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SCIENTIFIC RESEARCH METHODS IN PEDAGOGICAL TECHNOLOGY: ANALYSIS AND APPLICATION IN MEDICAL EDUCATION EXAMPLES

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Abstract
This article provides a comprehensive analysis of the application of scientific research methods within pedagogical technologies in modern medical education and their theoretical foundations. Throughout the study, the role of empirical, sociological, and statistical methods in developing clinical reasoning among future physicians is highlighted through specific examples, particularly Problem-Based Learning (PBL) and Case-Based Learning (CBL) technologies. The author provides evidence-based arguments for the effectiveness of methods such as pedagogical diagnostics and SWOT analysis in enhancing the quality of education in medical higher education institutions. The article concludes with scientifically grounded recommendations for physician-educators on algorithmizing the teaching process and objectively assessing students' practical clinical skills.

Keywords: Pedagogical technology, medical education, scientific research methods, clinical reasoning, physician-educator, PBL (problem-based learning), case-study.

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Relevance

Today, medical education requires not only theoretical knowledge, but also high-level practical skills and clinical thinking. Traditional teaching methods are losing their effectiveness in an era of accelerated information flow. The main problem facing medical educators is to teach students to make independent decisions and work on the principles of evidence-based medicine [1].

The introduction of pedagogical technologies on a scientific basis allows us to abandon haphazard approaches in the educational process and direct it towards a planned and guaranteed result. The use of pedagogical research methods in medicine is very important, especially in improving the skills of differential diagnosis in the field of therapy and internal medicine. Therefore, the analysis of scientific methods of pedagogical technologies and their integration into higher medical education is an urgent task today that cannot be postponed [3].

Information

Features of pedagogical technologies specific to medicine. Medical education differs from other fields in its "clinical orientation". Therefore, pedagogical research methods here serve not only to impart knowledge, but also to test the deontological culture of the doctor and his ability to make quick decisions. In the scientific analysis of pedagogical technologies, we consider education on the basis of the "subject-subject" principle, that is, the student is not just a listener, but an active participant in the treatment process [3, 4].

Systematic analysis of scientific research methods

The methods considered in the article should be deepened in the following components:

- Modeling method: In medicine, this method is manifested through simulation technologies. Before working with a real patient, the student improves his skills using a "virtual clinic" or mannequins. Studies show that when simulation methods are used, the probability of medical errors is reduced by 40% [1].

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- Cognitive mapping (Concept Mapping): This method helps to visualize the relationship between complex therapeutic diseases (for example, systemic lupus erythematosus or chronic renal failure). The student strengthens logical memory by drawing the pathogenesis of the disease in the form of a chain [5].
- Pedagogical monitoring: This process is not just about grading, but also about monitoring the dynamics of the student from the first year to the end of the master's degree. Here we will determine the correctness of our teaching method using statistical methods (for example, analysis of variance) [2].

The effectiveness of case-based learning (CBL) and problem-based learning (PBL) in medical education

Cases for students in the therapeutic direction must be based on real clinical situations. For example, on the topic "Kidney damage due to arterial hypertension", the student is asked the following questions:

1. Which indicator in the patient's analyzes indicates a decrease in kidney function?
2. Assess the effectiveness and risks of the selected treatment plan using the SWOT analysis method.

In this process, the student not only uses the textbook, but also analyzes international clinical protocols (for example, ESC/ESH guidelines). **This forms in him the skills of conducting independent scientific research.** Research results show that in groups taught using such methods, the self-directed learning index of students increased by 1.8 times [4].

Analysis of the digitalization of pedagogical technologies

Today, medical pedagogical methods are being integrated with distance learning and artificial intelligence (AI). As a scientific method, we propose a comparative analysis of the diagnostic conclusions given by AI with the student's conclusions. This method teaches the student to think critically and use technologies correctly [2, 5].

Pedagogical experiment: Formative and explanatory stages

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It is scientifically justified to conduct research in two stages to prove the effectiveness of pedagogical technology in medical education. In the first - **explanatory (confirmative)** stage, the current level of knowledge and clinical skills of students are measured using traditional methods. In the second - **formative** stage, a new pedagogical technology (for example, cognitive simulation) is introduced [2, 5].

The scientific value of this method is that it allows the doctor-pedagogue to directly observe changes in the educational process and mathematically model the results. For example, experiments conducted at the Department of "Therapy" show that after the formative stage, students' ability to perform differential diagnostics improved by an average of 34% [1].

The Delphi method and expert assessment system in education

The Delphi method (expert survey) is of great importance as a research method in medical pedagogy. It involves conducting an anonymous survey among leading experts in the field (professors, practicing physicians). This method serves to scientifically determine which clinical skills should be included in the curriculum first [4].

Analysis: Improving the curriculum in the subject of "Internal Medicine" using the Delphi method will help to prioritize the diseases that students will most often encounter in real practice in the future (for example, metabolic syndrome, chronic pneumonia).

Medical-pedagogical diagnostics and the "Flipped Classroom" model

In the age of digital technologies, pedagogical research methods have also changed. When scientifically analyzing the "Flipped Classroom" technology, we study the speed of independent information search and analysis of students outside of class.

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Application: The student studies the theoretical part at home (based on video lectures or international protocols), and in the classroom he discusses only complex clinical cases (Cases) with the doctor-pedagogist. This method **increases the student's competence** in working with information, which is one of the most important qualities for a doctor [3, 6].

The role of psychological methods in pedagogical research

In medical education, the study of a student's stress tolerance and empathic abilities is also part of pedagogical technology. For this, psychophysiological methods such as the Luscher test or Schulte tables are used. The doctor-pedagogue selects a suitable teaching algorithm by scientifically assessing the student's ability to concentrate [2].

Conclusion:

Systematic analyses of the use of scientific research methods of pedagogical technologies in medical education allow us to draw the following fundamental and scientifically based conclusions:

Pedagogical technologies are not just a set of technical methods, but a holistic scientific system that guarantees the quality of education. Studies show that designing the educational process on a scientific basis in the medical field increases the student's mastery rate by 25-30% compared to traditional methods [1, 5]. This confirms the need to abandon randomness in education and move towards specific effectiveness.

Scientific and pedagogical methods (observation, experiment, questionnaires) allow the doctor-pedagogue to accurately diagnose "weak points" in the educational process. In particular, the data identified through the SWOT analysis method show that the main obstacle in modern medical education is not a lack of information, but a lack of skills in analyzing clinical data and critical thinking among students [3, 4]. The role of interactive methods such as PBL and CBL in solving this problem is invaluable.

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It is extremely important to establish a scientific and pedagogical monitoring system in the training of masters in therapeutic areas. As Petrov V.I. noted, the use of mathematical and statistical methods in assessing diagnostic algorithms in medical education not only ensures the objectivity of the assessment, but also allows for accurate prediction of the dynamics of the student's professional growth [2]. This is an important factor in increasing the responsibility of future doctors.

The integration of scientific methods of pedagogical technologies is not just an academic requirement, but a necessary requirement of the era of high-tech medicine. The analysis presented in the article proves that a physician-pedagogue must be not only an accomplished therapist, but also a researcher who can analyze his pedagogical activity on the basis of modern scientific methodologies (for example, cognitive mapping or simulation modeling) [5, 6].

The comparative analysis conducted shows that modern pedagogical technologies ensure the transformation of the student from a "passive object" to an "active subject". As Hardin R.M. noted, the biggest mistake in training a doctor is to arm him only with data; real education is to teach the technology of applying that data in a clinical setting [4]. Our study supports this idea scientifically and methodologically.

The integration of pedagogical research methods with digital platforms (Moodle, Zoom, Virtual simulators) makes the learning process transparent. Statistical indicators prove that in groups where digital diagnostic methods were used, errors in assessing students' knowledge (subjectivism) decreased by 15-20% [5, 6].

As a final conclusion, it can be said that scientific research methods of pedagogical technology are not just a theory, but the main driver determining the quality indicator (KPI) of higher medical education. The mastery of these methods by physician-pedagogues and their application in the teaching process will serve to provide our country's healthcare system with a "new generation" of doctors who are not only knowledgeable, but also able to choose the right strategy in any complex clinical situation [1, 3].

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In conclusion, the effective use of scientific research methods serves as the most effective strategy for training specialists in higher medical education institutions who are competitive, independent and have the ability to think clinically.

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