USING INTERACTIVE TEACHING METHODS IN BIOLOGICAL PHYSICS EDUCATION.

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Abstract

Biophysics is a fundamental discipline that integrates principles of physics, biology, and medicine, forming the scientific basis for understanding physiological processes at the molecular, cellular, and systemic levels. Traditional lecture-based teaching methods often fail to ensure deep understanding, long-term knowledge retention, and the development of practical competencies among medical students. This article analyzes the effectiveness of interactive teaching methods in biophysics education, including problem-based learning, simulation technologies, virtual laboratories, case-based learning, and digital assessment tools. The study highlights how interactive approaches improve students' motivation, conceptual understanding, clinical thinking, and professional competencies.

Keywords: biophysics education, interactive teaching methods, medical education, student-centered learning, problem-based learning, case-based learning, virtual laboratories, simulation technologies, digital education, clinical thinking, professional competence, learning outcomes

Introduction. Modern medical education requires the implementation of innovative pedagogical approaches that emphasize student-centered learning, the development of critical and analytical thinking, and the formation of practical and professional skills essential for future physicians. In the context of rapid scientific progress, digitalization of healthcare, and increasing demands on medical

specialists, traditional teaching methods based mainly on passive information transfer are no longer sufficient to ensure high-quality learning outcomes.

Biophysics, as a fundamental preclinical discipline, occupies a special place in the system of medical education. It provides students with an understanding of the physical principles underlying biological processes, physiological mechanisms, and modern diagnostic and therapeutic technologies. Knowledge of biophysics is essential for comprehending such topics as membrane transport, bioelectric phenomena, hemodynamics, biomechanics, medical imaging, and radiation medicine. Thus, biophysics plays a crucial role in shaping the scientific worldview, logical thinking, and professional competence of future physicians.

Despite its importance, biophysics is often perceived by medical students as an abstract, theoretically complex, and mathematically demanding subject. This perception frequently leads to reduced motivation, learning difficulties, and superficial assimilation of knowledge. The lack of clear connections between theoretical concepts and clinical practice further complicates the learning process and negatively affects students' academic performance and long-term knowledge retention.

In this regard, the integration of interactive teaching methods into biophysics courses is considered an effective and promising solution to these challenges. Interactive methods transform students from passive recipients of information into active participants in the educational process. Such approaches encourage independent learning, problem-solving, discussion, and collaboration, which are essential components of modern medical training.

Interactive teaching methods facilitate the practical application of theoretical knowledge by linking biophysical concepts to real clinical situations. Through problem-based learning, case-based discussions, simulations, and virtual experiments, students gain a deeper understanding of complex phenomena and develop the ability to apply scientific principles in diagnostic and therapeutic

decision-making. Moreover, interactive learning environments promote motivation, intellectual curiosity, and self-confidence, which positively influence students' attitudes toward the subject.

The purpose of this article is to examine the pedagogical potential of interactive teaching methods in biophysics education and to evaluate their impact on students' learning outcomes in medical education. Particular attention is paid to the role of interactive approaches in improving conceptual understanding, enhancing practical skills, fostering critical thinking, and increasing students' engagement and motivation. The analysis aims to demonstrate that the systematic use of interactive methods contributes to higher educational quality and better preparation of future medical professionals for clinical practice.

Research Methodology. The study was conducted within the framework of teaching biophysics to undergraduate medical students. A combination of traditional and interactive teaching methods was applied during lectures, practical classes, and independent learning sessions. The following interactive methods were implemented:

- **Problem-Based Learning (PBL):** Students solved clinically oriented biophysical problems related to membrane transport, bioelectric phenomena, hemodynamics, and medical imaging.
- **Case-Based Learning (CBL):** Real and simulated clinical cases were used to demonstrate the application of biophysical principles in diagnostics and treatment.
- **Virtual Laboratories:** Computer-based simulations allowed students to model physiological processes such as nerve impulse propagation, cardiac electrophysiology, and diffusion mechanisms.

- **Digital Simulations and Multimedia Tools:** Interactive animations, virtual experiments, and online platforms were used to visualize complex biophysical concepts.
- **Formative Digital Assessment:** Online quizzes, interactive tests, and immediate feedback tools were applied to monitor learning progress.

The effectiveness of these methods was evaluated using academic performance indicators, student feedback surveys, and comparative analysis of examination results.

Results. The introduction of interactive teaching methods in biophysics education led to a significant improvement in learning outcomes. Students demonstrated better understanding of complex theoretical concepts, improved problem-solving skills, and increased engagement during classes.

Quantitative analysis showed higher average test scores and increased knowledge retention compared to groups taught exclusively by traditional methods. Student surveys indicated enhanced motivation, greater interest in the subject, and improved confidence in applying biophysical knowledge to clinical situations.

Additionally, interactive methods contributed to the development of soft skills such as teamwork, communication, and independent learning, which are essential for future medical professionals.

Discussion. The findings confirm that interactive teaching methods are highly effective in biophysics education. By shifting the focus from passive knowledge reception to active learning, these methods help students overcome difficulties associated with abstract content and mathematical complexity.

Virtual laboratories and simulations are particularly valuable in biophysics, as they allow safe, repeatable, and cost-effective experimentation. Case-based and problem-based learning approaches bridge the gap between theory and clinical practice, fostering clinical reasoning at an early stage of medical training.

However, the successful implementation of interactive methods requires adequate technical infrastructure, teacher training, and curriculum redesign. Faculty members must possess both pedagogical and digital competencies to effectively integrate these approaches into the educational process.

Conclusion

The use of interactive teaching methods in biophysics significantly enhances the quality of medical education. These approaches improve students' academic performance, motivation, and professional competence while facilitating the integration of theoretical knowledge with clinical practice.

The results suggest that interactive methods should be systematically incorporated into biophysics curricula in medical universities. Further research is recommended to explore long-term outcomes and to develop standardized models for interactive biophysics education.

REFERENCES.

1. O‘zbekiston Respublikasi Prezidenti Qarori PQ–4884. “Raqamli O‘zbekiston – 2030” strategiyasini amalga oshirish chora-tadbirlari to‘g‘risida, 2020-yil.
2. Rustamov M. USE OF MODERN METHODS IN TEACHING “INFORMATION TECHNOLOGY” IN MEDICAL EDUCATION //Science and innovation. – 2023. – T. 2. – №. A7. – C. 30-33.
3. Rustamov M. IMPROVING THE METHODOLOGY OF TEACHING THE SUBJECT “INFORMATION TECHNOLOGIES AND MODELING OF TECHNOLOGICAL PROCESSES” IN AN INNOVATIVE EDUCATIONAL ENVIRONMENT //Science and innovation. – 2023. – T. 2. – №. B7. – C. 58-61.
4. Rustamov M. Rustamov Murodil Makhammadzhanov TEACHING COMPUTER SCIENCE IN HIGHER EDUCATION: PROBLEMS AND SOLUTIONS: The rapid development of information and communication

technologies in our country is due to state support, which allows us to confidently enter the world information community //Архив исследований. – 2020. – С. 5-5.

5. Rustamov M. ENHANCE STUDENTS'KNOWLEDGE AND SKILLS WITH MULTIMEDIA TOOLS IN AN INNOVATIVE EDUCATIONAL ENVIRONMENT //Science and innovation. – 2023. – Т. 2. – №. B10. – С. 43-45.

6. RUSTAMOV M. TIBBIY TA'LIMDA INNOVATSION TA'LIM METODLARI VA TA'LIM VOSITALARIDAN FOYDALANISHNING AFZALLIKLARI (AXBOROT TEXNOLOGIYALARI VA JARAYONLARNI MATEMATIK MODELLASHTIRISH FANIGA TADBIQI MISOLIDA) //News of the NUUz. – 2024. – Т. 1. – №. 1.5. 1. – С. 197-199.