

additional simulation scenarios. The survey results confirmed the high effectiveness of simulation-based training and its positive impact on the development of students' professional competencies.

Conclusions

The results of the study allow us to draw the following conclusions:

1. The course "Emergency Medical Care for Children" proved highly effective for fifth-year students majoring in pediatrics.
2. To ensure the long-term effectiveness of training, it is advisable to integrate simulation technologies at all levels of specialist training in order to adhere to the concept of reflective practice, repeated practice, and the sustainable development of professional skills.

Manuscript received on August 7, 2026

PEDAGOGICAL FACILITATION AS A FACTOR IN ENHANCING THE EFFECTIVENESS OF VR TRAINING FOR MEDICAL STUDENTS IN MASTERING EMERGENCY CARE SKILLS

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DOI: 10.46594/2687-0037_2026_3_2217

Abstract. We evaluated the impact of pedagogical facilitation on the effectiveness of VR training for fifth-year students majoring in "Pediatrics" as they mastered emergency care skills. A comparative analysis of the results of the clinical scenario, Likert scale data, and statistical analysis showed that pedagogical support significantly improves the quality of algorithm execution, reduces cognitive load and stress, and contributes to the development of sustainable clinical thinking and student confidence.

Scientific specialty: 3.2.3. Public Health and Health Care Organization, Sociology, and History of Medicine.

Relevance

Virtual reality (VR) technologies are increasingly being used in medical education as a tool for developing students' practical skills and clinical reasoning. However, the effectiveness of VR-based training is determined not only by the technical capabilities of the simulators but also by how the learning process is organized through pedagogical facilitation. Consequently, there is a need to assess the impact of pedagogical facilitation on the quality of medical students' mastery of emergency care algorithms.

Objective

To assess the impact of pedagogical facilitation on the effectiveness of performing a clinical scenario for providing emergency medical care in a virtual reality environment among fifth-year medical students majoring in "Pediatrics."

Materials and Methods

A prospective comparative study was conducted involving 60 fifth-year medical students majoring in "Pediatrics"

who had completed the training course "Emergency Medical Care for Children." None of the participants had prior experience with VR technologies. The students were divided into two equal groups: Group I (with instructional facilitation, $n = 30$) and Group II (without instructional facilitation, $n = 30$). Training was conducted using a clinical VR scenario on the topic "Emergency Medical Care in a Traffic Accident," implemented in the "AcademixVR Virtual Reality Simulator for Practicing Action Algorithms" hardware and software package. Pedagogical facilitation included a preliminary review of the algorithms, guidance during scenario execution, and a structured debriefing based on the Plus-Delta model. Training effectiveness was assessed by the students using standardized checklists that included 42 steps of the emergency care algorithm. Additionally, a subjective assessment of cognitive load was conducted using a Likert scale. For statistical analysis, Student's t -test was used, and Cohen's d effect size was calculated; differences were considered statistically significant at $p < 0.05$.

Results

The mean total score for completing the clinical VR scenario in Group I was 20.1 ± 1.4 out of a possible 42 (47.8%), whereas in Group II it was 39.2 ± 1.1 (93.3%); the differences were statistically significant ($t = 18.7$; $p < 0.001$). The most pronounced differences were observed in the performance of key steps of the algorithm: the initial assessment using the ABCDE algorithm (43% in Group I versus 96% in Group II, $p < 0.001$), assessment of the severity of the condition (38% versus 93%, $p < 0.001$), establishing venous access (41% vs. 90%, $p < 0.001$), administering analgesia (35% vs. 91%, $p < 0.001$), and immobilization (52% vs. 95%, $p < 0.001$), and reporting to the senior physician (29% vs. 88%). Pedagogical facilitation was accompanied by a decrease in subjective stress levels (4.6 in Group I vs. 2.3 points in Group II), a reduction in the perceived complexity of the scenario (4.4 vs. 2.5 points), increased confidence in their own actions (2.1 vs. 4.5 points), and improved understanding of emergency care protocols (2.3 vs. 4.7 points).

Discussion

An analysis of the error patterns showed that, without pedagogical guidance, students were significantly more likely to omit critically important steps in the algorithm, deviate from the sequence of actions, and experience difficulties in making clinical decisions, whereas in the facilitated group, the implementation of the algorithm was consistent and systematic.

Conclusions

1. Pedagogical facilitation is a key factor in the effective use of virtual reality technologies when teaching medical students emergency care skills.
2. Preliminary review of clinical algorithms and structured debriefing significantly improve the completeness of algorithm execution, reduce cognitive load, boost students' confidence, and foster more robust clinical reasoning.
3. The study's findings confirm the need to integrate VR technologies into a pedagogically organized

educational environment in which digital tools complement, but do not replace, the instructor.

Manuscript received on August 7, 2026

ANALYSIS OF INTERNATIONAL EXPERIENCE IN DEVELOPING OPHTHALMOSCOPY SKILLS AMONG MEDICAL UNIVERSITY STUDENTS USING SIMULATION TECHNOLOGIES

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DOI: 10.46594/2687-0037_2026_3_2218

Abstract. This study analyzes international experience in the use of simulation technologies to develop ophthalmoscopy skills among medical university students. It examines the capabilities of modern simulators — Eyesi Direct, Eyesi Indirect, and OphthoSim™ — which enable the safe mastery of diagnostic techniques, the objective assessment of practical skills, and the development of clinical reasoning. International studies confirm that the use of simulation-based training improves the quality of training, boosts students' confidence, and enhances the effectiveness of ophthalmoscopy training.

Scientific specialty: 3.2.3. Public Health and Health Care Organization, Sociology, and History of Medicine.

Relevance

The development of practical skills is one of the key objectives of modern medical education. In ophthalmology, mastering direct and indirect ophthalmoscopy poses significant challenges due to limited access to patients, the complexity of visualizing the fundus, and the need for repeated diagnostic procedures. The use of simulation technologies allows for the creation of a safe educational environment that ensures the effective mastery of practical skills without risk to patients. Experience with ophthalmology simulators at the simulation center of Karaganda Medical University has shown that this equipment contributes to improving students' practical training; however, the number of instructional hours allocated for training using ophthalmology simulators is limited.

Objective

To analyze the potential of simulation technologies in developing ophthalmoscopy skills among medical university students and to present international experience in their implementation in the educational process.

Materials and Methods

An analytical review of domestic and international publications on the use of simulation technologies in ophthalmology was conducted. We analyzed the experience of using the Eyesi Direct, Eyesi Indirect (VRmagic GmbH, Germany), and OphthoSim™ (OtoSim Inc., Canada) simulators, which are used to teach students direct and indirect ophthalmoscopy techniques, to further explore the possibilities of expanding training hours at the simulation center of Karaganda Medical University.

Results

The possibilities of virtual reality, objective assessment of practical skills, and automated feedback, as implemented in modern ophthalmic simulators, are examined. The use of simulators allows students to safely practice direct and indirect ophthalmoscopy skills repeatedly, develop motor coordination, refine fundus examination techniques, and cultivate clinical reasoning. Modern simulation systems provide automated assessment of examination duration, the thoroughness of the examination, and the accuracy of anatomical structure recognition, which helps to objectify the learning process and improve the quality of feedback. The use of virtual reality technologies helps boost students' confidence, reduce anxiety before their first patient encounter, and create conditions for repeated practice of practical skills. A combined approach, incorporating theoretical training, simulation-based training, and subsequent clinical practice, ensures the sequential development of professional competencies and fosters the development of clinical reasoning. According to international studies, incorporating simulation-based training into student training in direct ophthalmoscopy improves the quality of practical skill acquisition. In a randomized study, students who received 1 hour of theoretical training followed by 1 hour of simulator-based training demonstrated statistically significantly higher performance on ophthalmoscopy technique compared to those who received traditional training ($p = 0.034$). A module lasting at least 2 academic/instructional hours, followed by independent practice and competency assessment, can be considered optimal for the initial acquisition of this skill. International data show that simulation training improves students' recognition of fundus structures and their confidence; for example, when using Eyesi, the theoretical mastery score increased from 6.10 ± 0.13 to 7.74 ± 0.16 points (an increase of approximately 27%; $p < 0.001$), with 75.6% of students preferring the simulator to traditional instruction and 88.4% supporting its inclusion in the educational program.

Discussion

An analysis of international experience shows that the use of simulation technologies improves the quality of ophthalmoscopy skill acquisition, the objectivity of practical competency assessment, and students' confidence. The introduction of modern ophthalmic simulators is a promising direction for improving the training of medical students.

Conclusions

Simulation technologies are an effective tool for developing ophthalmoscopy skills among medical students. The use of state-of-the-art simulators — Eyesi Direct, Eyesi Indirect, and OphthoSim™ — ensures the safe mastery of diagnostic techniques, an objective assessment of practical skills, and the development of clinical reasoning. The integration of simulation-based training into the educational process helps improve the quality of training for future physicians and meets the modern requirements of practice-oriented medical education.

Manuscript received on August 7, 2026