Training of future doctors in computer modeling

A.B Baimakhanova[1], *Y. Kulton*[2] *L.B Rakhimzanova*[3]

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Abstract

Rapid changes in modern medicine and the requirements for training specialists in medicine require the active use of computer modeling in medical education. The aim of this study is to study effective methods of introducing computer modeling into the educational process of medical educational institutions. To achieve this goal, the methods of analysis, synthesis, generalization and systematization were used. The results of the study revealed the key stages of computer modeling training in medical education, which include theoretical lectures, practical classes, laboratory work, specialized internships, projects and research, as well as multidisciplinary training. Theoretical lectures provide basic knowledge of the principles of computer modeling, including anatomy, physiology and mathematical principles. Practical classes and laboratory work allow students to master the skills of working with software and creating virtual models of organs. Specialized internships provide an opportunity to apply the acquired skills in a real clinical environment. Participation in projects and research is focused on the application of computer modeling in solving clinical problems, and multidisciplinary training creates a comprehensive understanding of methods in medical science.

The results point to the need for a systematic and fundamental approach to teaching computer modeling in medical education and its inclusion in the curricula of medical schools on a systematic basis.

Keywords: Medical Education, Virtual Reality, Interdisciplinary Approach

1 Introduction

In modern medical education and practice, there is a rapid introduction of modern computer modeling technologies that provide unique opportunities to improve the diagnosis, treatment

[1] Al-Farabi Kazakh National University.
E-Mail: aigul.b@internet.ru
[2] Wirtschaftsuniversität Bratislava, Abteilung für Angewandte Informatik.
E-Mail: jaroslav.kultan@euba.sk
[3] Lyazzat Boltabaevna, Al-Farabi Kazakh National University.
E-Mail: lyazatr72@gmail.com

and training of medical specialists. In light of this context, it is necessary to conduct in-depth research in the field of computer modeling training in medical education in order to understand the current challenges, achievements and potential of this approach.

Despite some research in this area, the issues of developing effective teaching methods to improve the computer competence of students in medical education, as well as the use of interdisciplinary possibilities of anatomy and informatics, have not been considered. Computer modeling training should be conducted in the context of an elective course. An elective course in computer modeling offered to students of the Faculty of Medicine can provide an important overview of key anatomical concepts.

The elective computer modeling course offered to students of the Faculty of Medicine can provide an important overview of key anatomical concepts and include aspects related to the integration of artificial intelligence into computer modeling in medicine.

The research problem lies in the need to develop effective teaching methods that will ensure the steady assimilation of theoretical aspects by students, the systematization of practical skills and a deep understanding of computer modeling methods in the context of the anatomy course.

Based on this, the aim of the study is to identify effective methods of integrating computer modeling into the educational process of medical schools when teaching the elective course "Computer modeling of the human genitourinary system" in order to improve the quality of training of future medical specialists.

D. Li and co-authors (Li, D., Hu, W., Zhou, X., Li, L., Wang, J., Zou, M., & Zhou, D. (2023)) investigated the development of virtual reality technologies in medical education and treatment in China. They created integrated models, including the structure of the stomach, pathologies, pharmacological processes and clinical scenarios.

The study highlights the improvement in the quality of medical education, the updating of approaches and the potential of three-dimensional models for future medicine.

D. Edwards and co-authors (Swede, M. I., Geryak, S. M., Martynyuk, L. P., Susla, O. B., Martynyuk, L. P., & Yastremskaya, I. A. (2023) in their work consider the technology of three-dimensional printing (3D) to create individual structures based on digital models of patients. They highlight its wide application in engineering, architecture and medicine, especially in dentistry and regenerative medicine, where it is used to create custom-made small implants and organ bioprinting.

A study by L. Lyu et al. (Lyu, L., Cui, H., Shao, M., Fu, Y., Zhao, R., & Chen, Q. (2021) analyzes the development of computational medicine, highlighting it as an area that uses computer models to simulate diseases and treatment. The authors emphasize the importance of algorithms and GPU that expand the use of computing technologies in medicine, and discuss the potential of computer vision in clinical research. The research includes an analysis of the history of development, presentation of global progress in computational medicine, discussion of clinical applications, identification of problems and limitations, as well as forecasts, including computational Chinese medicine.

In addition to virtual reality, in-game radiological education and team competitions in virtual worlds have been recognized as exciting and innovative teaching methods with numerous benefits, including student engagement, social interaction and a personalized learning environment (Rudolphi-Solero, T., Jimenez-Zayas, A., Lorenzo-Alvarez, R., Domínguez-Pinos, D., Ruiz-Gómez, M., & Portero, F. (2021). In addition, the use of virtual clinical modeling has been recognized as an attractive learning strategy for developing disciplinary and flexible skills in medical students through structured educational activities with assessment and feedback (Segura-Azuara, N. & Lopez, M. (2021).

Moreover, the use of virtual simulation, including high-precision simulation of real clinical scenarios based on adult mannequins in virtual reality, has been evaluated for its effectiveness in teaching clinical pharmacology to medical students. Virtual modeling is defined as interactive computer simulation of real clinical scenarios of medical training, teaching or assessment, meeting various training requirements in medical education (Gudadappanavar, A., Hombal, P., Benni, J., Patel, S., & Tubaki, B. (2023).

The existing methods of teaching computer modeling in Kazakhstan medical universities are crucial to ensure that medical students receive high-quality education and training. Simulation learning is promoted as a way to provide medical education that is very similar to a real clinical environment, conforms to medical ethics, and uses simulated scenarios to train and evaluate various skills.

In the context of medical education, it has been shown that simulation training is effective in teaching basic skills in various specialties, including otolaryngology (Keilin, C. A., Farlow, J. L., Malloy, K. M., & Bohm, L. A. (2021). In addition, the use of simulation-based advanced training programs for teaching doctors new medical procedures was evaluated, which demonstrated their potential effectiveness in medical education (Issa, N., Liddy, W., Samant, S., Conley, D. B., Kern, R. C., Hungness, E. S. & Cohen, E. (2021).

Simulation-based medical education is a widely recognized approach that can be carried out both in the form of low- and high-precision training, using dummies and special technologies for on-site training. The use of high-precision simulators for teaching the principles of cardiovascular physiology to medical students was studied, which demonstrated the potential of modeling as an effective learning tool (Suvarna, P. & Basti, A. R. S. (2022).

2 Methodology

The introduction of computer modeling in medical education is associated with various problems and difficulties that need to be solved. In the context of computer modeling training, evaluating the effectiveness of teaching medical students emphasizes the importance of having a good teaching staff, intensive training, timely feedback, curriculum development, integration of real cases and the use of realistic computer models. The needs of future doctors in computer modeling-related competencies are necessary to prepare medical students to meet the demands of the evolving healthcare environment.

The use of deep learning models for automated assessment of students during high-precision modeling makes it possible to improve the accuracy and effectiveness of assessment in medical education, especially in the context of computer modeling and simulation.
Table 1 provides an overview of the key methods of computer modeling in medicine.

Computer modeling method	Description
Modeling of organs and tissues	Creation of highly detailed computer models of human organs and tissues.
The development of augmented reality	The use of augmented reality to simulate created computer models.

Table 1: Computer modeling methods

The main stages of training are presented in Table 2.

Stages	Description
Theoretical lectures	Providing fundamental knowledge about the principles of computer modeling, including basic aspects of anatomy.
Practical exercises	Mastering students' skills of working with modern software tools used to create computer models. The formation of practical skills necessary for the successful application of modeling in medical practice.
Projects and research	Active participation of students in projects and research aimed at computer modeling of anatomical orgones in medicine.

Table 2: Stages of computer modelling training in medicine

The authors of the article have developed an elective course "Computer modeling of the human genitourinary system", which has the following content:

INTRODUCTION
I. MODELING THEORY
1.1. The history of modeling as a method of cognition
1.2. The concept of modeling
1.3. Types of modeling
1.4. Classification of models
1.5. Stages of computer model development
II Computer modeling of human internal organs.
2.1. Setting the task
2.2. Building an information model of human internal organs
2.2. Building 3D models on 3D MAX or (Blender)
2.3. Checking the adequacy of the model
III. CREATING AUGMENTED REALITY ELEMENTS

3.1. QR code
3.2. Creating a QR code for each internal organ of a person

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