TECHNOLOGY-ENHANCED CLINICAL CASES FOR ADVANCING MEDICAL STUDENTS' DIAGNOSTIC COMPETENCE

ABDURAKHMANOV NIYOZBEK KHAMDAMJON UGLI

assistant of General surgery and ophthalmology department

Fergana Medical Institute of Public Health, Fergana, Uzbekistan

E-mail: doctoranx@gmail.com

Relevance. The ability to establish accurate and timely diagnoses is a cornerstone of medical practice. In specialties such as ophthalmology, where subtle clinical signs determine treatment strategies, diagnostic competence is critical. Traditional methods of teaching—didactic lectures, limited patient contact, and observational learning—often do not provide sufficient immersive practice opportunities. Recent advances in virtual reality (VR), simulation platforms, and digital case-based learning tools provide innovative avenues for cultivating diagnostic skills. Exploring these technologies within medical education not only enhances experiential learning but also addresses challenges such as limited patient availability, variability of clinical cases, and the need for scalable training. This study, conducted at the Fergana Medical Institute of Public Health (FMIOPH), investigates the role of technology-enhanced clinical cases in developing diagnostic competence among medical students.

Introduction. Clinical case-based learning is widely recognized as an effective approach for bridging theory and practice in medical education. By engaging students in structured diagnostic scenarios, educators foster the integration of clinical knowledge, reasoning, and decision-making skills. In ophthalmology education, where diagnostic proficiency is shaped by visual recognition and systematic reasoning, technology-enhanced approaches such as VR simulations and interactive online cases have demonstrated significant promise (Ong et al., 2021).

Despite growing adoption worldwide, there remains a need to assess the effectiveness of such methods in specific educational contexts. This study aims to evaluate the impact of technology-enhanced clinical cases on the diagnostic competence of undergraduate medical students at FMIOPH by comparing outcomes across two student groups exposed to different learning modalities.

Materials and Methods. The study was conducted at FMIOPH. A total of 278 healthy medical students enrolled in ophthalmology courses participated. They were divided into two groups:

Experimental group (n=139): received training through technology-enhanced clinical cases (including VR-based ophthalmic simulators, interactive case modules, and guided online platforms).

Control group (n=139): followed traditional instructional methods (lectures, textbooks, and limited patient demonstrations).

Methodology. A structured questionnaire was designed to measure diagnostic competence, clinical reasoning, and student perceptions of the learning process. Items included case-based diagnostic

accuracy, confidence in clinical decision-making, and satisfaction with learning resources. Responses were collected at baseline and after a six-week intervention period.

Results. At baseline, both groups demonstrated similar diagnostic competence scores. After six weeks: Experimental group:

Showed significant improvement in diagnostic accuracy, with mean scores increasing by 32%.

Reported higher confidence in interpreting ophthalmic signs (82% “high confidence” compared to 46% in control).

91% expressed satisfaction with VR and simulation-based training, citing realism, interactivity, and feedback as major advantages.

Control group:

Improved by 12% in diagnostic competence scores.

Reported limited exposure to varied clinical scenarios.

54% were satisfied with traditional teaching, noting reliance on memorization rather than problem-solving.

Overall, students trained with technology-enhanced clinical cases demonstrated significantly higher diagnostic competence than those in the control group.

Discussion. The results reinforce existing evidence that technology-enhanced approaches offer measurable advantages in medical education. VR and simulation tools, by replicating real-world diagnostic challenges, promote active learning and deeper engagement. These findings are consistent with prior research demonstrating improved clinical reasoning and reduced diagnostic errors in students using immersive platforms (Deuchler et al., 2024; Succar & Grigg, 2010).

Importantly, this study highlights the scalability and accessibility of technology-based teaching. Even in resource-limited settings, affordable smartphone-based simulations and online cases can supplement traditional teaching. However, challenges remain, including cost of advanced simulators, integration into curricula, and ensuring faculty readiness to guide debriefing sessions.

Furthermore, while technology enhances competence, it should complement—not replace—direct patient interactions. Blended models, combining clinical exposure with VR and simulation, appear most effective for holistic training (Ong et al., 2021).

Conclusion. This study demonstrates that technology-enhanced clinical cases significantly improve medical students’ diagnostic competence in ophthalmology compared to traditional teaching methods. Students exposed to VR and simulation reported greater diagnostic accuracy, confidence, and

satisfaction. These findings confirm the value of integrating immersive technologies into medical curricula to better prepare future physicians.