



TRANSFORMATION OF HIGHER NURSING EDUCATION IN UZBEKISTAN IN THE CONTEXT OF HEALTHCARE DIGITALIZATION AND THE EMERGENCE OF NEW PROFESSIONAL COMPETENCIES

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Article history:	Abstract:
Received: 14 th April 2026 Accepted: 11 th May 2026	This paper analyzes changes in the system of higher nursing education driven by the development of digital technologies in healthcare. It demonstrates that the updating of clinical practice requires a revision of educational approaches, including a transition to a competency-based model and the integration of digital tools into the learning process. Based on an analysis of scientific literature, the main limitations of personnel training were identified, including an insufficient level of digital and managerial readiness, as well as the mismatch between educational programs and modern practice requirements. Special attention is paid to the conditions in Uzbekistan, where the modernization of education must account for the national characteristics of the healthcare system. The authors substantiate directions for improving nursing training aimed at increasing the quality of education and ensuring its alignment with the digital environment of professional activity.

Keywords: Education, digitalization, competencies, nursing, healthcare

INTRODUCTION

The digital transformation of healthcare is currently viewed not as an isolated technological process, but as a systemic factor determining the structural reorganization of medical care and personnel training. In accordance with the World Health Organization's global strategy (2021), digitalization involves the integration of technological, organizational, and human resources aimed at achieving sustainable development goals in the field of healthcare [39]. At the same time, special attention is paid to forming a person-centered healthcare model supported by digital solutions, as well as developing mechanisms to manage the digital maturity of national systems [39]. Unlike the early stages of information technology implementation, modern digital solutions cover a wide range of processes—from telemonitoring to clinical decision support algorithms. As demonstrated in a systematic review by Longhini J., Rossetini G., Palese A. (2022), such technologies are associated not only with increased efficiency of medical care but also with improved clinical outcomes, including therapy safety and patient satisfaction [24]. However, despite the significant potential of digital solutions, their implementation comes with substantial requirements regarding the training level of medical personnel. Similar conclusions are presented in the work of Isidori V. et al. (2022), where, based on an analysis of 60 publications selected from an initial pool of 250 sources, it is shown that digitalization leads to changes in the functional role of the nurse and requires expanding the

scope of her professional competencies [19]. At the same time, the authors emphasize that existing educational models do not always keep pace with the rate of technological change, which creates a gap between the requirements of practice and the training level of specialists [19]. Empirical data confirms the existence of this gap. For instance, in a study by Raghunathan K., McKenna L., Peddle M. (2023), which included 142 nursing students, only 40.84% of participants assessed their informatics competence as corresponding to the "competent" level [30]. Analogous trends were identified in the work of Abou Hashish E. A., Alnajjar H. (2024), where a survey of 266 students revealed mean scores for digital skills at points, whereas the level of knowledge and attitudes toward artificial intelligence remained lower [10]. These data indicate that even with a high frequency of digital technology use (up to 85.3% of respondents), the level of their meaningful professional application remains limited. Meanwhile, the results of a systematic review by Kulju E. et al. (2024), which included 20 studies, show that targeted educational interventions can significantly increase the level of digital competence among healthcare workers [22]. However, the effectiveness of such programs largely depends on their practice-oriented nature and integration into the educational process rather than the episodic inclusion of digital disciplines.

The purpose of this article is to analyze the transformation of higher nursing education in Uzbekistan under conditions of healthcare digitalization



and to substantiate directions for its improvement, considering modern requirements for the professional competencies of nurses.

Modern Challenges and Limitations of the Higher Nursing Education System in the Context of Digitalization

The development of digital healthcare significantly outpaces the transformation of educational systems providing nursing training. As a result, a persistent mismatch is formed between the requirements of clinical practice and the content of educational programs. While modern medical care increasingly relies on digital platforms, telemedicine technologies, and data processing tools, the educational process in many cases retains a traditional structure primarily oriented toward knowledge transmission. Under these conditions, the transition to competency-based education acquires fundamental importance, since it is the learning outcome, rather than the volume of assimilated information, that determines a specialist's readiness for professional activity (Lewis L. S., Rebesch L. M., Hunt E., 2022) [23].

The mismatch of educational models with new requirements manifests primarily in the fragmented integration of digital technologies into the learning process. As shown by Meum T. T., Koch T. B., Briseid H. S., Vabo G. L., Rabben J. (2021), the use of digital solutions in education remains irregular and is not always linked to the clinical context [27]. Similarly, Taylor J., Fuller B. (2021) note that the expansion of telemedicine requires not just the separate inclusion of thematic modules, but a revision of the entire training logic, including teaching methods and practice

organization [37]. This indicates the persistence of methodological inertia within the educational system.

A significant limitation remains the deficit of digital competencies among students. In a study by Raghunathan K., McKenna L., Peddle M. (2023) involving 142 learners, only 40.84% of respondents rated their informatics training as matching the "competent" level [30]. At the same time, information management skills turned out to be the most vulnerable component, which is particularly critical in the context of healthcare digitalization [30]. Similar results were obtained by Abou Hashish E. A., Alnajjar H. (2024): despite a high level of digital device use, scores for knowledge and attitudes toward digital transformation remain moderate (and, respectively) [10]. Thus, access to technology does not guarantee its professionally oriented use.

An additional difficulty is the insufficient development of managerial and coordination competencies. Modern practice requires a nurse to participate in interprofessional collaboration, work with information flows, and make decisions based on digital data. Jedwab R. M. et al. (2023) demonstrate that developing health informatics competencies is necessary not only at the basic level but also at the leadership level [20]. In turn, Abou Hashish E. et al. (2025) emphasizes the importance of e-leadership in the context of digital management of nursing services [11]. However, these components remain underrepresented in educational programs. The systemic limitations of personnel training under digitalization are multi-level and affect methodological, personnel-related, and organizational aspects (Table 1).

Table 1. Main limitations of the development of higher nursing education in the context of digitalization

Group of Limitations	Essence of the Problem	Consequences
Methodological	Retention of the knowledge-oriented learning model	Insufficient readiness for digital clinical practice
Personnel-related	Deficit of digital and managerial competencies	Limited efficiency in technology utilization
Organizational	Heterogeneity of educational approaches and infrastructure	Uneven quality of training
Institutional	Slow adaptation of curricula and standards	Gap between education and practice
Regional	Unequal digital maturity of healthcare systems	Difficulties in adapting international models

As seen in Table 1, the problem is systemic rather than local, caused by inconsistency between different levels of the educational and medical systems.

Organizational barriers also manifest in the absence of unified approaches to developing digital competencies. Kulju E. et al. (2024), analyzing 20 studies, showed that educational interventions vary significantly in duration

(from 20 minutes to 6 months) and implementation formats [22]. This makes it difficult to assess their effectiveness and indicates insufficient standardization of educational solutions. Meanwhile, the training level of instructors remains an important constraint. Shon S. et al. (2024) showed that targeted programs to increase digital teaching competence contribute to better



integration of technology into the educational process; however, such initiatives are not yet systemic [34]. Regional features exacerbate these issues. Rechel B. et al. (2023) note that healthcare reforms in Central Asian countries develop unevenly and depend on resource and institutional factors [31]. In Uzbekistan, as pointed out by Khayitov Sh. N. (2022), digitalization is at an active stage of implementation but requires further infrastructure and human resource development [8]. Under these conditions, the educational system faces the need to simultaneously adapt to international standards and account for national specificities.

Transformation of Educational Paradigms in Nursing Training

Modern changes in the nursing training system are linked not so much to updating individual disciplines as to revising the very logic of the educational process. While the traditional model was built around knowledge transfer and mastering standard skills, under digitalization the priority shifts toward forming the ability to operate in a changing professional environment. In this context, competency-based education is viewed not as an alternative approach, but as a necessary prerequisite for preparing specialists capable of adapting to digital medical care formats (Lewis L. S., Rebesch L. M., Hunt E., 2022) [23].

The transition to a competency-based model is accompanied by a change in the structure of educational programs. Unlike traditional curricula focused on disciplinary segmentation, modern programs increasingly integrate clinical and digital components. However, as Meum T. T. et al. (2021) demonstrate, this integration remains inconsistent and depends on the capabilities of specific educational institutions [27]. Consequently, a heterogeneity of training emerges, wherein the level of digital skill mastery varies significantly.

A significant direction of transformation is the implementation of digital educational technologies; however, their role is not limited to expanding the format of learning. E-learning ensures the accessibility of educational resources and learning flexibility, while simulation technologies create conditions for practicing clinical decisions in a safe environment. Eckhoff D. O., Guido-Sanz F., Anderson M. (2022) note that incorporating telemedicine elements into the educational process helps build skills for remote interaction with patients, which is becoming indispensable in modern practice [16]. At the same time, the effectiveness of these technologies is determined not by their mere presence, but by the degree of their integration into the educational process and their connection to clinical tasks.

Changes also affect the roles of participants in the educational process. Instructors increasingly act not as mere repositories of knowledge, but as facilitators of the educational environment and coordinators of learning activities. Simultaneously, the importance of independent student work increases, aimed at mastering digital tools and applying them in a professional context. Shon S. et al. (2024) showed that improving the digital competence of educators leads to more effective implementation of educational technologies and increases the quality of specialist training [34]. This indicates that educational transformation is impossible without changes in pedagogical practices.

An additional aspect is the development of continuing professional education. In conditions of rapid technological updates, basic training cannot guarantee long-term professional sustainability. Tischendorf T. et al. (2024) emphasize that developing digital competencies require continuous updates of knowledge and skills throughout one's professional career [38]. Thus, the educational system must be oriented not only toward training specialists but also toward maintaining their professional relevance.

Structure and Content of Professional Competencies of Nurses in the Digital Era

Changes in educational approaches logically lead to a revision of the structure of professional competencies for nurses. In the context of digitalization, these are formed as a set of interconnected skills that ensure effective performance in a technology-rich environment. Digital and information-analytical competencies occupy a central place in this structure. As shown by Longhini J. et al. (2022), they include not only the use of information systems but also the ability to analyze data, evaluate its reliability, and apply it in clinical practice [24]. At this juncture, the transition from passive technology use to its meaningful application becomes significant.

The development of clinical thinking in a digital environment also acquires new characteristics. Hants L. et al. (2023) note that the introduction of digital decision support systems alters the structure of the nursing process, requiring the integration of digital data into the clinical assessment of a patient's condition [17]. This implies the need to cultivate a specialist's ability to work with digital tools without losing clinical autonomy. In the context of digitalization, the importance of interprofessional collaboration grows. The use of electronic communication systems requires nurses to be able to efficiently exchange information and coordinate actions with other specialists. Clarke-Darrington J. et al. (2023) emphasize that the digital environment



intensifies communication skill requirements, especially under remote interaction conditions [13]. Managerial and leadership competencies occupy a special place. Modern nurses are increasingly involved in organizing care delivery processes and managing information flows. Jedwab R. M. et al. (2023) showed that developing informatics competencies at the

leadership level is a necessary condition for the effective functioning of medical teams [20]. In turn, Abou Hashish E. et al. (2025) highlights the importance of e-leadership as a new form of managerial activity in the digital environment [11]. For a systemic overview of the competency structure, it is useful to highlight their key characteristics (Table 2).

Table 2. Characteristics of nurses' professional competencies in digital healthcare

Component	Key Feature	Professional Significance
Digital Literacy	Ability to interpret and critically evaluate digital information	Validity of clinical decisions
Analytical Thinking	Use of data to assess patient status	Improved quality of diagnosis and care
Communication Adaptability	Working within digital interaction channels	Ensuring continuity of medical care
Organizational Coordination	Managing processes and interactions	Efficiency of medical teams

As follows from Table 2, the modern competency model extends beyond the traditional understanding of professional training and includes elements related to analytics, management, and digital technologies. This reflects the changing role of the nurse, who increasingly acts not just as an executor but as an active participant in coordinating medical care.

Scientific-Methodological and Organizational Directions for Improving Higher Nursing Education in Uzbekistan

Improving higher nursing education in the context of digitalization requires moving from local changes to systemic modernization aligned with healthcare reforms. A key direction is the adaptation of international training models, taking national specificities into account. World Health Organization documents (2020) emphasize that nursing competencies include clinical decision-making, care coordination, communication, and working with data [42]. Crucially, these competencies are viewed as interconnected and must be formed within an integrated educational model. However, their implementation in Uzbekistan requires adaptation considering the structure of the healthcare system and the level of digital infrastructure.

A priority direction is the integration of digital technologies into the educational process. This is not

about introducing separate disciplines, but about forming a digital learning environment linked to clinical practice. Irwin P. et al. (2025) show that the effectiveness of digital learning is determined by the degree of its systemic integration [18]. In Uzbekistan, this requires a phased implementation, considering resource constraints and differences between educational institutions.

No less significant is the development of human resources, primarily the teaching staff. Insufficient preparation of instructors in digital technologies limits the possibilities of transforming the educational process, which is confirmed by modern research [34]. In this regard, faculty professional development must be considered a mandatory element of reform.

Organizational changes must be accompanied by the development of educational infrastructure, including the creation of digital platforms and simulation centers. At the same time, as Khayitov Sh. N. (2022) notes, the digitalization of healthcare in Uzbekistan develops unevenly, requiring the pace of educational modernization to be coordinated with the capabilities of the healthcare system [8]. Key improvement directions are presented in Table 3.

Table 3. Priority directions for modernizing higher nursing education

Direction	Implementation Condition	Limitation
Adaptation of Standards	Accounting for national specifics	Formal transfer of models
Digitalization of Learning	Availability of infrastructure	Low degree of adoption
Personnel Development	Instructor training	Insufficient digital competence
Infrastructure Development	Connection to clinical practice	Gap between education and practice



As follows from Table 3, the effectiveness of transformations is determined not only by the content of the reforms but also by the conditions of their implementation. Forming a modern model of nursing education in Uzbekistan requires a comprehensive approach that includes the adaptation of international standards, human resource development, and the integration of digital technologies in light of national conditions.

CONCLUSION

The conducted analysis showed that the digitalization of healthcare shapes new requirements for nurse training that are not fully realized in existing educational models. The main limitations remain the fragmented integration of digital technologies, insufficient development of digital and managerial competencies, and the mismatch between educational programs and practice. Improving the system of higher nursing education in Uzbekistan should be directed toward implementing a competency-based approach, developing a digital educational environment, and training teaching personnel, which will ensure that specialist preparation aligns with modern conditions of medical activity.

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