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ARTIFICIAL INTELLIGENCE AND SIMULATION TECHNOLOGIES IN THE TRAINING OF MEDICAL STUDENTS IN THE DISCIPLINE OF OBSTETRICS AND GYNECOLOGY

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Abstract. *The article is dedicated to the integration of cutting-edge technologies—artificial intelligence (AI) and high-fidelity simulation—into the educational process of the Department of Obstetrics and Gynecology at Dnipro State Medical University (DSMU). The possibilities of adapting and implementing innovative pedagogical strategies in the context of global healthcare digitalization and the specific challenges facing Ukrainian medical education due to the COVID-19 pandemic and martial law are examined. The structure of simulation training is analyzed, ranging from basic phantom training to work with virtual patients, as well as the role of remote systems (Moodle, Google Meet) in ensuring the continuity of education*

For centuries, medical education was based on the principle formulated by William Halsted: "See one, do one, teach one". This model assumed that a young doctor acquires skills directly near the patient's bedside, learning on real patients under the supervision of an experienced mentor. However, in the 21st century, this paradigm has faced serious ethical, legal, and practical problems.

Increased attention to patient safety, reduced hospital stays, and the increased complexity of medical technologies have made "trial and error" learning on humans impossible.

In obstetrics and gynecology, these challenges are particularly acute. Critical conditions, such as eclampsia, shoulder dystocia, or massive postpartum hemorrhage, occur suddenly and require a lightning-fast reaction from the team. So it is impossible to train students how to act in such situations during real

childbirth, then the priority is the life of the mother and child, not the pedagogical process. This necessitated the transition to simulation training—creating a safe environment where an error becomes a learning tool rather than the cause of a tragedy [1].

Dnipro State Medical University (DSMU) amidst healthcare reform and the transition to international standards of doctor training, has chosen a strategy of deep integration of digital technologies. This concerns not only technical equipment but also a fundamental change in teaching philosophy. The implementation of simulation technologies at DSMU is a systemic response to the necessity of building professional skills as outlined by higher education standards.

The uniqueness of the situation in which medical education in Ukraine and DSMU, in particular, finds itself lies in the necessity to adapt to two consecutive crises [2]. Initially, the COVID-19 pandemic limited students' physical access to clinics, forcing the university to urgently deploy distance learning platforms. Subsequently, the full-scale invasion by the Russian Federation in 2022 created unprecedented threats to the safety of participants in the educational process. In this context, simulation technologies and artificial intelligence transformed from a "desirable addition" into a critically important element for the survival of the education system. The use of virtual patients (Body Interact) and cloud platforms (Microsoft Teams, Moodle) allowed students to continue forming clinical thinking even while in shelters or abroad [3,4].

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The training stages according to the department's methodology encompass the following:

1. Cognitive Stage: Theoretical study of the manipulation algorithm (e.g., fetal vacuum extraction) utilizing multimedia lectures and Moodle online resources.

2. Demonstration Stage: The instructor demonstrates the execution of the skill on a phantom, providing commentary on each movement ("skill deconstruction").

3. Practice of Individual Elements (Part-task training): Students train on low-fidelity phantoms (pelvic models), practicing, for example, only the specific moment of applying the vacuum extractor cup.

4. Integration (Whole-task training): Execution of the complete procedure within the context of a clinical scenario.

5. Debriefing: A detailed analysis of the student's actions, including a discussion of errors and psychological aspects.

The implementation of simulation at DSMU is closely linked to the transition to a competency-based approach in education. Instead of abstract "knowledge of obstetrics," a graduate must demonstrate the ability to perform a specific list of actions: manage physiological childbirth, provide aid during hemorrhage, eclampsia, etc. Simulation trainings are integrated into curricula as a mandatory component. This allows for standardized preparation: every student is guaranteed to practice algorithms for providing aid in rare but critical pathologies on manikins [6].

An important aspect is the psychological preparation of future doctors [5]. Work in the delivery room is associated with a high level of stress. Simulation scenarios mimicking emergency situations (sound effects, time limits, "death" of the manikin) allow students to adapt to stress in controlled conditions. Studies show that students who have undergone such training feel significantly less anxiety during their first contact with real patients

The center of innovative education at the university is the Simulation Center (Interdepartmental Training Center), which unites resources of different departments to ensure multidisciplinary training[4]. It is a complex system that mimics the structure of a hospital

Structural units of the center relevant to Obstetrics and Gynecology (Table 1):

- Delivery Room: Equipped with a functional transformer bed and a neonatal resuscitation table. The key element is the childbirth simulator.
- Gynecological Office: Equipped with a chair, colposcope, and a set of phantoms for practicing examinations and minor gynecological interventions.
- Debriefing Room: Equipped with a video system for reviewing the recording of the simulation and discussing it.

Table 1

Classification of DSMU simulation equipment by technological level

Fidelity Level	Equipment Type	Examples of Models (or analogues used)	Learning Goals and Tasks
Low-Fidelity	Static phantoms and moulages	Cervix trainers, pelvic models, phantoms for suturing (episiorrhaphy)	Practice of separate manual skills: bimanual examination, smear collection (Pap test), breast palpation.

Continuation of table 1

Fidelity Level	Equipment Type	Examples of Models (or analogues used)	Learning Goals and Tasks
Medium-Fidelity	Mechanical childbirth simulators	Childbirth manikin, vacuum extraction manikins	Study of the biomechanism of labor in cephalic and breech presentations, assistance in shoulder dystocia, application of obstetric forceps.
High-Fidelity	Robotic patient simulators	Noelle (maternal simulator)	Complex scenarios: eclampsia, amniotic fluid embolism, massive hemorrhage, cardiac arrest in pregnancy, neonatal resuscitation.

To understand the depth of student immersion in the learning process, let us examine in detail several typical simulation scenarios implemented at DSMU.

Scenario 1: "Postpartum Hemorrhage" (PPH) This is one of the most important scenarios, as hemorrhage remains a leading cause of maternal mortality.

- Equipment: Childbirth simulator, hemorrhage control kit (Bakri balloon, medications), blood simulant.
- Plot: 15 minutes after birth, the woman (manikin) begins massive bleeding, blood pressure drops, and tachycardia develops (displayed on the monitor).
- Student Actions (Teams):
  - *Diagnosis:* Assessment of uterine tone (palpation of the manikin's abdomen—sensation of a "soft" uterus).
  - *Communication:* Call for help ("Code Red!"), distribution of roles.
  - *Manipulations:* External uterine massage, bimanual compression, establishing intravenous access, oxytocin administration.
  - *Surgical actions:* Examination of the birth canal on a phantom, if necessary—simulation of uterine balloon tamponade.

Outcome: If actions are correct and timely, hemodynamics stabilize on the monitor, and bleeding stops. If not—the "death" of the patient occurs.

The war forced a rethinking of approaches to organizing the educational process [2]. When physical access to simulation centers is limited due to air raid alerts, digital platforms come to the fore. The university has created a powerful

digital infrastructure combining the capabilities of the Learning Management System (LMS) Moodle and the communication platform Google Meet.

Technical Implementation: Using Microsoft 365 Integration plugins allowed for the synchronization of user accounts. A student logs into the system under a single corporate account and has access to all resources. Educational Content: Educational materials are hosted on the Moodle platform: video lectures by department professors, tests, and clinical tasks. Video Conferencing: lectures and practical classes are held in Google Meet. An important feature is the ability to record classes, which allows students experiencing power or internet outages to view materials in asynchronous mode

Analysis of the results of the "Krok-2" licensing exams and the Objective Structured Clinical Examination (OSCE) by DSMU students indicates the high effectiveness of simulation training. Students who have completed the full training course demonstrate better results in solving situational tasks and performing practical skill.

The most important result is the change in the mentality of future doctors. They learn: not to fear mistakes: in the simulation center, a mistake is a reason for analysis, not for punishment. Also, studnts study to work in a team. Students master the algorithmic approach to decision-making during emergency situations.

Conclusions. The experience of the Department of Obstetrics and Gynecology proves that even in conditions of war and limited resources, the combination of faculty enthusiasm and modern digital solutions is capable of ensuring high-quality medical education. Simulation has ceased to be a "toy" and has become an integral part of the professional development of an obstetrician-gynecologist, guaranteeing that a specialist who already has experience of victories over disease in the virtual and simulated world will approach the real patien.

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