROPASS network identifies core digital competencies essential for success in medicine (Boyd, & Ellison, 2007, p. 211–215):

– managing information – the expertise to identify, interpret, and utilize information profession-

ally, which includes internet research skills, crafting effective search strategies and curating data for professional use;

– collaborating online – the aptitude for participating in digital networks and partnering with other users to achieve common goals;

– creating and sharing content – the capacity for innovative and professional expression through technology, such as generating original multimedia materials and comprehending the application of copyrights and licenses;

– practicing digital ethics – a firm grasp of the skills and knowledge necessary for responsible and appropriate behavior online;

– evaluating and solving problems – competence in selecting digital assessment tools, appraising academic and clinical skills and leveraging technology to interpret outcomes and address challenges;

– ensuring technical safety – foundational skills for the competent and secure use of technology, focusing on protecting personal data, recognizing intellectual property and defending against online risks like fraud and malware (Fedchyshyn, Shulhai & Krytskyi, 2022, p. 7).

The use of digital technologies in teaching clinical disciplines expands the possibilities of traditional learning, which helps improve the practical training of future doctors. Multimedia-based educational information allows for supplementing traditional teaching methods with media files (graphic images, 3D graphic images and models, audio and video files created, for example, using Google Workspace for Education), which enriches the educational process with diverse information and facilitates more effective learning (Vuorikari, Punie, Carretero, & Van den Brande, 2016).

The undisputed advantage of electronic information systems is electronic medical databases; however, along with the great opportunities opened up by the introduction of digital learning formats, the danger of data protection issues cannot be ignored. For example, personal data is usually stored during video conferences, so digital tools should be chosen not only for their didactic purposes but, first and foremost, based on their data protection conditions. During the learning process, students do not always have the opportunity to perform all the manipulations whose skills they may need in their future practice. Another reason is the ethical and deontological limitations in the relationship between students and patients in a clinic. These problems can be solved by a digital technology-based simulation training center, which successfully operates at Ternopil National Medical University and helps in practicing various clinical skills using simulator manikins and trainers.

To gain practical experience, the center is equipped with simulators that allow students to practice the technique of auscultation of heart tones and respiratory sounds, obstetrical skills during childbirth, cardiopulmonary and cerebral resuscitation, surgical skills, injection techniques, and many others. Such simulation training centers create conditions for forming skills that can be obtained while working with a real patient. Another advantage of these centers is the opportunity to perfectly practice a specific practical skill because a student can repeat it as many times as necessary. The manikins completely reproduce a certain pathological condition and can be examined and treated. The instructor's task is to control the quality of the student's actions according to the algorithm and to analyze each student's actions.

Virtual reality provides an opportunity for medical students to immerse themselves in various clinical situations that can be useful for the practical application of knowledge and skills. Visualization of learning plays a particularly important role in developing clinical thinking and increasing motivation to learn. The great significance of the visual component's influence on the effectiveness of the learning process lies in its ability to visually represent the phenomena being studied.

In the process of treating patients, the importance of telemedicine is constantly growing, primarily due to the need for narrow specialization and a lack of qualified experts. Telemedicine opens new digital communication channels within a professional team and in interactions with patients. Therefore, even at the initial stages of clinical training, students must learn about its applications to be able to make informed decisions about using telemedicine for the benefit of patients.

When teaching students how to use digital technologies, it is crucial to emphasize the importance of their responsible use, especially concerning legal and ethical aspects. In order to prepare future doctors for the use of digital medicine, close interprofessional collaboration between medical informatics and medicine is essential. However, with the exception of a few pilot projects, medical curricula have not yet been adapted to meet future digital challenges (Kotukha, Fonaryuk, & Kotsan-Olynets′, 2022, p. 135).

It is worth noting that the task of clinical informatics (biomedical or medical informatics) is to apply information technologies in healthcare. This includes developing and implementing software for collecting, storing, and analyzing medical data, as well as protecting information and supporting medical staff (training doctors and other medical professionals to use information technologies in their work). High-tech advancements are being implemented continuously, so educators must learn constantly alongside their primary activities.

Both young specialists and students still find it difficult to make clinical decisions (Hilty, Hales, & Briscoe, 2006, p. 31–33). In clinical practice, sys-

tems designed to support clinical decision-making are increasingly gaining ground. This highlights the need not only to acquire decision-making skills but also to learn how to use digital decision support systems and their basic functional principles in a differentiated way (Boyd, & Ellison, 2007, p. 220), so that future doctors do not blindly trust technology but can confidently use it as an auxiliary tool.

Another tool that will play a significant role in the digitalization of higher education is artificial intelligence (AI). The capabilities of AI are extremely broad, so its use in medicine and in the professional training of future doctors will continue to grow. With the help of artificial intelligence and AI-based software, it is possible not only to optimize the treatment process but also to increase the productivity of the medical profession, minimizing the risk of human error.

Some sources (Seyhan, & Carini, 2019) indicate that in Europe, approximately 9 out of 10 hospitals regularly use one or more AI solutions in four key areas: data processing, logistics, diagnostics and care. The new generation of doctors is participating in the development of digital technologies, as these «tools» consider four aspects: appropriateness, user-friendliness, adaptability and practicality.

Artificial intelligence has been actively applied in working with patient medical records and is constantly being improved in this area. For example, to facilitate the use of the cumbersome and inconvenient Orbis, electronic patient record, the Paris Hospital Association uses Watson software. The first commercial application of this software, «Watson for Oncology», was for creating personalized treatment plans for cancer patients. The AI compared information about a specific patient with a massive database that included millions of pages of medical literature (including medical journals, guidelines, clinical trials, electronic medical record data, treatment histories of similar patients, etc.). With each new patient, this software becomes more accurate and provides invaluable assistance in creating an individual treatment plan.

Medical knowledge is constantly being updated, and treatment methods are continuously being improved. In 1950, it was predicted that medical knowledge would double every fifty years. In 1980, this number was already shortened to seven years, and in 2010 – to three and a half years. From 2025, it is expected to be only 72 days. Our brain can barely keep up with this progress.

As for the human component, which forms the basis of the doctor-patient relationship, robots can never replace a medical professional. Therefore, in the digital era, it is important to develop social interaction skills and an awareness of purposeful communication of medical students. It is crucial to draw attention to the specifics of communication within the framework of digital capabilities (such as using telecommunications) and to provide future doctors with structured training in this area.

An example of digitalization at Ternopil National Medical University is the implementation of the Moodle and ASU systems. Both platforms play an important role in optimizing the educational process and creating favorable learning conditions. As an educational platform, Moodle provides students with access to all necessary learning materials and test tasks for final and current control, which students complete and submit through the system. Additionally, students have access to syllabi and curricula for all disciplines, which contain detailed information about required courses, study duration, etc. The ASU educational platform gives students access to their work results – they can see their grades and track their academic progress.

Instead of traditional lectures in the classroom, the university practices online lectures, which allow students to save time and, if necessary, review materials multiple times. The traditional whiteboard in many classrooms has been replaced by a digital or interactive one. In addition to writing, it can be used to view various content, interact with other users, and use special programs. Interactive exercises are very effective for learning because they allow for instant feedback and learning at one's own pace. Computer programs can create interactive tests for students, which allows them to activate the knowledge they have gained. Mobile applications that can contain interactive tasks and tests are also convenient for learning, as they allow for studying anywhere and at a convenient time.

Electronic textbooks are accessible for learning material and convenient for finding information. They allow you to find the necessary information quickly and ensure its convenient storage. Such electronic textbooks can be updated and supplemented, which ensures that the information is current and accurate.

While highly valuing the importance of using informational and educational web technologies (ZOOM, Google Meet, Skype, Webinar, MSTeams) in the teaching process, we cannot ignore the problems associated with the online format of higher education. Traditional education still has its advantages, which digitalization can never fully replace. Primarily, classroom sessions and online learning are two different worlds with different forms of interaction between the participants in the educational process. The limited scope of live communication between a student and their friends or teachers acts as a restraining factor on students' social development.

In online learning, the weakening of the teacher's influence on the formation of the culture of educational activity, as well as students' cognitive and learning motivation, is particularly acute. Traditional

education provides opportunities for interaction and collaboration on projects and tasks, which forms crucial teamwork skills for future professional activities. No digital technology can be used to organize successful group teamwork that allows for generating ideas and quickly implementing them, such as brainstorming. No electronic resource can replace the teacher, live communication with the instructor and classmates, and the ability to see them in person, not just on a monitor screen.

Therefore, we believe that the modern educational model of a higher medical educational institution should continuously develop and be based on various approaches: it should include both the classic lecture-seminar model and one in which lectures are replaced by discussion. In this educational model, digitalization will play the role of a promising mechanism for the modernization and development of a modern university.

Conclusions and Prospects for Research. Thus, digitalization provides more opportunities for society and has countless advantages. The new realities of today, having affected almost all spheres of social life, have not bypassed the educational process. Digital technologies are a unique mechanism for the comprehensive development of a modern higher education institution. A fast exchange of experience and knowledge has been enabled, as have online learning and the development of digital libraries and campuses. The circle of individuals who receive unique information, which was previously available only to a narrow group of experts and scientists, is expanding. Thanks to digital technologies, we can confidently talk about the globalization of the scientific world and the active development of academic mobility.

We see prospects for further research in improving the content of education and developing special interactive methods that should be used for the professional training of future doctors and the development of their academic mobility.

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