

Formation of digital competence in the medical educational environment

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ABSTRACT

Aim: To present theoretical and practical approaches to the development of digital competence among participants in the medical education environment based on the digitalization of Ukraine's healthcare system.

Materials and Methods: To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method, system analysis method, conversations and interviews with participants in the educational process, modeling of the process of formation of digital competence.

Results: An analysis of self-assessment and the level of digital competence formation among healthcare representatives helped determine the criteria for updating educational programs on digital competence development as a result, steps were taken to introduce comprehensive training in digital competencies, covering previously unaddressed aspects and enabling healthcare professionals to acquire all necessary competencies. Therefore, we presented a model illustrating the interrelation of competency formation and learning outcomes (LOs) through the lens of qualification characteristics and higher education standards for the specialty, interpreted in the information-educational environment model NMU_DIGITAL.

Conclusions: Medical and pharmaceutical education must adapt to modern standards and tools, regardless of whether they relate to treatment, prevention, rehabilitation, or management activities. Developing digital competence and using digital tools should begin at the earliest stages of professional orientation, be thoroughly studied at the pre-higher and higher education levels, and continue through lifelong professional development.

KEY WORDS: digital education, digitalization, digital transformation, electronic healthcare, system, e-Health, digital competence framework of healthcare professionals

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INTRODUCTION

The healthcare system reform in Ukraine has been fully transitioned to digital infrastructure. From now on, all stages – from the allocation of the state budget to direct patient care are conducted using modern information and digital technologies. A key element of this digital transformation is the two-tier Electronic Healthcare System (EHS). This system ensures instant and secure information exchange between medical institutions and government bodies responsible for policy development and healthcare service financing.

The implementation of digital technologies affects not only government agencies and medical professionals but also patients, who are the central element of the healthcare system. Local governments, pharmacies, diagnostic centers, and other stakeholders are also actively involved in this process. However, as practice shows, the importance of education and training in the digital transformation process has been underestimated. Many existing educational programs in medical and pharmaceutical institutions require updates and expansion [1, 2].

Given the rapid changes in the field of electronic healthcare, medical professionals must constantly adapt and master new digital tools and technologies. Therefore, high-quality education and workforce training are critically important for the success of healthcare digital transformation, especially in wartime conditions and workforce shortages.

AIM

The aim of the article is to present theoretical and practical approaches to the development of digital competence among participants in the medical education environment based on the digitalization of Ukraine's healthcare system.

MATERIALS AND METHODS

To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, meth-

odological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – for comparing and generalizing experiences in digitalization and digital transformation, empirical methods – conversations and interviews with participants in the educational process, modeling – for implementing the structure of educational process support at the Bogomolets National Medical University.

RESULTS

Before the implementation of the EHS in practical activities, computer equipment and the use of digital technologies in the healthcare system were minimal or sometimes even absent, indicating insufficient staff preparedness for applying digital technologies in practice. Additionally, the almost complete absence of educational courses and programs for medical and pharmaceutical professionals in vocational pre-university and higher education institutions, as well as in the system of continuous professional development, at the initial stage of EHS implementation led to several problems and obstacles in the effective introduction of electronic healthcare into practical activities [3].

Given the current wartime conditions and security risks at this stage of electronic healthcare development and EHS implementation, it is strategically important to define ways to improve the education of medical and pharmaceutical professionals at all levels. This is necessary to develop digital competencies and enhance human resources as the main driving force behind healthcare digital transformation. The strategic directions of the state in developing the healthcare sector include: creating a unified medical information environment, transitioning from paper to structured electronic medical records, integrating into the global medical information space, implementing international medical and information standards, ensuring public access to aggregated healthcare data, creating a favorable environment for the development of decision-support systems, personalized medicine, telemedicine, big data processing, artificial intelligence (AI), and more. An analysis of self-assessment and the level of digital competence formation among healthcare representatives helped determine the criteria for updating educational programs on digital competence [4] development as a result, steps were taken to introduce comprehensive training in digital competencies, covering previously unaddressed aspects and enabling healthcare professionals [5] to acquire all necessary competencies.

It is essential to follow the Digital Education Matrix principle when developing academic curricula. As stated in [4] the Digital Education Matrix aims to create

a comprehensive system for integrating the Digital Competence Framework into professional education for healthcare professionals. This system covers all education levels (Fig.1), specialties, and professional-educational standards, ensuring effective planning and implementation of digital education activities throughout a medical professional's career – from the beginning of training to continuous professional development.

The Digital Education Matrix provides a holistic approach to planning curricula and programs across specialties and educational standards. These standards, in turn, are based on the qualification requirements of the healthcare sector and will eventually align with professional standards currently under development. The ultimate goal is to create a structured training plan for model curricula and programs for all forms of education, specialties, and educational standards, considering the requirements and content of the Digital Competence Framework [6].

For example, due to the limited number of ECTS credits at Bogomolets National Medical University, not all areas of the digital competence framework can be mastered during the study of the core discipline "Information Technology" (for the specialty "Pharmacy, Industrial Pharmacy"). Therefore, elective courses and certification programs (non-formal education courses) come to the rescue. Additionally, it is crucial to reflect the digital competence matrix in the working programs of academic disciplines, based not only on competencies but also on learning outcomes.

A research team [4] developed a comprehensive table based on education level and specialty. However, it is important to examine the relationship between the Digital Competence Framework and the formation of learning outcomes. Therefore, we present a model (Fig. 2) illustrating the interrelation of competency formation and learning outcomes (LOs) through the lens of qualification characteristics and higher education standards for the specialty, interpreted in the information-educational environment model NMU_DIGITAL [7].

It is evident that the course program cannot be all-encompassing and can only cover certain components of the Digital Competence Framework for Healthcare Workers to form specific competencies and learning outcomes.

As the digitalization of the healthcare sector is an inevitable and irreversible process, the need to train qualified users of medical information systems is increasingly relevant. This drives the development and enhancement of informatics training for students of higher medical (pharmaceutical) education in many developed countries. Ukraine is no exception to these processes. A new driving force emerged in 2016 with

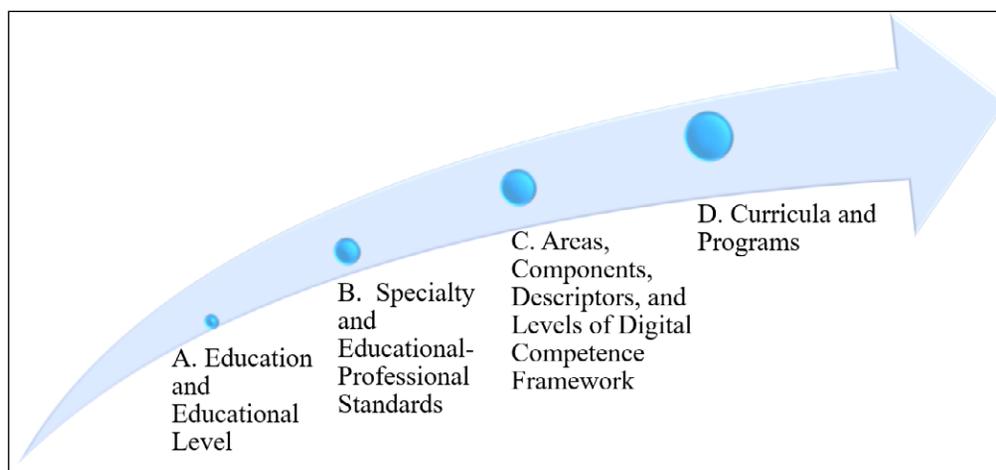


Fig. 1. System of digital education

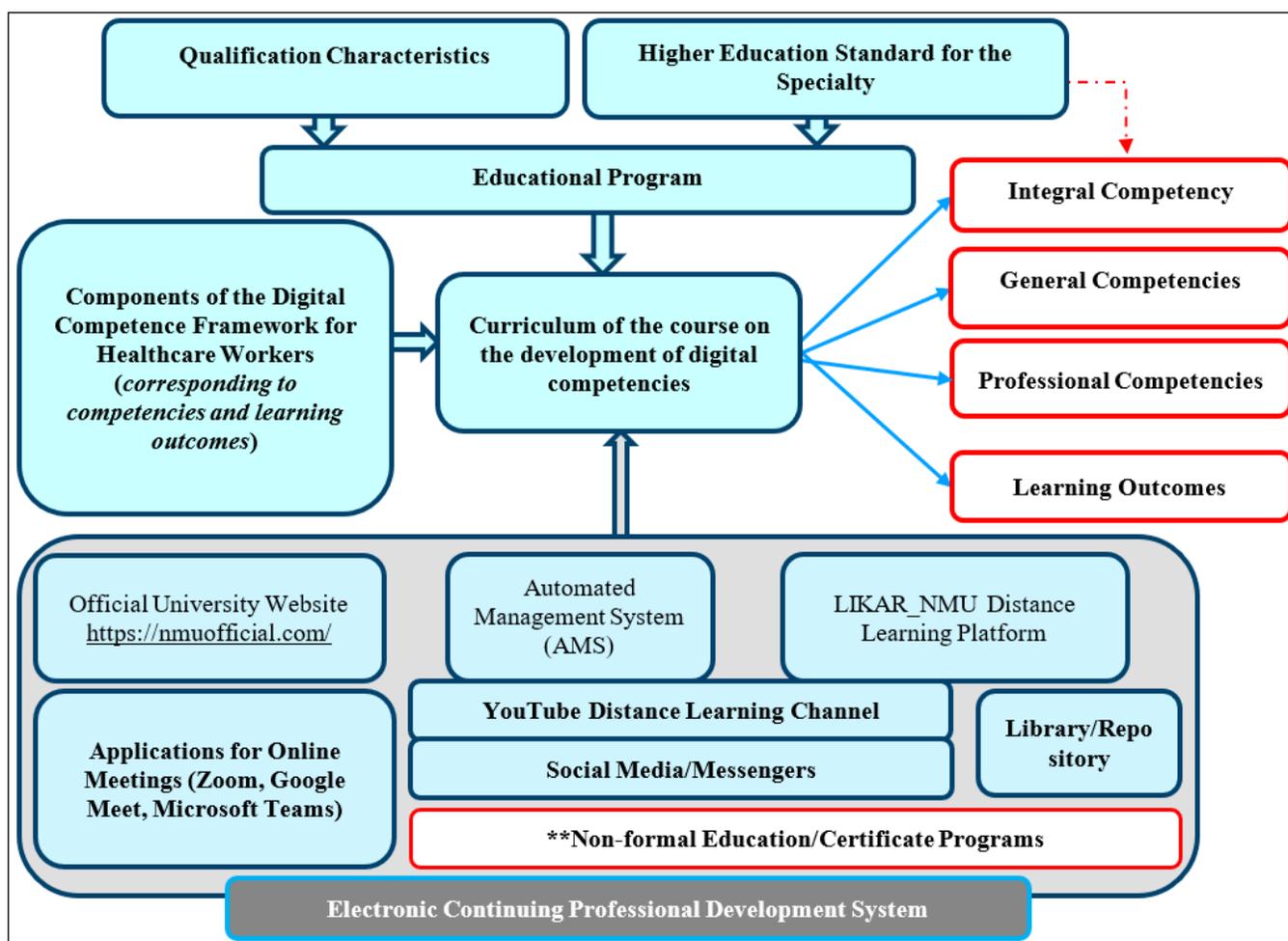


Fig. 2. Interpretation of the digital education matrix in the implementation of a digital competency formation course

the reform of the healthcare sector, which aimed to transition to electronic medicine.

Since 2019, the educational process in Ukrainian higher education institutions has been continuously affected by quarantine restrictions related to the COVID-19 pandemic and, later in 2022, by the introduction of martial law in Ukraine. The national higher medical education system faced a set of challenges related to organizing in-person, distance, and blended learning

formats while ensuring the quality of the educational process. These events have influenced the development of distance learning technologies, particularly in informatics training, and have driven the search for new technologies, tools, and teaching methods.

Currently, to support the educational process, the modular object-oriented dynamic learning platform LIKAR (Learning, Innovation, Knowledge, Assistance, Result) has been integrated into the distance learning system at

Bogomolets National Medical University. It is based on MOCO and MOODLE systems. The functionality of this system is extensive. As an automated information system for learning management, it enables the design, creation, and management of the university's educational resources while providing convenient content management tools and various forms of organizing classes [8].

According to survey results [4], all participants in the educational process require a higher level of digital competence. To master as many components of the Digital Competence Framework as possible and achieve a higher level of digital competence, students, healthcare workers, and university faculty at Bogomolets National Medical University are offered additional elective courses, non-formal education (external platforms), certification programs, and the "Digital Competency School" for all participants in the educational process.

Aims of the Digital Competency School:

- Enhancing digital literacy.
- Developing critical thinking regarding digital information.
- Building skills for safe digital practices.
- Assisting in professional activities.
- Promoting social inclusion.

For academic and research staff working in healthcare institutions, it is crucial to align with the following frameworks:

- The Digital Competence Framework for Ukrainian Citizens [9].
- The Conceptual-Referential Framework for the Digital Competence of Educators and Researchers [10].
- The Digital Competence Framework for Healthcare Workers [5].

DISCUSSION

The Ministry of Digital Transformation of Ukraine, together with its partners, has been researching digital literacy levels of the population, publishing reports in 2019, 2021, and 2023 [11-14]. On the "Diia. Education" platform, documents detailing digital competence frameworks for various professional groups – including librarians, educators, and healthcare workers – are available [5, 9, 10, 15, 16]. The latest development, concerning healthcare workers, was presented in 2023 and is published on the Diia. Education and Ministry of Health of Ukraine websites. According to [17], the digitalization of healthcare is driven by two factors specifically scientific and technological progress, which enables the adoption of new technologies in medicine and also the concept of e-health development, which establishes digital tools as fundamental for the progress and operation of the healthcare sector.

The analysis of these studies has revealed several issues that require further examination. In particular, this concerns the role of education in the development of digital competence and its impact on the digital transformation of the healthcare system. A thorough study of research results and practical pedagogical experience has highlighted the need to create a comprehensive concept for developing digital competence among participants in the medical educational environment based on the digitalization of Ukraine's healthcare system.

Based on the approaches considered within the framework of digital competencies and the results of research on the level of digital literacy of the population, we can note that the modernization of educational programs in medical education is critically important for success in the context of digital transformation. New programs must equip students, medical professionals, and rehabilitation specialists with the necessary skills and knowledge to operate effectively in a modern digital environment. Special attention should be given to education that fosters digital competence in all healthcare system participants throughout their professional lives. Educational programs should incorporate the effective use of digital tools and support the achievement of digitalization goals in healthcare and society as a whole.

Medical and pharmaceutical education must be adapted and synchronized with all external processes and changes in the healthcare sector. The study of disciplines and topics that develop digital competence should begin in the early years of higher education and continue throughout professional careers, while the implementation of digital solutions in universities and healthcare institutions is an essential component of quality [3]. Based on this, the target groups for changes in digital technology education include: students of professional pre-higher and higher education, practicing doctors, pharmacists, and rehabilitation specialists at the postgraduate level, as well as medical workers who use digital tools in electronic healthcare.

In our opinion, knowledge of innovations and new digital technologies in healthcare enables current and future professionals to be well-prepared for implementing modern approaches in management, diagnostics, treatment, rehabilitation, and patient care. The effective and rational use of digital technologies reduces the waiting time for research results, which is particularly important during surgical interventions. Additionally, digitalization, which transforms all public services into convenient online services, allows for the efficient servicing of a large number of patients and contributes to providing quality medical care not only to residents of developed metropolitan areas but also to those in remote regions of the country. Another advantage is

the reduction of medical errors, which are unacceptable since the primary goal of medicine is to preserve and improve human health without causing harm.

CONCLUSIONS

Medical and pharmaceutical education must adapt to modern standards and tools, regardless of whether they relate to treatment, prevention, rehabilitation, or management activities. Developing digital competence and using digital tools should begin at the earliest stages of

professional orientation, be thoroughly studied at the pre-higher and higher education levels, and continue through lifelong professional development.

The development and integration of various components of the educational online environment not only modernize the learning process and change teaching methods but also encourage the acquisition of new competencies for both students and faculty. The university's information-educational environment continues to evolve, integrating new technologies and resources to meet current challenges and needs.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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