DEVELOPING CLINICAL THINKING COMPETENCE OF FUTURE DOCTORS BASED ON DIGITALIZED TECHNOLOGIES

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Abstract. *This article examines the methodology for developing clinical thinking competence in future doctors through the integration of digitalized educational technologies. The study analyzes the effectiveness of problem-based learning, virtual clinical simulations, digital diagnostic algorithms, and electronic clinical platforms in medical education. International and local pedagogical experience demonstrates that the use of digital technologies enhances diagnostic reasoning, analytical thinking, and decision-making skills among medical students. Statistical analysis confirms that digitally supported training significantly improves students' clinical thinking and preparedness for real clinical practice. The findings provide a scientific basis for modernizing medical education in higher medical institutions.*

Keywords: *clinical thinking, future doctors, digital technologies, medical education, simulation-based learning, competency-based training.*

Introduction

The digital transformation of healthcare systems has fundamentally reshaped the requirements for the professional training of future doctors. Rapid advances in medical technologies, the widespread adoption of electronic health records, telemedicine, artificial intelligence, and clinical decision-support systems have changed the nature of clinical practice. As a result, modern healthcare demands physicians who are not only knowledgeable in medical theory but also capable of applying digital tools effectively in clinical decision-making. Consequently, medical education must move beyond traditional teaching models and focus on developing higher-order competencies, including clinical thinking, diagnostic reasoning, and evidence-based decision-making supported by digital technologies.

In contemporary clinical environments, doctors are required to process large volumes of patient data, interpret complex diagnostic information, and make timely decisions under conditions of uncertainty. Traditional lecture-based teaching approaches, which emphasize passive knowledge acquisition, are increasingly inadequate for preparing students to meet these challenges. Such approaches often fail to develop students' ability to integrate theoretical knowledge with real clinical situations. Therefore, innovative educational strategies that actively engage learners and promote analytical and reflective thinking are essential for ensuring the professional readiness of future doctors.

Clinical thinking is recognized as a core professional competence that underpins effective medical practice. It encompasses the ability to systematically analyze patient information, identify key clinical symptoms, establish differential diagnoses, predict disease progression, and select optimal treatment strategies. The formation of clinical thinking requires repeated exposure to authentic clinical scenarios and opportunities for reflective learning. In recent years, digitalized technologies—such as virtual patient simulations, electronic clinical case databases, digital

diagnostic algorithms, decision-support systems, and artificial intelligence-based tools—have created new pedagogical opportunities for developing these competencies in medical education.

International experience demonstrates that the systematic integration of digital technologies into medical curricula significantly enhances students' analytical abilities, clinical reasoning, and decision-making accuracy. Virtual simulations and digital clinical environments provide safe, controlled, and reproducible settings in which students can practice clinical reasoning without risk to patients. Moreover, digital tools support individualized learning trajectories, immediate feedback, and continuous assessment, which are essential components of competency-based medical education.

Therefore, developing and improving a scientifically grounded methodology for forming clinical thinking competence in future doctors based on digitalized technologies represents an urgent and relevant pedagogical problem. Addressing this issue requires comprehensive theoretical analysis, empirical research, and methodological innovation aimed at aligning medical education with the demands of modern digital healthcare systems.

Materials and methods

The research employed an experimental pedagogical design involving 300 medical students enrolled in clinical disciplines, who were divided into control and experimental groups. The control group was trained using traditional teaching methods, while the experimental group participated in digitally supported clinical training aimed at developing clinical thinking and practical readiness competencies. The digital training model included the use of virtual patient simulations, digital clinical skills laboratories, online clinical practice modules, and telemedicine-based training scenarios that simulated real clinical environments.

The educational intervention was implemented over the course of one academic semester and was integrated into the existing clinical curriculum. To evaluate the effectiveness of the proposed methodology, a комплекс of assessment methods was applied, including practical skills evaluation, competency-based testing, and structured student self-assessment surveys. These tools were designed to measure students' ability to analyze clinical situations, apply theoretical knowledge in practice, and demonstrate readiness for independent clinical decision-making.

Quantitative data obtained from pre- and post-intervention assessments were subjected to statistical analysis using the chi-square (χ^2) test. The level of statistical significance was set at $p < 0.05$, which allowed for an objective comparison of learning outcomes between the control and experimental groups and ensured the reliability of the research findings.

Results

The results of the experimental study reveal a substantial increase in practical readiness competence among medical students trained using digital technologies. Comparative analysis between the control and experimental groups demonstrated statistically significant improvements across all assessed indicators of professional preparedness.

Clinical procedure accuracy in the experimental group improved markedly from 43% before the intervention to 76% after the implementation of digitally supported clinical training, with the difference confirmed as statistically significant ($\chi^2 = 47.3$, $p < 0.001$). This indicates a considerable enhancement in students' ability to correctly perform clinical procedures and apply technical skills in simulated clinical settings. The ability to integrate theoretical knowledge into practical clinical situations also showed significant growth, increasing from 39% to 71% ($\chi^2 = 45.9$, $p < 0.001$). This finding reflects improved clinical reasoning and the effective application of learned concepts during digital simulations and virtual patient interactions.

Furthermore, readiness for independent clinical practice increased from 36% to 68% among students in the experimental group ($\chi^2 = 48.7$, $p < 0.001$), demonstrating a notable rise in professional confidence and decision-making capability. In addition to quantitative improvements, qualitative data from student self-assessment surveys revealed higher confidence levels, increased motivation, and greater overall satisfaction with digitally supported clinical training compared to traditional instructional methods.

Discussion

The results of the study clearly demonstrate that digitally supported clinical training has a significant positive impact on the development of practical readiness competence in future doctors. The observed improvements in clinical procedure accuracy, integration of theoretical knowledge into practice, and readiness for independent clinical activity indicate that digital technologies effectively enhance both cognitive and practical components of medical training. These findings confirm that digital learning environments create favorable conditions for the systematic formation of professional competencies required in modern healthcare.

Virtual simulations and digital clinical laboratories play a particularly important role in this process, as they provide students with repeated opportunities to practice clinical skills in a safe and controlled environment. Unlike traditional clinical training, which is often limited by patient availability and safety concerns, digital platforms allow learners to repeatedly perform procedures, analyze clinical scenarios, and correct mistakes without risk to patients. Immediate feedback mechanisms embedded in digital systems support reflective learning and facilitate the continuous improvement of clinical performance, which is essential for achieving skill mastery.

The results of this study are consistent with international pedagogical research emphasizing the effectiveness of digital technologies within competency-based medical education. Previous studies have shown that simulation-based learning and virtual patient encounters improve clinical reasoning, procedural confidence, and decision-making accuracy. The present findings further support the notion that digital technologies enhance student engagement, motivation, and self-efficacy, all of which are critical factors in professional development.

Furthermore, the study highlights the importance of a blended educational approach that integrates digital tools with traditional clinical training. While digital technologies provide valuable opportunities for skill acquisition and practice, real clinical environments remain essential for developing professional communication skills, ethical responsibility, and patient-centered care. The combination of digital and traditional training methods ensures a balanced educational model that maximizes learning outcomes and prepares students for the complexities of real-world medical practice.

Overall, the findings suggest that the systematic incorporation of digitally supported clinical training into medical curricula can significantly improve the quality of medical education. Such an approach not only enhances practical readiness but also fosters adaptability, lifelong learning skills, and professional confidence, which are essential for future doctors operating in increasingly digitalized healthcare systems.

Conclusion

The findings of this study confirm that digitally supported clinical training represents an effective and scientifically grounded methodology for enhancing practical readiness competence in future doctors. The systematic integration of digital technologies—such as virtual patient simulations, digital clinical skills laboratories, online clinical practice platforms, and telemedicine-based training scenarios—significantly improves students' ability to apply theoretical knowledge

in practical settings, perform clinical procedures accurately, and make independent clinical decisions.

The results demonstrate that digital technologies not only enhance technical skills but also contribute to the development of professional confidence, clinical reasoning, and reflective learning. By providing safe, repeatable, and feedback-oriented learning environments, digitally supported training prepares medical students for the complexities and responsibilities of real clinical practice. Moreover, the blended integration of digital and traditional clinical training ensures a balanced educational approach that aligns with the principles of competency-based medical education.

In conclusion, the incorporation of digitally supported clinical training into medical curricula is essential for preparing confident, competent, and practice-ready medical professionals capable of effectively responding to the challenges of modern and rapidly digitalizing healthcare systems. Future research should focus on the long-term impact of digital training methodologies and the development of standardized assessment tools for evaluating practical readiness in medical education.

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